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Examining the Effects of School Composition on North Carolina Student Achievement over Time[1]

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Abstract: This study explores the effects of school-level characteristics on North Carolina students' reading and math achievement from fourth through eighth grade, focusing on the relationships between achievement and the racial and poverty composition of schools. After creating race-by-poverty cohorts of schools, I use multilevel models to examine math and reading achievement for the same students in fourth, sixth, and eighth grades. The racial and poverty composition of schools affect student achievement after factoring in student, family, and other school influences. In addition, increasing teacher quality and school resources reduces but does not eliminate the effects of school racial and poverty composition on student achievement. Policies leading to reductions in racial and poverty isolation in schools and increases in teacher quality should be pursued to guarantee equality of educational opportunities to all children in North Carolina schools.
Keywords: North Carolina; educational achievement; math; reading; poverty; segregation; multi-level models.

Examinando los efectos de la demografía escolar a través del tiempo en el rendimiento de los estudiantes en Carolina del Norte
Resumen: Este estudio explora los efectos de las características demográficas a nivel escolar en el rendimiento en matemáticas y lectura de los estudiantes en Carolina del Norte desde cuarto a octavo grado, centrándose en las relaciones entre el rendimiento académico y la composición racial y de la pobreza de las escuelas. Después de crear cohortes de escuelas según las variables demográficas de raza-por-pobreza, se utilizaron modelos multinivel para examinar el rendimiento en matemáticas y

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lectura para los mismos estudiantes en cuarto, sexto, y octavo grados. Después de considerar las influencias estudiantiles, familiares, y otras influencias escolares, se determinó que la composición racial y el nivel de pobreza de las escuelas impacta el rendimiento de los estudiantes. Además, el aumento en la calidad de los docentes y de los recursos escolares reduce pero no elimina los efectos de la composición racial y el nivel de pobreza de las escuelas en cuanto al rendimiento estudiantil. Deben aplicarse políticas orientadas a reducir el aislamiento racial y el nivel de pobreza en las escuelas y que aumenten la calidad de los docentes para garantizar la igualdad de oportunidades educativas para todos/as los/as estudiantes en las escuelas de Carolina del Norte.
Palabras claves: Carolina del Norte; logro educativo; matemáticas; lectura; pobreza; segregación; modelos multinivel.

Examinando os efeitos da demografia escolar ao longo do tempo no desempenho dos alunos na Carolina do Norte

Resumo Este estudo explora os efeitos das características demográficas a nível escolar em matemática e leitura do desempenho dos alunos na Carolina do Norte a partir de quarta até a oitava série, enfocando a relação entre desempenho acadêmico e da composição racial e da pobreza de escolas. Depois de criar gerações de escolas de acordo com variáveis demográficas de raça, pela pobreza, os modelos multinível foram usados para examinar o desempenho em matemática e leitura para os mesmos alunos em séries quarto, sexto e oitavo. Depois de considerar o aluno influências, família, escola e outras influências, foi determinado que a composição racial e nível de pobreza das escolas de desempenho dos alunos impactos. Além disso, o aumento da qualidade dos professores e recursos da escola reduz mas não elimina os efeitos da composição racial e nível de pobreza das escolas no desempenho dos alunos. As políticas devem ser destinadas a reduzir o isolamento racial e os níveis de pobreza nas escolas e aumentar a qualidade dos professores para garantir a igualdade de oportunidades educacionais para todos os / as alunos nas escolas da Carolina do Norte.
Palavras-chave: North Carolina; grau de escolaridade; matemática, leitura; pobreza; segregação modelos multinível.

Introduction

Inequalities in educational opportunities afforded to students of differing social standing have been present since the inception of public education in the United States. In the 1954 *Brown v. Board of Education* decision, the Supreme Court recognized the inequities associated with racially segregated schools. Twelve years later, the Coleman Report (1966) brought widespread attention to academic achievement gaps between middle-class white students and many minority groups or low-income students (Coleman, 1966). Forty-two years after the Coleman Report and 54 years after the *Brown* decision, many of the achievement gaps between white and minority students and low-income and high-income students remain.

Nationally, students in urban districts, students who are poor, and members of disadvantaged minority groups still attend higher poverty schools and have lower educational achievement than non minority, non poor students in non urban districts (Rumberger & Palardy, 2005). The disparities in achievement among students reflect the individual income and racial/ethnic standing of the student as well as the incongruent educational opportunities offered to students within the types of schools they attend. Many minority groups or poor students are likely to have fewer financial and cultural resources in the home than white and middle-class students. They are also more likely to attend schools with fewer resources such as adequate facilities, access to higher level knowledge and high quality teachers, than the schools white and middle class students attend (Orfield, 2005). This issue is of continued importance because inequities in educational

opportunities for children tend to perpetuate income and racial inequalities once those children reach adulthood. After the *Brown* decision many districts sought to decrease inequalities through desegregation either voluntarily or as a result of court mandates. The premise of desegregation was that educating all children together would increase the availability of high quality schools to all students. Since the 1990's however, the courts have lifted many desegregation orders, even in districts with voluntary desegregation plans ("PICS," 2007).

With the 2002 *No Child Left Behind* Act, education policy shifted the focus from manipulating student school assignments to reducing achievement gaps by holding students, teachers, districts, and states accountable for student achievement. The premise of high-stakes accountability policies is that if all schools are staffed with high quality teachers and those teachers use "scientifically proven" teaching measures, all students would have the same opportunities to learn and that the student composition of schools would not be an issue. Achievement for these purposes is measured through yearly standardized testing and schools that do not produce passing achievement scores run the risk of having their federal funding eliminated (No Child Left Behind Act of 2001, 2002). Because the *No Child Left Behind* Act focuses on increasing the quality of all schools rather than student assignment, it is important to discover what school qualities result in higher achievement for all students and the extent to which the race and poverty composition of schools continue affect student achievement.

Purpose of the Study

While there is little that educational policy can do to affect students' family background or activities students choose to engage in outside of school, educational public policy can influence school-level inputs. Therefore, public policy must focus on the organizational inputs that best predict achievement for all groups of students. In this study I explore several organizational inputs that contribute to academic achievement for a cohort of students in North Carolina public schools.

The specific questions investigated in this study focus on these school-level inputs. First, do the racial and poverty composition of schools interact to affect achievement on students' End of Grade (EOG) reading and math achievement? Second, what school-level characteristics affect student achievement? Third, how do achievement gaps, controlling for school and student characteristics, differ by students' race and gender? Finally, are the effects of school characteristics on achievement the same at different points in time?

In this study I extend previous research by creating race by poverty level (race/poverty) cohorts of schools. Although some of the nuance that would be gained by using continuous measures of the percentage of minority or low-income students in a school and using interaction terms may be lost using race/poverty cohorts, this method allows me to examine the unique effects of both race and poverty composition on student achievement scores. Although the racial and poverty composition of schools are often highly correlated, this is not always the case. For instance, a school that is racially balanced does not necessarily have middle levels of poverty. By examining the achievement scores of students in schools with similar racial composition but differing poverty concentrations, I am able to understand the complex and interactive dynamics effects of both the racial and poverty composition of schools on academic achievement. There may be attributes of schools that not only reflect the poverty level of the school, but reflect the racial composition as well. These joint effects are not visible in analyses that do not take the interactive nature of racial and poverty composition into account.

In addition to creating race/poverty cohorts, I add to the current literature by incorporating teacher characteristics, class size, and per-pupil expenditures into the analyses of student outcomes. Although each of these variables has been examined at length in other studies, they have not been

observed in conjunction with the interrelated racial and poverty composition of schools. Furthermore, I add to the school composition literature by examining the effects of school composition on students disaggregated by individual student's race and gender. Although the achievement gap between male and female students has largely diminished, race differences in achievement remain, and there are likely within race differences between males and females that are difficult to observe when examining aggregate gender achievement data.

Finally, I add to the methodological literature by observing the effects of school characteristics on the same cohort of students at three different points in time. There is little if any previous research comparing the effects of school characteristics on outcomes of the same students at distinct points in their educational trajectory. This is important because resources are typically blanketed across schools and grades. Knowing whether policies are more effective for particular grades could help increase efficiency and result in better learning opportunities for children.

Previous Research

Gender and Achievement

For several decades before and after World War 2, males were more likely than females to finish college or take advanced math and science classes in high school (Tyack & Hansot, 1993). Over the last several decades, however, the gap between male and female academic achievement has diminished and in some cases reversed (National Center for Educational Statistics [NCES], 2008).Today, females consistently perform better in reading and writing and the gender gap in math and science is shrinking. On average, females have higher GPAs in high school and are more likely to attend and graduate from college than males (NCES, 2008). As far as course taking, males are more likely to be placed in remedial courses while females are more likely to be placed in gifted programs (Oakes, 2005). These trends are largely reflected in national achievement tests. The National Center for Educational Statistics (NCES) reports that nationwide in 2008, females out-performed males on the National Assessment of American Progress (NAEP) reading and writing tests in the 4th, 8th and 12th grades. Males had slightly higher math scores (NCES, 2008).

The fact that females outperform males on average in school has led some researchers to question whether males are at an academic disadvantage. Sommers (2000) asserted that the way schools are organized works against male achievement. Boys, particularly in elementary school, have few male role models. Additionally, curriculum focusing on language and literature is designed in a way that favors girls (Sommers, 2000). Cole (1997) suggested that the mean achievement of boys is often lower than for girls because there is a larger spread in their scores. Boys are more likely to score at the bottom of the distribution of scores, but they are also more likely than girls to have the highest scores.

However, some scholars conclude that the between-gender gap is less important than the gap within genders. The within-gender gap stems from the differences in achievement of students who are the same gender but of different races or social classes (Epstein, 1988). For example, within racial/ethnic groups females tend to have higher overall achievement than their male counterparts (Coley, 2001; Kimmel, 2006). Kimmel (2006) points to the fact that upper-class males do not have significantly different achievement from upper-class females. However, lower-class males and particularly black and Hispanics tend to have significantly lower achievement scores and high school completion rates than their lower class female counterparts. Thus, in this vein of thought, policymakers who seek to close academic achievement gaps should focus on the larger gaps corresponding to race and social class.

Race and Achievement

Black and Hispanic students consistently perform lower on standardized tests than white students (Jencks & Phillips, 1998; NCES, 2008). There is some evidence, however, that, unlike the black-white achievement gap, which tends to be stable or increase over time, the Hispanic-white gap narrows as students progress through school when school and family background are controlled (Clotfelter, Ladd, & Vigdor, 2009; Reardon & Galindo, 2008; Rumberger & Palardy, 2005).

There are several likely school-level explanations for the persistence of the white-black and white–Hispanic achievement gaps. First, minority students are more likely than white students to be educated in schools with high concentrations of other minorities or high levels of poverty. In 2006, 56% of Hispanic students and 50% of black students attended schools with over 75% minority students. In contrast, only 3% of white students attended school with over 75% minority student enrollment (NCES, 2006). This is important because segregated minority schools are more likely to have higher poverty levels, fewer qualified teachers, and fewer resources than schools with fewer minority students all of which contribute to lower mean achievement (Borman & Dowling 2009; Wells & Holme 2005).

Another explanation focuses on the over representation of Hispanic and black students in special education, vocational, and remedial courses (Eitle, 2002). Even in racially diverse schools, minority students are more likely than white students to be placed in lower level academic tracks which provide fewer opportunities to learn than higher level tracks (Eitle, 2002; Lucas & Berends, 2002; Mickelson, 2001 , 2005; Mickelson & Smith, 1999; Oakes, 2005; Southworth & Mickelson, 2007).

School-level Characteristics

Poverty levels of school and achievement. Economic housing segregation has increased over the last two decades, which in turn contributed to the increased income stratification among public schools (Cook & Evans, 2000). The increase in income stratification among schools is important because the poverty levels in schools have a profound effect on students' achievement, after adjustment for family income (Anyon, 2005; Borman & Dowling, 2009; Mickelson, 2005; Rumberger & Palardy, 2005). For instance, regardless of their individual race or poverty standing, all children who attend middle-class schools are more likely to score higher on standardized tests than those in low-income schools (NCES, 2007). In fact, middle-class children attending schools with high levels of poverty have, on average, lower achievement than low-income children in middle-class schools (Mickelson, 2005; NCES, 2007)

The effects of concentrated poverty in schools are particularly relevant for black and Hispanic students because independent of their individual social class, they are more likely to attend higher poverty schools than white students (Frankenburg, Lee, & Orfield, 2003; Orfield & Eaton, 1996; Rumberger & Palardy, 2005). The disproportionate numbers of minority students attending high poverty schools is partially a reflection of the differences in the neighborhoods in which white and minority families live in. For example, black families of all economics strata tend to live in less affluent neighborhoods than whites of similar income levels (Alba, Logan, & Stults, 2000; Massey & Denton, 1993; Orfield & Eaton, 1996). Consequently, when schools are segregated by poverty composition, they are often segregated by race as well.

The poverty level of a school affects student achievement through the quality of teachers associated with different types of schools. High poverty schools tend to have higher percentages of new teachers, teachers with fewer credentials, and teachers who are less effective than middle-class schools (Clotfelter, Ladd, & Vigdor, 2005; Clotfelter, Ladd, Vigdor, & Diaz, 2004; Darling-Hammond, 1999; Dornbusch, Glasgow, & Lin, 1996). Clotfelter et. al. (2004) demonstrated that

teachers are more likely to apply to schools that have students who are prepared to learn and facilities and equipment such as computers and textbooks that make their job less difficult. In addition, even teachers in the same district are more likely to withdraw from high poverty schools to more "desirable" schools if offered the opportunity (Clotfelter et al., 2004; Harris, 2006). Teachers in low-income schools may also have lower expectations of students and offer less challenging curriculum than teachers in middle-class schools (Kahlenberg, 2000; Rumberger & Palardy, 2005).

A second explanation for the effect of poverty composition on achievement is the peer effect. Students perform better in higher income schools because there are positive spillovers from the students in those schools (Godwin. & Kemerer, 2002; Hoxby & Weingarth, 2005; Kahlenberg, 2000). These spillover effects consist of peers who are academically oriented, are more likely to do homework, and are more likely to continue on to college (Kahlenburg 2000). Godwin and Kemerer (2002) found that the individual poverty standing of a student matters less when there are positive spillovers from their middle-class peers. Additional spillover effects include a pressure to succeed as well as access to human and social capital low-income students would not otherwise be exposed to.

A third factor associated with the advantage of middle-class schools that parents in middle-class schools are more likely to be involved in the school and are more likely to have financial resources than parents of students in high poverty schools. Parents in middle-class schools are more likely to join PTAs, volunteer in the classroom, donate funds, and hold schools accountable for the schooling of their children (Kahlenburg, 2001).

Racial composition of schools and achievement. From the 1960s through the 1980s, much of the emphasis of educational policy focused on desegregation to equalize educational opportunities between minority and white students. In the years that schools in the Unites States were the most desegregated (the early 1980s), the test score gap between blacks and whites declined, as predicted by desegregation advocates. In the 1990s, when schools began to resegregate, the test score gap between white and minority children leveled out (Gamoran, 2001; Hanushek, 2001; Hanushek & Raymond, 2005; Orfield, 2005).

Schools today are more diverse than ever before (Orfield, 2005). Despite the increasing diversity of school age children, schools are increasingly resegregating (Clotfelter et al., 2005; Frankenburg et al., 2003; Orfield, 2005). Students today are far more likely to attend racially homogenous schools than they were two decades ago (Mickelson, 2005; Orfield, 2005; Orfield & Eaton, 1996, 2005). In fact, in 2003 only 3% of white students attended schools where fewer than 25% of their peers were white. In contrast, over half of black and Hispanic students attended schools that were over 75% minority (NCES, 2006).

Recent studies on the effects of desegregation found that desegregated learning environments have a positive effect on minority achievement (Hanushek, 2001; Hanushek, Kain, & Rivkin, 2002, 2008; Mickelson, 2005). Consequently, studies examining racial balance have found that, even after controlling for the poverty level of schools, the racial balance of a school has a notable statistically significant effect on both math and reading achievement (Borman & Dowling, 2006; Caldas & Bankston, 1998; Hanushek, Kain, & Rivkin, 2008; Harris, 2006; Roscigno, 1998). At the individual level, the racial composition of a school has effects on student achievement that are independent of the individual race of the student (Caldas & Bankston, 1998; Hanushek et al., 2008; Harris, 2006; Mickelson, 2001). Similar to the poverty levels of schools, the racial composition of schools often reflects the educational opportunities provided to students. As with middle-class schools, schools that are more racially diverse are also more likely to have more educated parents, more advantaged peers, and higher teacher quality (Harris, 2006; NCES, 2007). Racially balanced schools are also more likely to offer a range of higher level courses and the opportunities for both white and minority students to enroll in them than segregated schools (Mickelson, 2005; Oakes, 2005; Southworth & Mickelson, 2007).

Teacher characteristics and achievement. Teacher quality is a resource studied at length and there is little doubt that being instructed by a teacher who is qualified to teach is essential for student learning (Ingersoll, 2005; Sirin, 2005). There is a debate, however, as to what constitutes teacher quality. Until the 1980s, teachers were considered qualified to teach if they completed a teacher preparation program approved by the state (Wayne & Youngs, 2003). Today however, the U.S. Department of Education defines qualified teachers as those who have a bachelors degree, are certified in their field of instruction, and are competent in any core subject taught (U.S. Department of Education, 2007).

Although most observers would agree that that teacher characteristics matter, there have been disparate findings on the relative influence of licensure, certification, and experience of teachers (Ingersoll, 2005). Some studies found that teacher experience is the most important factor in promoting achievement (Clotfelter et al., 2005; Hanushek & Raymond, 2005; Rockoff, 2004). Rivkin, Hanushek, and Kain (2005) show that in Texas schools, teacher experience has a positive effect on student achievement, but that having a master's degree is not significant. Rivkin, Hanushek, and Kain (2005) found that students in classrooms with teachers that have even one year of experience perform better than students in classrooms with new teachers. "Even if none of the between-school variation in achievement is attributed to schools or teachers, it is clear that school policy can be an important tool for raising the achievement of low-income students and that a succession of good teachers could…go a long way toward closing existing achievement gaps across income groups" (Rivkin, Hanushek, & Kain, 2005, p. 449).

Other studies found that teacher education levels or certification status are the most significant factors (Darling-Hammond, 1999; Fetler, 2001). In an analysis of SASS and NAEP data, Linda Darling-Hammond (1999) found that the quality of teachers is more predictive of academic achievement than class size, the poverty level of the student, or teacher salaries. Darling-Hammond also found that students in states with a higher percentage of teachers with a major in their field and full certification have higher test scores (Darling-Hammond, 1999). In a more recent study, Darling-Hammond found that teacher qualifications as measured by their certification status accounts for 64% of the variance in South Carolina student achievement outcomes and are the strongest predictors of student achievement (Darling-Hammond 2004).

Understanding the teacher characteristics that result in higher achievement for students is essential because the majority of school budgets are used to pay teacher salaries and benefits. Having teachers in the classroom with the qualifications that are shown to increase student achievement also means a decrease in the inefficiencies that result from paying salaries to ineffective teachers. It is also important because however defined, high-poverty and segregated minority schools are less likely to have qualified teachers than schools with less poverty and fewer minority students (Hochschild, 2003; Ingersoll, 2005; Kahlenburg, 2001). Additionally, several studies found that the effect of having good teachers is even more important for minority student than for white student achievement (Ferguson 1998; Mickelson 2001).

Per-pupil expenditures and achievement. Despite decades of research on the correlation between school funding and achievement, there is still little consensus about if, or how, expenditures affect student achievement. Hanushek (1996, 1998, 2003) found that increased funding throughout the United States between the 1970's and 1990's did not significantly increase student achievement. He posits that this result is because funds are spent to decrease student-teacher ratios and that lower student-teacher ratios do not increase achievement. Other studies found the opposite. Wenglinsky examined NAEP data and found that if school funding is spent to reduce student-teacher ratios, the effect of increased spending is positive (Wenglinsky 1997). Darling-Hammond (2004) found that higher funding levels in high income districts results in smaller classes, better facilities, more

qualified teachers, more course offerings, and better resources in the form of books, computers, and other instructional aids.

In a report commissioned by Governor Easley in North Carolina, Henry and Thompson (2008) found that increasing per-pupil expenditures could only affect high school achievement if the money was directed at classroom instructors rather than guidance counselors or health and psychological services. Henry and Thompson also found that reducing student-teacher ratios had a positive effect on achievement. In addition, while spending money on student services such as counselors may help students in other ways, these expenditures did not increase achievement scores (Henry & Thompson 2008).

Class size and achievement. Reducing class size is an appealing policy for many educators because, if financial resources are available to hire additional teachers and classroom space is available, it is a fairly easy policy to implement, and it is not difficult to control whether implementation occurs (Nye, Hedges, & Konstantopoulos, 2004). However, some districts including those who wish to lower student-teacher ratios find the policy difficult to execute because of inadequate funding (Gilman and Kiger, 2003). Between 1990 and 2004 the average student-teacher ratio in U.S. classrooms decreased (National Center for Educational Statistics, 2007).[2] Overall, however, students who are in low-poverty schools tend to be in classrooms with lower student-teacher ratios than students in high-poverty schools (Wenglinsky, 2000).

Research on whether or not reducing student-teacher ratios is an effective method for increasing student achievement is conflicting. Some studies found little or no effect of reducing class size on student achievement (Hanushek, 1997, 1999). In contrast, others argue that reducing class size is an effective tool for increasing achievement (Bracey, 1995, 2004; Lee, 2002 Wenglinsky, 1997). The most meticulously conducted class size achievement study was the Tennessee STAR (Student Teacher Achievement Ratio) project. In the STAR project, students were assigned to one of three class types, including one with fewer students per teacher. Although there were complications throughout the study, such as students moving between schools, the study was able to track a large number of students throughout their primary school years (Biddle & Berliner, 2002). Findings from the STAR study as well as follow up studies show that when students are assigned to small classrooms in the early grades, they have higher achievement than students not assigned to small classrooms (Nye, Hedges, & Konstantopoulos, 2004; Krueger & Whitmore, 2001). The STAR study also shows that minority and low-income students are particularly benefitted by reduced class size (Krueger & Whitmore, 2001).

Research Methods

Design

I conducted hierarchical linear regression analyses on North Carolina students' reading and math End of Grade (EOG) achievement scores in fourth, sixth, and eighth grades.. Multi-level modeling is necessary when observing student and school effects because of the nested nature of these data. Because students are nested within schools, methods that only include student-level data for the explanation of achievement differences may overestimate the effects of family background and leave school variance unexplained. In contrast, analyses that only include school characteristics will overestimate the effects of school characteristics on student achievement (Raudenbush & Bryk, 2002).

Using ordinary least squares regression (OLS) and including both students and schools is inaccurate as well because OLS treats both students and schools as the same unit of analysis

[2] Student-teacher ratio is used in the ensuing analyses as an approximation of class size. Student-teacher ratios are often smaller than actual class size because they do not take into account teachers who teach in multiple classrooms (Levitt & Baker, 1997).

(Goldstein, 2003). Multi-level models allow for the simultaneous modeling of both school and student characteristics by partitioning variance into school and student components. Additionally, OLS assumes independence of observations, but because students in the same school are more similar to each other than students in different schools, the assumption of independence is often violated in OLS models, resulting in low estimates of standard errors (and thus a higher risk of Type I errors). Thus, to examine the unique contributions of school and individual characteristics, a multi-level model is required. Creating models for achievement at distinct points in time allows us to assess whether school effects are consistent throughout students' educational trajectories or if there are effects that appear at particular points in time. In addition, this allows for the exploration of whether the importance of school inputs are the same or different across years.

Data

This study follows a cohort of students in North Carolina schools from their fourth through eighth grade school years. North Carolina is unique in that it was one of the first states in the country to implement an accountability system based on standardized test scores. Students participate in End of Grade (EOG) tests from third through eighth grade and End of Course (EOC) tests in high school. The North Carolina Department of Public Instruction (NCDPI) has collected data on student achievement, student background characteristics, and school characteristics since the early 1990s. In addition, since 1995 the North Carolina Educational Research Center at Duke University (NCERC) has archived and organized NCDPI data and made this data available to scholars through their public-use files. For this analysis, NCERC granted access to the school, teacher, district, and student files for all districts, schools, teachers, and students in North Carolina. With these data, I am able to examine student achievement outcomes in relation to school characteristics.

For this study, I utilize data from a cohort of North Carolina students who were in third grade in the 2000—2001 school year (third grade test scores are used as controls), in fourth grade in the 2001–2002 school year, in sixth grade in the 2003–2004 school year, and in eighth grade in the 2005–2006 school year. I exclude students who attended charter schools, alternative schools, or students who were in special education classes. I excluded these groups because their education is not representative of the typical public-school experience. For instance, charter schools are not managed by school systems and do not have to follow many of the same guidelines as a typical public school. Students in special education classes may also be exposed to a different type of curriculum from students in a typical classroom, and data at the state level would not accurately describe the curriculum such students are exposed to. After list-wise deletion for missing data, the fourth-grade sample consists of 77,425 students in 1,193 schools. The sixth-grade sample consists of 71,744 students in 561 schools, and the eighth-grade sample consists of 62,548 students in 527 schools.

Dependent Variables

The dependent variables are students' yearly achievement in fourth grade, sixth grade and eighth grade (math and reading) measured by their EOG scores. Because the scale of the tests change over the course of the study, I standardize the math and reading raw scale scores for each year. In this way, I am able to observe the students' average deviation from a mean of 0 across the various years.

School-level Independent Variables

Race and socioeconomic composition. This study explores whether there is an interaction between school race and poverty composition that uniquely predicts student achievement. To that end, I

created dummy variables for the following race by poverty composition (henceforth race/poverty) categories of elementary and middle schools: racially imbalanced minority/high poverty, racially imbalanced minority/mid poverty, racially imbalanced white/high poverty, racially imbalanced white/mid poverty, racially imbalanced white/low poverty, racially balanced/low poverty, and racially balanced/high poverty. *Racially balanced/midpoverty* schools are used as the reference category excluded in the analysis. (There are no racially imbalanced minority/low poverty schools in the data set.) For each race/poverty category, the dummy variable for the school equals 1 if the school falls into that category and 0 otherwise. All minority groups are included in the minority category.

There is little consensus in previous literature as to what constitutes racial and economic balance in schools. Until 2002, the second largest district in North Carolina, Charlotte-Mecklenburg, was under a court-ordered desegregation mandate. All schools were required to seek to have minority populations within 15% of the mean black population in the district. Thus, studies have often used this measure to constitute racial balance in North Carolina schools (Mickelson, 2001, 2004, 2006). The largest district in North Carolina, Wake County, seeks to have all schools with fewer than 40% of their students on free lunch. Brown-Jeffy (2006) used 55% minority students as a characteristic of a segregated school, a threshold that divides the majority of schools from the top quartile of schools in the High School Effectiveness study.

For this study, because I am interested in the effects of concentrated poor and minority populations on student achievement, none of the previous measures make theoretical sense. Additionally, I sought to use a consistent measure for both race and poverty composition. Mickelson (2005) showed that students in North Carolina schools with more than 74% students on free or reduced-price lunch are less likely to pass their EOG exams than students in schools with fewer low-income children. Before deciding on cutoff points for the race/poverty cohorts I also examined the National Center for Educational Statistics cutoffs for NAEP results. The NAEP test scores drop sharply in schools with more than 75% of the students are on free lunch and are higher in schools with fewer than 25% poor students (NCES 2007).

The Frank Porter Graham Child Development Institute (FPG) and the School of Education at the University of North Carolina at Chapel Hill examined North Carolina schools using a cutoff of 75% minority students and found that students who attend schools with over 75% minority students have lower reading achievement, even after controlling for their individual race and gender (University of North Carolina-Chapel Hill, 2007). Additionally, NCES reports that more than half of the students in the United States who are black or Hispanic attend schools with more than 75% minority students.

With these data in mind, I calculated the poverty and racial composition of a school as follows: Low poverty schools have 0-25% students on free or reduced-price lunch. Mid poverty schools have 26-74% students on free or reduced-price lunch. High poverty schools have 75-100% students on free or reduced-price lunch. To align with this definition of concentrated poverty, I define racially imbalanced white schools as those with more than 74% white students, racially imbalanced minority schools as those with fewer than 25% white students, and racially balanced schools as schools that have between 25% and 74% white students.

*Student-teacher ratios***.** Part of the statewide strategy for increasing student achievement in North Carolina schools is to reduce student-teacher ratios in disadvantaged schools (North Carolina Public Schools, 2004). The data from NCERC includes a variable for student-teacher ratio. This variable consists of the number of fulltime classroom teachers divided by the students in the school. Although student-teacher ratio is a rough measure for class size, I use this variable because it is consistent throughout the NCERC data set. For these analyses, I use the standardized student-teacher ratio for each year.

Teacher characteristics. I include the following teacher variables: percentage of fully licensed teachers, percentage of teachers with advanced degrees, and percentage of teachers in a school with less than three years of experience. To allow comparison of coefficients across years and variables, I standardized the variables by year.

Per-pupil expenditures. The final school-level variable included in the analyses is the per-pupil expenditures. These data include state, local and federal funds allocated to each district. Because this variable was created from district level data, for the current analyses each school in a district is calculated as having the same per-pupil expenditures. In North Carolina, districts that are low income, or that are smaller than average receive supplemental state funding intended to help reduce inequities in educational opportunities (NC Public Schools 2004).

Because dollars go farther towards the purchase of goods and services in districts with lower costs of living, I adjusted the per-pupil expenditure data for cost of living in the district. To compare per-pupil expenditures across years, I then converted the results into year 2000 constant dollars to adjust for inflation[3]. I standardize the per-pupil expenditure variable for each year to compare to other coefficients.

Race-gender cohorts. The first student-level predictor of achievement is the race and gender of students. I aggregate students into the following race by gender (henceforth race/gender) cohorts: black male, white male, white female, Hispanic male, other male, black female, Hispanic female, other female. I use white females as the reference category because this cohort has relatively high mean achievement compared to other race/gender cohorts. The variable for "other" male and female includes students who self identified as "Other", "Asian", "Native American", or "Mixed." Although initially I included variables for Asian males and females, there were too few Asian students remaining in the sample to warrant their own category after cases were deleted due to missing data.

Socioeconomic status. I use variables for both the education of the parents and the free lunch status of the student as rough measures of individual student's socioeconomic standing. Although free lunch eligibility is a crude measure of family income because not all eligible parents apply for free lunch for their children, it is often used as a poverty indicator (Sirin, 2005). Free lunch is also the indicator used for poverty by the National Center for Educational Statistics (NCES 2007). I created a dummy variable identifying whether or not students are eligible for free or reduced-price lunch (0=not eligible, 1=eligible for free or reduced-price lunch).

I also include a variable for parental education. At the beginning of the school year, North Carolina schools ask parents to fill out a demographic profile of themselves. The variable used for parent education is the highest level of education self-reported by the parent or guardian completing the demographic questionnaire. The scale ranges from 1 (less than high school) to 7 (completed graduate school). I combined the categories for technical school and community college, leaving a scale ranging from 1-5. I treated the recoded categories as a scalar variable and used the standardized coefficient for parental education within each year.

Afterschool activities. To control for how students spend time outside of school, I included variables for the amount of time a student watches television (1=never through 5=more than 5 hours), reads (1=never through 5=more than 2 hours), spends time on homework (1=none through

[3] To adjust for cost of living I first created a cost of living index. I identified the median household income and median housing cost for each county from the 2000 U.S Census Summary file 3 (variables P53 and H85). I then divided the income for each county by the mean cost of living for the state of North Carolina. To remove the effects of inflation on per-pupil expenditures, I adjusted the per-pupil expenditures for each district for base year of 2000 by using table B-7 from the Department of Commerce website. Using this table, I divided the coefficient for 2000 by the coefficient for each year and then multiplied this by the per-pupil expenditures for each year. I then multiplied (1/cost of living) by the inflation-adjusted per-pupil expenditures.

4=more than three hours), and uses a computer at home (1=never through 5=daily). For each of these variables, I standardized the coefficients for each year.

Gifted. Students who are labeled as gifted early in their school career are often granted access to special programs and put into higher academic tracks. Because of this, I created a dummy variable for whether or not a student is labeled as gifted (0=not gifted, 1=gifted).

Prior achievement. In all of the hierarchical regression models, for both reading and math, I control for students' prior achievement. I use students' End of Grade math or reading achievement test scores from third grade. Because students in different types of schools often enter school with differing levels of initial achievement, controlling for prior achievement reduces the chances that the school effects found will be overstated. Ideally, a measure of prior achievement would not include any school effects. An ideal measure would be taken before students actually enter school. For this study however, the earliest measure of ability available is students' third grade EOG scores.

Table 1 displays the mean standardized student characteristics by year, disaggregated by the students' race and gender. Table 2 presents the mean school characteristics by school type and year.

Table 1

Descriptive characteristics of North Carolina schools by school type and year (standardized measures)

School type	Year	N	S/T ratio	T. license	T. adv. degrees	T < 3 yrs	Per-pupil $
Racially-imbalanced white/high poverty	2002	9	-1.30	0.09	-0.54	-0.24	0.73
	2004	3	0.45	1.28	-0.71	-1.30	0.45
	2006	1	0.56	1.69	-2.73	-0.23	0.56
Racially-imbalanced white/mid poverty	2002	291	0.08	0.43	0.06	-0.36	-0.14
	2004	168	-0.13	0.43	0.25	-0.32	-0.21
	2006	146	-0.40	0.52	0.36	-0.42	-0.03
Racially-imbalanced white/low poverty	2002	111	0.60	0.44	0.48	-0.35	-0.53
	2004	36	0.77	0.53	2.20	-0.51	-0.36
	2006	31	0.19	0.47	0.80	-0.54	-0.03
Racially balanced/high poverty	2002	65	-0.55	-0.40	-0.23	0.42	0.77
	2004	35	0.18	-0.37	-0.51	0.31	0.94
	2006	10	-0.57	-0.59	-0.57	0.05	0.76
Racially balanced/mid poverty	2002	484	0.00	-0.01	-0.02	0.06	0.00
	2004	223	0.09	-0.03	-0.04	0.05	-0.02
	2006	236	0.01	0.01	-0.19	0.10	-0.09
Racially balanced/low poverty	2002	47	0.45	0.36	0.21	-0.06	-0.68
	2004	18	-0.23	0.21	0.72	-0.28	-0.72
	2006	21	-0.07	0.64	0.78	-0.24	-0.07
Racially-imbalanced minority/high poverty	2002	133	-0.40	-0.89	-0.29	0.42	0.56
	2004	55	-0.34	-0.90	-0.53	0.63	0.72
	2006	42	-1.10	-1.30	-0.72	0.72	0.85
Racially-imbalanced minority/mid poverty	2002	50	-0.08	-0.72	-0.18	0.61	0.00
	2004	23	-0.19	-1.16	-0.58	0.92	-0.23
	2006	40	-0.33	-0.71	-0.47	0.60	0.72

Source: North Carolina Educational Research Center at Duke University public-use files.

Table 2
Mean North Carolina student characteristics by year and race/gender cohort

	White Female	White Male	Black Female	Black Male	Hispanic Female	Hispanic Male	Other Female	Other Male
Reading[a]								
2002	0.30	0.25	-0.45	-0.61	-0.31	-0.38	0.03	-0.10
2004	0.31	0.24	-0.43	-0.58	-0.43	-0.29	0.00	-0.15
2006	0.29	0.22	-0.47	-0.59	-0.22	-0.23	0.02	-0.06
Math[a]								
2002	0.23	0.35	-0.56	-0.57	-0.30	-0.21	0.00	0.02
2004	0.25	0.36	-0.57	-0.60	-0.19	-0.18	0.08	0.04
2006	0.22	0.28	-0.50	-0.57	-0.14	-0.15	0.03	0.03
Gifted[b]								
2002	0.22	0.22	0.06	0.05	0.06	0.07	0.17	0.15
2004	0.26	0.26	0.07	0.06	0.08	0.08	0.22	0.19
2006	0.27	0.26	0.08	0.07	0.09	0.09	0.21	0.19
Lunch[b]								
2002	0.23	0.23	0.64	0.61	0.69	0.71	0.44	0.44
2004	0.24	0.21	0.72	0.70	0.76	0.79	0.54	0.54
2006	0.24	0.21	0.68	0.65	0.74	0.74	0.50	0.52
Home computer use[a]								
2002	0.07	-0.02	-0.01	-0.05	-0.16	-0.26	0.06	0.00
2004	0.15	-0.04	-0.05	-0.16	-0.12	-0.24	0.11	-0.07
2006	0.13	-0.05	-0.02	-0.13	-0.14	-0.24	0.14	-0.07
Home reading[a]								
2002	0.17	-0.03	-0.04	-0.27	0.08	-0.13	0.16	-0.07
2004	0.19	-0.10	0.01	-0.27	0.14	-0.19	0.26	-0.05
2006	0.15	0.22	0.13	-0.20	0.14	-0.22	0.25	-0.08
TV watching[a]								
2002	-0.22	-0.03	0.24	0.34	-0.16	0.03	-0.09	0.03
2004	-0.26	-0.12	0.42	0.40	0.03	0.08	-0.05	-0.01
2006	-0.28	-0.18	0.51	0.47	0.09	0.04	-0.02	-0.02
Parental education[a]								
2002	0.19	0.24	-0.33	-0.31	-0.81	-0.81	-0.06	-0.04
2004	0.16	0.20	-0.28	-0.25	-0.70	-0.71	-0.08	-0.03
2006	0.15	0.20	-0.25	-0.23	-0.77	-0.75	-0.11	-0.08
Homework[a]								
2002	0.08	0.05	-0.10	-0.17	-0.04	-0.06	0.01	-0.04
2004	0.13	0.02	-0.01	-0.22	0.01	-0.10	0.09	-0.02
2006	0.12	-0.01	-0.08	-0.18	0.05	-0.02	0.11	-0.05

[a] Standardized measure
[b] Dichotomous (dummy, 0/1) variable
Source: North Carolina Educational Research Center at Duke University public-use files.

Analyses

The first model for each subject-by-grade HLM regression analysis is the intercept-only model. This model does not include any predictor at any level and shows the mean attainment of students in schools plus the standard error. Next, for each grade (fourth, sixth, and eighth) and subject (reading and math), I introduce all student-level predictors. This model allows me to observe the effects of students' race/gender combination, afterschool activities, family background, and prior achievement on their achievement, net of school characteristics. In model 3, I include the race and poverty composition cohorts of schools in the analyses, and in the final model I include the other school-level characteristics.

I used the group mean center of the standardized individual control variables. With this type of centering the level-one intercept is the average outcome for white females in schools and individual control variables reflect the expected values for the average child in a racially balanced mid poverty school. Coefficients are considered significant if $p < .05$.

Limitations of This Study

The major limitation of this study is selection bias. There are several selection bias issues that should be acknowledged. The first is that students in North Carolina are not assigned to schools in the same way in all districts. For example, during the years under study, Wake County (the largest urban district, with Raleigh) assigned students to schools based on a formula that includes the mean poverty and achievement levels in schools. No school in Wake County was expected to have over 40% of their students on free or reduced-price lunch. Other districts assigned children based on the neighborhood in which they live. Even within districts, student assignment policies may change over time. For instance, during the course of this study Charlotte-Mecklenburg changed their student assignment policy three times (Godwin et. al. 2005; Mickelson & Southworth, 2006).

A further form of selection bias stems from the fact that some parents are able to "choose" schools for their students. They choose schools based on the neighborhoods that they decide to live in, or they may select into a magnet or charter school. Parents also select to use the public education system rather than home-schooling or sending their children to private school. Children of parents who actively choose a school may be different from those who attend whatever school they are assigned (Godwin & Kemerer, 2002). I controlled for some of this selection bias by not including students in charter schools, but with any study where there are differences in student assignment, some bias is still present.

Next, in addition to the fact that including only students who were not in exceptional programs reduced the variability of student test scores and controlled for outside services offered to some students, it also reduced the percentage of males, black, and Hispanic students included in the study. Males are more likely than females to be placed in special education, and black and Hispanic students are more likely to be in special education students than white students (U.S. Department of Education 2003)The resulting sample therefore may not be representative of the achievement for all male, black, and Hispanic students.

The final form of selection bias is attrition. Using third-grade test scores as a measure of prior achievement is necessary to most accurately predict the effects of schools net of the prior knowledge of students. However, using third-grade test scores limits the sample to students who attended North Carolina in third grade as well as subsequent years. Thus, as students progress through school, the sample size declines.

Results

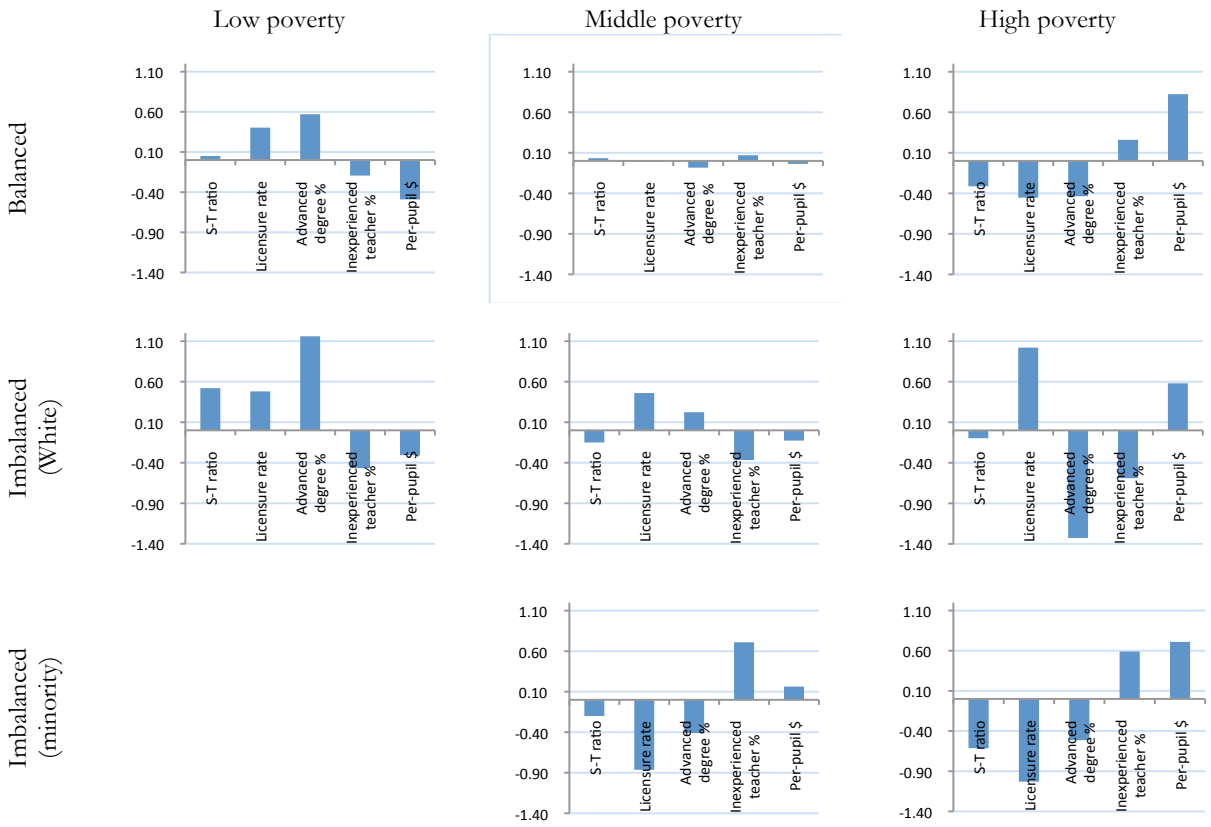

Figure 1. School-level classroom characteristics by demographic category: standardized variables for student-teacher ratio, licensure rate, advanced degrees, inexperienced teacher percentage, and per-pupil expenditures. No schools are in the RIM/low poverty cell.

Table 1 (on page 11) provides the results of the descriptive data for school characteristics by year. Figure 1 above displays these results in a graphical form. Figure 1 shows that schools that are racially imbalanced minority or have high levels of poverty receive more funding per pupil than schools in other race/poverty cohorts. These schools also have lower student-teacher ratios than other types of schools. In contrast, high poverty, racially imbalanced minority schools also have fewer experienced teachers, fewer licensed teachers, and fewer teachers with advanced degrees. The schools that have both middle levels of poverty and are racially balanced are allocated about average amounts of funding, have about average teacher characteristics, and about average pupil-teacher ratios.

Table 2 (on page 12) displays the descriptive results for students in schools by year. Overall, Hispanic and black students of both sexes have lower achievement than white and other students. Female black and Hispanic students tend to have higher achievement than their male counterparts. Both male and female black and Hispanic students also are far more likely to be on free lunch and on average have parents with lower levels of education than white students. Other students also have parents with lower levels of education and are more likely to be eligible for free or reduced-price lunch than white students. White students and other students are also more likely to be labeled as gifted than black and Hispanic students.

Few would deny that there are achievement gaps between different groups and that family background often differs by groups as well. Few would also argue that there are disparities within school types. The descriptive statistics show than high poverty schools and schools that are racially imbalanced minority have more of some resources (funding, smaller classrooms) and fewer of other resources (qualified teachers) than other types of schools. So if money and small classrooms are important indicators of success, then North Carolina is allocating resources effectively. If the composition of students and teachers are more important indicators of achievement, however, then North Carolina may not be efficient in their resource allocation. The question is then how to identify the proper tools that schools can use to decrease achievement gaps. In other words, what are the characteristics of schools that contribute to the perpetuation or reduction of achievement gaps in North Carolina schools?

Hierarchical analyses allows an answer to the following research questions: Do the racial and poverty composition of schools interact to affect achievement on students' End of Grade (EOG) Reading and Math achievement? Are the effects of school characteristics on achievement the same at different points in time? What school-level characteristics affect student achievement? How do achievement gaps, controlling for school and student characteristics differ by students' race and gender? Tables 3 and 4 display summary results from the hierarchical analyses conducted in this study for reading and math respectively. The appendix contains detailed coefficients and estimates of variance components.

Table 3
Results from final HLM models of North Carolina student reading achievement

Variable	*Fourth Grade* 2001–2002 77425 students 1193 schools	*Sixth Grade* 2003–2004 71744 students 561 schools	*Eighth Grade* 2005–2006 62548 students 527 schools
Intercept	0.10	-0.07	-0.04
	(0.05)	(0.18)	(0.32)
School characteristics	0.07***	0.34***	0.30***
RIW/high poverty	(0.02)	(0.04)	(0.04)
	-0.01	0.10***	0.09***
RIW/mid poverty	(0.02)	(0.04)	(0.04)
	-0.05*	-0.24***	-0.27***
RIW/low poverty	(0.01)	(0.02)	(0.02)
	-0.06***	-0.32***	-0.34***
RIM/high poverty	(0.02)	(0.04)	(0.04)
	0.11***	0.36***	0.27***
RIM/mid poverty	(0.02)	(0.04)	(0.05)
	-0.06**	-0.16***	-0.19**
RB/high poverty	(0.00)	(0.01)	(0.01)
	-0.01**	-0.02*	-0.01
RB/low poverty	(0.02)	(0.04)	(0.07)
	-0.02**	-0.05***	0.01
Per pupil $	(0.00)	(0.01)	(0.01)
	-0.02**	0.00	-0.00
Class size	(0.01)	(0.01)	(0.01)
	0.01*	0.05***	0.03*
% Ts <3 yrs exp.	(0.00)	(0.01)	(0.01)

Variable	*Fourth Grade* 2001–2002 77425 students 1193 schools	*Sixth Grade* 2003–2004 71744 students 561 schools	*Eighth Grade* 2005–2006 62548 students 527 schools
% licensed teachers	0.01	0.02*	0.05***
	(0.00)	(0.01)	(0.01)
% teach w/ adv. deg.	0.10	-0.07	-0.04
	(0.05)	(0.18)	(0.32)
Student characteristics	0.07***	0.34***	0.30***
White male	-0.01*	-0.05***	-0.02**
	(0.00)	(0.00)	(0.01)
Black male	-0.17***	-0.23***	-0.20***
	(0.01)	(0.01)	(0.01)
Black female	-0.12***	-0.154***	-0.18***
	(0.01)	(0.01)	(0.01)
Hispanic male	0.02	0.00	0.13***
	(0.02)	(0.02)	(0.02)
Hispanic female	0.04**	0.06**	0.08***
	(0.01)	(0.02)	(0.02)
Other male	-0.02	-0.05**	0.05**
	(0.01)	(0.02)	(0.02)
Other female	0.01	0.00	0.04*
	(0.01)	(0.02)	(0.02)
Reading hours	0.05***	0.08***	0.08***
	(0.02)	(0.02)	(0.02)
TV hours	0.00	-0.00	-0.01***
	(0.00)	(0.00)	(0.00)
Computer hours	-0.02***	-0.01***	-0.01***
	(0.00)	(0.00)	(0.00)
Homework hours	0.03***	0.03*	0.04***
	(0.00)	(0.00)	(0.00)
Parent education	0.08***	0.08***	0.09***
	(0.00)	(0.00)	(0.00)
Free lunch	-0.07***	-0.09***	-0.10***
	(0.01)	(0.01)	(0.01)
3rd gr. reading score	0.64***	0.55***	0.51***
	(0.00)	(0.00)	(0.00)
Gifted	0.28***	0.37***	0.41***
	(0.01)	(0.01)	(0.01)

* $p<.05$; ** $p<.01$; *** $p<.001$
RIW: racially-imbalanced White
RIM: racially-imbalanced minority
RB: racially balanced
Source: North Carolina Educational Research Center at Duke University public use files.

Table 4
Results from final HLM models of North Carolina student math achievement

Variable	*Fourth Grade* 2001–2002 77425 students 1193 schools	*Sixth Grade* 2003–2004 71744 students 561 schools	*Eighth Grade* 2005–2006 62548 students 527 schools
Intercept	-0.03*	-0.08***	-0.10***
	(0.01)	(0.02)	(0.02)
School characteristics			
RIW/high poverty	0.12	-0.31*	-0.31
	(0.10)	(0.08)	(0.36)
RIW/mid poverty	0.04	0.12***	0.11**
	(0.02)	(0.03)	(0.03)
RIW/low poverty	0.27***	0.44***	0.45***
	(0.03)	(0.05)	(0.06)
RIM/high poverty	-0.34***	-0.35***	-0.33***
	(0.03)	(0.04)	(0.05)
RIM/mid poverty	-0.22***	-0.28***	-0.32***
	(0.04)	(0.05)	(0.05)
RB/high poverty	-0.24***	-0.20***	-0.26**
	(0.04)	(0.05)	(0.09)
RB/low poverty	0.39***	0.39***	0.30***
	(0.05)	(0.07)	(0.07)
Per-pupil $	-0.06***	-0.05***	-0.00
	(0.01)	(0.01)	(0.01)
Class size	-0.01	-0.02	-0.01
	(0.01)	(0.01)	(0.01)
% Ts <3 yrs exp.	-0.03**	0.02	-0.00
	(0.01)	(0.02)	(0.02)
% licensed teachers	0.04***	0.07***	0.01
	(0.01)	(0.02)	(0.02)
% teach w/ adv. deg.	0.04***	0.03*	0.07***
	(0.01)	(0.01)	(0.01)
Student characteristics			
White male	0.02***	-0.01*	0.00
	(0.00)	(0.00)	(0.01)
Black male	-0.08***	-0.09***	-0.10***
	(0.01)	(0.00)	(0.01)
Black female	-0.05***	-0.02***	-0.02*
	(0.01)	(0.01)	(0.01)
Hispanic male	0.10***	0.14***	0.16***
	(0.01)	(0.02)	(0.02)
Hispanic female	0.08***	0.20***	0.23***
	(0.01)	(0.02)	(0.02)
Other male	0.06***	0.10***	0.11***
	(0.01)	(0.02)	(0.02)
Other female	0.05***	0.14***	0.14***
	(0.01)	(0.02)	(0.02)
Reading hours	0.03***	0.02***	0.01***

Variable	*Fourth Grade* 2001–2002 77425 students 1193 schools	*Sixth Grade* 2003–2004 71744 students 561 schools	*Eighth Grade* 2005–2006 62548 students 527 schools
	(0.00)	(0.00)	(0.00)
TV hours	0.00	-0.00	-0.01***
	(0.00)	(0.00)	(0.00)
Computer hours	-0.01***	0.00	0.01**
	(0.00)	(0.00)	(0.00)
Homework hours	0.03***	0.05***	0 .06***
	(0.00)	(0.00)	(0.00)
Parent education	0.07***	0.08***	0.10***
	(0.00)	(0.00)	(0.00)
Free lunch	-0.05***	-0.08***	-0.07***
	(0.00)	(0.01)	(0.01)
3rd gr. reading score	0.71***	0.63***	0.54***
	(0.00)	(0.00)	(0.00)
Gifted	0.30***	0.34***	0.45***
	(0.01)	(0.01)	(0.01)

* $p<.05$; ** $p<.01$; *** $p<.001$
RIW: racially-imbalanced White
RIM: racially-imbalanced minority
RB: racially balanced
Source: North Carolina Educational Research Center at Duke University public use files.

Race/Poverty School Composition

One of the school-level factors contributing to academic achievement is the percentage of low-income and minority students in schools. The reference group in this study includes schools that are racially balanced and have middle levels of poverty. In fourth grade and sixth grade in both reading and math, students who attend racially balanced low poverty schools have statistically higher achievement than any other race/poverty school cohort after controlling for school and individual factors. The next highest achievers attend racially imbalanced white low poverty schools. In eighth grade, the schools that are racially imbalanced white with low levels of poverty have the highest mean achievement followed by the racially balanced schools with low levels of poverty.

The lowest achievers in all three grades are found in high poverty, racially imbalanced minority schools and the next lowest achievement is found in racially imbalanced minority schools with middle levels of poverty. Thus, racial balance and poverty levels are both important indicators of academic achievement. This finding is interesting in that it highlights both the effects of race and poverty concentration. Figure 2 displays the effect of school type on mean fourth, sixth and eighth grade math achievement net of other individual and school effects.

The reference group are schools that are racially and economically balanced. When examining the schools with middle levels of poverty, test scores decline as the concentration of minority students increase. In contrast, when examining racially balanced schools, those with the lowest levels of poverty have the highest achievement scores and, even within racially balanced schools, as the percentage of poor children increases, test scores decline. These findings are significant even after controlling for individual and other school characteristics.

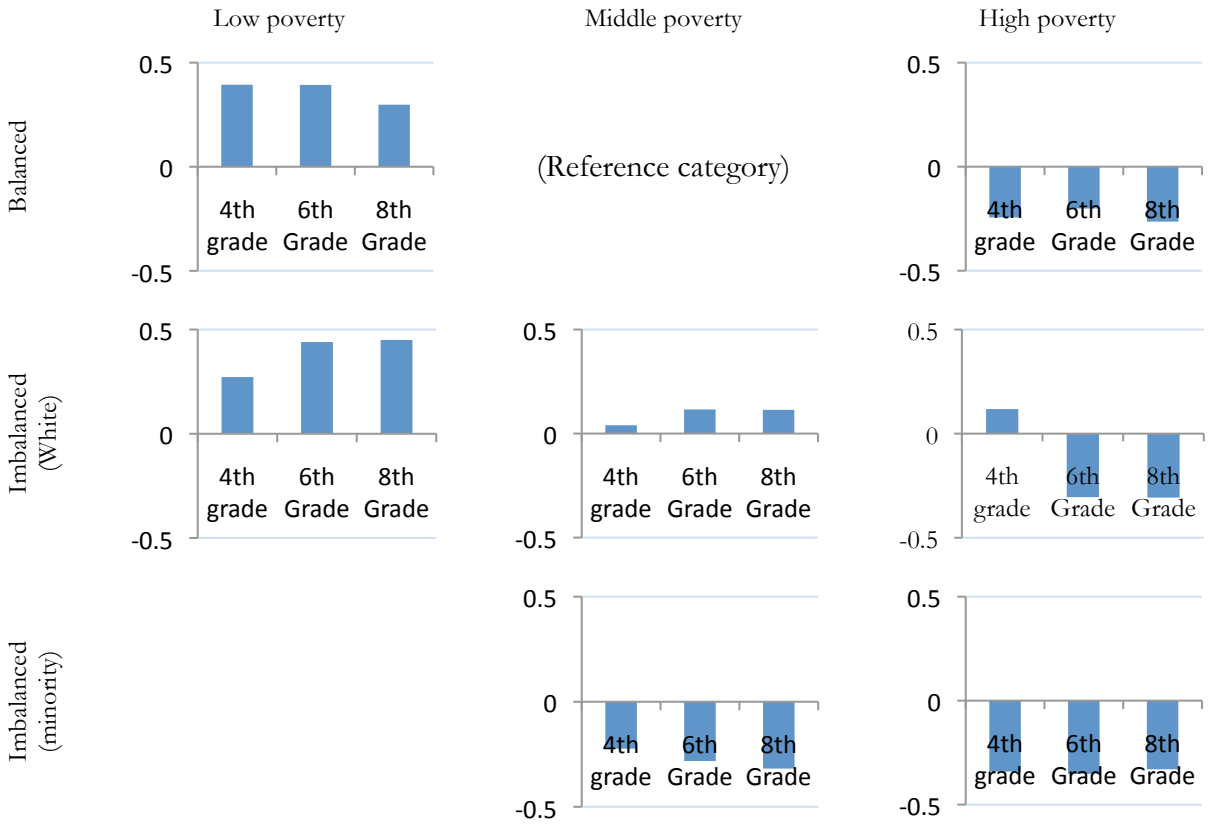

Figure 2. Mean math achievement of students in North Carolina schools by school type, controlling for home and other school characteristics, 2002–2006. Balanced, mid-poverty schools are the reference category. No schools are in the RIM/low poverty cell.

Teacher Characteristics

The percentage of licensed teachers in a school has a positive, significant effect on achievement for both reading and math in all three grades examined. The percentage of teachers with advanced degrees and the percentage of new teachers in a school however, have differing effects depending on the grade of the student. In fourth grade, for both reading and math, as the percentage of teachers in a school with less than three years experience increases, test scores decrease. The coefficient for the percentage of teachers with less than three years experience is not significant in the sixth and eighth grade models.

The percentage of teachers with advanced degrees in a school has a significant, positive effect on sixth and eighth grade reading achievement. The variable is not significant in other grades or for math however. The student-teacher ratios in schools are significant predictors of achievement in fourth grade reading and for both reading and math in eighth grade. As student-teacher ratios increase, particularly in eighth grade, even when controlling for other school, student, and teacher effects, test scores decline.

Per-pupil expenditures

In all three years, there is a negative correlation between per-pupil expenditures and achievement. This finding shows that the extra funding that high poverty schools receive is likely not enough to increase achievement in those schools. This is not to say that the extra resources given to low-income schools are not important. Rather, the descriptive statistics (Table 2) show that although

per-pupil expenditures are higher in low-income schools, the additional funding is not used to hire more licensed teachers, teachers with advanced degrees, or to pay the salaries for more experienced teachers.

Prior Achievement, After-School Activities, and Family Background Characteristics

Across all the years of this study, students' third grade math and reading test scores have the most effect on their subsequent achievement. What a child knows by third grade, via schooling, early family socialization, innate ability, or test taking skills, largely predicts how they will perform in fourth, sixth, and eighth grades even when controlling for other student and school characteristics. The next largest factor in achievement is whether or not a student is labeled as gifted. The descriptive analysis shows that white students, both male and female are much more likely to be labeled as gifted than students in any other race/gender cohort.

White male and female students in North Carolina schools also have more educated parents which may contribute to the increase likelihood of being labeled as gifted. Students with more educated parents have higher achievement in all three years of this study than parents with less educated parents. This may be in part because more educated parents are more likely to have more books in the home. The HLM results show that students who read more have higher achievement in both reading and math than children who spend less time reading at home. In addition, students who report spending more time doing homework have higher achievement than students who report less time spent on homework. Controlling for the type of school a student attends, other school and student variables, students who are on free lunch have significantly lower achievement than students who are not on free lunch in both math and reading for all three years.

In contrast, the hours a student reports watching television is not significant for math or reading in fourth and sixth grade, but there is a significant negative effect seen in grade eight. The time a student reports being on a computer at home is negative for reading in all three grades. For math however, the result is negative in fourth grade, not significant in sixth grade, and positive in eighth grade after controls are in place.

Race/Gender Cohorts

The results of the HLM analyses show that, even when family background and the way students spend time after school are controlled, achievement gaps between race/gender cohorts remain. In fourth, sixth, and eighth grade, black male and black female students have significantly lower achievement than white females in both reading and math, even after controlling for home and school characteristics. Within this group, black females have higher achievement than black males both with and without controls in place.

The results are not as consistent for white males, other students, and Hispanic students however. The final model for reading shows that, with controls, white males perform slightly below white females in all three grades. The final models for math however, have males outperforming white females in fourth grade and sixth grade. There is not a significant difference between white males and females in eighth grade. For reading, after controlling for school and individual variables, other students do not have significantly different reading scores than white females in fourth grade. By eighth grade, both male and female students in the other race/gender category have significantly higher achievement than white females. For math, the positive effect is statistically significant in all three grades. As with the black students, within the group of other students, other females have higher achievement than other male students both with and without controls in place.

Hispanic students, on average, have less educated parents and are more likely to be on free or reduced-price lunch than any other racial cohort. Hispanic family background characteristics are very similar to the black student characteristics. A large percentage of Hispanic students are on free

lunch and they have lower levels of educated parents than white and other students. After controlling for home and school factors however, Hispanic test scores do not reflect their family background in the same manner as it does for the black students, who have the lowest achievement and have gaps that persist throughout the years of this study.

Although the descriptive statistics show that Hispanic students (both male and female) in North Carolina schools have much lower mean achievement test scores than white females, the results differ when controlling for school and family background. With controls, Hispanic males do not have significantly different reading scores than white females in fourth and sixth grade. By eighth grade however, the coefficient is significant and positive. Hispanic females have higher reading achievement in all three grades and both males and female Hispanic students out-perform white female students in math with controls in place. As with black and other students, Hispanic females have higher achievement than Hispanic males both with and without controls.

Discussion

The hierarchical models allowed me to answer the research questions in this study. First, I was able to answer the question: Do the race and poverty composition of schools interact to affect achievement on End of Grade reading and math achievement?

The models for both reading and math in all three grades show that achievement is directly affected by the racial and poverty composition of the schools that students attend throughout their primary school career. As the percentage of either minority students *or* students on free lunch increases in schools, predicted reading and math scores decline. This finding supports desegregation advocates' assertions that diversity in schooling does indeed affect student achievement.

For reading and math, at all three grades, students in racially imbalanced minority high poverty schools have the lowest achievement. In contrast, students in low poverty, racially balanced schools have the highest predicted achievement in fourth and sixth grade and children in racially imbalanced white low poverty schools have the highest math and reading achievement in eighth grade. When comparing only the schools with middle levels of poverty, with differing racial compositions, students attending schools that are imbalanced white have higher scores than racially balanced schools and students attending racially imbalanced minority schools have lower predicted scores. Thus, although being in classrooms with higher proportions of low-income students affects student achievement, the racial balance of a school has effects independent of the poverty composition of a school, even when controlling for student factors and other school characteristics.

The second question posed in this study was: What school-level characteristics affect student achievement? For fourth and sixth grade there is a negative correlation between per-pupil expenditures and achievement and for eighth grade the relationship is not significant in math or reading. The descriptive statistics show that high poverty schools in North Carolina do receive more funding per pupil than low poverty schools. This finding shows that the extra funding that high poverty schools receive is likely not enough to increase achievement in those schools.

This is not to say that the extra resources given to low-income schools are not important. Rather, although per-pupil expenditures are higher in low-income schools, the additional funding is not used to hire more licensed teachers, teachers with advanced degrees, or to pay the salaries for more experienced teachers. In fact, compared to schools with less poverty, high poverty schools have fewer teachers with advanced degrees, fewer licensed teachers, and fewer experienced teachers, all of which increase student achievement. It is probable that the extra funding received by low-income schools are aimed at increasing the numbers of special education classes, providing supplemental services for the low-income children in the schools, and for improving the physical

structure of the schools rather than on improving teacher quality. This corresponds with Henry and Thompson's (2008) study of North Carolina high schools. In this study Henry and Thompson found that schools that had the highest funding levels did not spend the money on attaining high quality teachers.

High poverty schools do however, on average, have lower student-teacher ratios, and in fourth and sixth grade, this variable does have a significant, positive effect on reading and math achievement. Thus, to increase achievement net of other schools and family effects, keeping lower student-teacher ratios in place in high poverty schools will have a small but positive effect on student achievement in those schools.

I find that all of the teacher characteristics observed have effects on student achievement in one or more grades. In fact, at least part of the achievement gap between schools of differing race/poverty cohorts should be attributed to the differences in teacher quality between school types. The percentage of teachers with less than three years of experience in a school is a significant indicator of achievement in fourth grade for both reading and math. At the other grade levels however, the percentage of new teachers is not a significant indicator of predicted achievement. This means that targeting experienced teachers to the lower grades (in this case, fourth grade) may be beneficial in increasing achievement for students in those schools. The positive effect of teacher experience in fourth grade is likely due to the differences in teaching styles between elementary and middle schools. Middle school teachers are more likely to lecture on specific subjects and spend less time interacting with students. They are also required to transmit more critical thinking skills which may not require as much experience if they know their subject.

The percentage of teachers who are licensed and who have advanced degrees have positive and mostly significant effects on achievement in both reading and math in all three grades. Thus, the *No Child Left Behind* mandate that directs schools who receive federal funding to be staffed with "highly qualified" teachers, (*U.S. Department of Education)* is likely to improve achievement if implemented.

The third question explored in this study asked how academic achievement gaps differ between students of differing race/gender cohorts when controlling for family and school characteristics. The most interesting finding is that of Hispanic students. When controlling for school and family background, Hispanic students, both male and female have higher predicted math scores in all three grade and by eighth grade, both male and female Hispanic students have higher predicted achievement than white females in reading when home and school factors are controlled. This finding confirms earlier studies that found that gaps between white and Hispanic students decrease over time (Clotfelter et al., 2009; Reardon & Galindo, 2008; Rumberger & Palardy, 2005).

This is interesting is because the population of Hispanic students in this study have much lower levels of parental education than white students and higher poverty rates. In fact, in eighth grade 74% of both male and female Hispanic students are on free or reduced-price lunch. In contrast, controlling for school and family background do not have the same effect on black students as on Hispanic students. Although black students have similar percentages of students on free lunch and similar parental education levels than Hispanics, their achievement is significantly lower even with controls in place. In fact, even with controls in place black male and female students have the lowest achievement of any group. However, black females have higher achievement than black males at all grades in both reading and math.

The last relationship I was concerned with is the effect of the variables in this study over time. I found the most consistent relationship between the racial and poverty composition of schools and student achievement. At all three points in time, students who attended high poverty or schools have lower achievement than their counterparts in schools with fewer low-income students.

All students in racially balanced, low poverty schools had higher achievement than if they were in other school times at two of the three times included in this study.

I found that as students progress through school, gender gaps between white females and males in math are eliminated and the achievement gap between Hispanic and white students actually reverses when family and school characteristics are controlled. In contrast, I found that the gap between black and white students persists as students progress through school, even after controlling for school and individual characteristics. Because black students are more likely than other racial groups to attend high poverty schools and schools with more than 75% of minority students (schools with the fewest qualified teachers, and least academic press) they are at a distinct disadvantage in the North Carolina educational system.

Conclusion

In this study I found support for desegregation advocates' claims that racially segregated schools provide fewer opportunities for students to learn. I found that the racial and poverty composition of schools has the strongest effect on student achievement even when controlling for student's individual characteristics and other school variables. Students who attend racially balanced, low poverty schools have significantly higher achievement than students in any other race/poverty cohort at two of the three points in this study. This is important given that over the past two decades, many districts have been declared unitary and disbanded their desegregation policies, resulting in an increase in both racial and economic segregation. Even districts that have implemented voluntary desegregation plans have been challenged in the courts.

This results of this study also support districts such as Wake County, NC that seek to increase educational opportunities through reducing economic segregation in schools. In all three years, students in low poverty schools have significantly, higher achievement than students in schools with more poverty. Low poverty schools are also more likely to have licensed, experienced teachers with advanced degrees. It is likely that these types of schools are able more able to attract the high quality teachers because of the less stressful working conditions found in schools with lower levels of poverty.

Additionally, this study gives credence to the *No Child Left Behind* policy of staffing schools with high quality teachers. Teachers do make a difference. Unfortunately today, seven years after NCLB was implemented, experienced and licensed teachers and teachers with advanced degrees are less likely to be found in the schools that need them most.

The fact that there is a negative relationship between per-pupil expenditures and achievement is likely due to the fact that high poverty schools in North Carolina do receive more financial resources than schools with lower levels of poverty. The problem however, is that increasing financial resources is not likely to lead to increases in achievement if the money is allocated towards structural improvements, health and psychological services. Without access to motivated peers and qualified and supportive teachers, children in high poverty schools are not likely to achieve at the same rates as children in schools with lower levels of poverty.

This study shows the interaction between school racial and poverty composition and student achievement. It also shows that having qualified teachers in classrooms is important. High quality teachers are not as likely to be found in the high poverty or racially imbalanced minority schools however. Because both the composition of the students and the composition of the teachers are important, it is essential that policymakers call attention to and seek to ameliorate disparities between school types. Although the NCLB Act seeks to reduce achievement gaps by staffing all schools with high quality teachers, in North Carolina, this goal has not been achieved.

Because of the correlation between the race and poverty composition of schools and teacher quality, diversity is still a compelling interest when seeking to equalize educational opportunities for all students. It is not likely that school systems or the courts will be willing any time soon to return to implementing student assignment policies based on racial composition. Student assignment plans based on academic achievement and poverty composition such as the policy implemented in Wake County may be beneficial however. Increasing the number of specialized magnet schools in low-income neighborhoods, redrawing school attendance zones with an eye on racial and poverty composition, or allowing interdistrict transfers in highly segregated districts may be other options for increasing diversity.

Clearly, in North Carolina, as in other states, there is no magic formula for academic success. There are however disparities in educational opportunities available to students in schools of differing racial and poverty compositions. Addressing both the inherent disparities associated with the populations of the schools as well as the disparities in resource allocation is imperative if the goal of public education in North Carolina is in fact to provide equal educational opportunities to all children and reduce achievement gaps.

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Appendix

Detailed Tables

Table A-1.

Final estimation of variance components for math and reading HLM analysis by grade

	Fourth Grade		Sixth Grade		Eighth Grade	
	Unconditional Model	Final Model	Unconditional Model	Final Model	Unconditional Model	Final Model
Math						
τ_{00} (intercept)	.163	.082	.151	.068	.160	.074
σ^2 (Level 1)	.840	.258	.848	.264	.843	.364
Reading						
τ_{00} (intercept)	.141	.014	.124	.038	.118	.036
σ^2 (Level 1)	.860	.330	.882	.388	.890	.428

Table A-2.

Between-student and -school variance and percentage variance explained in HLM models by grade

	Fourth Grade		Sixth Grade		Eighth Grade	
	Math	Reading	Math	Reading	Math	Reading
Intraclass Correlation Coefficient: % variance in achievement lying between schools	16.2%	14.1%	15.1%	12.3%	16.0%	11.7%
% variance in achievement lying between students	83.8%	85.9%	84.9%	87.7%	84.0%	81.3%
% school variance explained by independent variables	49.6%	71.4%	54.9%	69.3%	53.7%	69.4%
% individual variance explained by independent variables	69.2%	61.6%	68.8%	56.0%	56.8%	51.9%

Intraclass correlation coefficient is calculated as: $\rho = \tau_{00} / (\tau_{00} + \sigma^2)$

Individual variance explained is calculated as: σ^2 (intercept-only) - σ^2 (random-coefficients)/σ^2(intercept-only)

School variance explained is calculated as: τ_{00} (intercept-only) - τ_{00} (means-as-outcomes) / τ_{00} (intercept-only)

Table A-3.
HLM, North Carolina fourth grade reading achievement (2001/2002)

Variable	*Model 1* Unconditioned	*Model 2* Student characteristics	*Model 3* Race/Pov cohorts	*Model 4* All variables
Intercept	-0.02 (0.02)	0.02 (0.01)	0.02 (0.01)	0.02** (0.01)
School characteristics				
RIW/high poverty			0.16** (0.06)	0.10 (0.05)
RIW/mid poverty			0.08*** (0.02)	-0.01 (0.01)
RIW/low poverty			0.32*** (0.03)	0.07*** (0.02)
RIM/high poverty			-0.44*** (0.03)	-0.06*** (0.02)
RIM/mid poverty			-0.28*** (0.04)	0.05* (0.02)
RB/high poverty			-0.30*** (0.04)	-0.06** (0.02)
RB/low poverty			0.45*** (0.04)	0.11*** (0.02)
Per-pupil expenditures				-0.02** (0.00)
Class size				0.01** (0.00)
% teachers <3 yrs exp.				0.02** (0.01)
% licensed teachers				0.01* (0.01)
% teach w/ adv. deg.				0.01
Student characteristics				
White male		-0.01* (0.01)	-0.01* (0.01)	-0.01* (0.01)
Black male		-0.19*** (0.01)	-0.17*** (0.01)	-0.17*** (0.01)
Black female		-0.14*** (0.01)	-0.13*** (0.01)	-0.12*** (0.01)
Hispanic male		0.01 (0.02)	0.02 (0.02)	0.02 (0.02)
Hispanic female		0.04* (0.01)	0.04** (0.01)	0.04** (0.01)
Other male		-0.02 (0.01)	-0.01 (0.02)	-0.02 (0.01)
Other female		0.00 (0.01)	0.01 (0.01)	0.01 (0.01)

Variable	*Model 1* Unconditioned	*Model 2* Student characteristics	*Model 3* Race/Pov cohorts	*Model 4* All variables
Reading hours		0.05***	0.05***	0.05***
		(0.00)	(0.00)	(0.00)
TV hours		0.00	0.00	0.00
		(0.00)	(0.00)	(0.00)
Computer hours		-0.02***	0.02***	-0.02***
		(0.00)	(0.00)	(0.00)
Homework hours		0.03***	0.03***	0.03***
		(0.00)	(0.00)	(0.00)
Parent education		0.08***	0.08***	0.08***
		(0.00)	(0.00)	(0.00)
Free lunch		-0.08***	0.07***	-0.07***
		(0.01)	(0.01)	(0.01)
Third grade reading score		0.64***	0.64***	0.64***
		(0.00)	(0.00)	(0.00)
Gifted		0.29***	0.29***	0.28***
		(0.01)	(0.01)	(0.01)
τ_{00}	0.14	0.11	0.06	0.01
σ^2	0.86	0.32	0.32	0.33
Reliability	0.89	0.94	0.90	0.70

* $p<.05$; ** $p<.01$; *** $p<.001$
RIW: racially-imbalanced White
RIM: racially-imbalanced minority
RB: racially balanced
Source: North Carolina Educational Research Center at Duke University public use files.

Table A-4.
HLM, fourth grade North Carolina math achievement (2001/2002)

Variable	*Model 1* Unconditioned	*Model 2* Student characteristics	*Model 3* Race/Pov cohorts	*Model 4* All variables
Intercept	-0.020	-0.038**	-0.038*	-0.034*
	(0.012)	(0.011)	(0.015)	(0.013)
School characteristics				
RIW/high poverty			0.098	0.118
			(0.082)	(0.100)
RIW/mid poverty			0.085***	0.040
			(0.022)	(0.022)
RIW/low poverty			0 0.354***	0 0.272***
			(0.034)	(0.032)
RIM/high poverty			-0.432***	-0.341***
			(0.029)	(0.031)
RIM/mid poverty			-0.276***	-0.223***
			(0.048)	(0.044)
RB/high poverty			-0.324***	-0.244***
			(0.039)	(0.040)
RB/low poverty			0.464***	0.394***
			(0.047)	(0.045)
Per-pupil expenditures				-0.064***
				(0.009)
Class size				-0.009
				(0.009)
% teachers <3 yrs exp.				-0.033**
				(0.010)
% licensed teachers				0.042***
				(0.011)
% teach w/ adv. deg.				0.036***
				(0.009)
Student characteristics				
White male		0.017**	0 0.017**	0.017***
		(0.004)	(0.004)	(0.004)
Black male		-0.086***	-0.077***	-0.077***
		(0.006)	(0.006)	(0.007)
Black female		-0.060***	-0.051***	-0.051***
		(0.006)	(0.006)	(0.006)
Hispanic male		0.092***	0.097***	0.097***
		(0.014)	(0.014)	(0.013)
Hispanic female		0.083***	0.088***	0.088***
		(0.012)	(0.013)	(0.013)
Other male		0.059***	0.065***	0.065***
		(0.013)	(0.013)	(0.012)
Other female		0.048***	0.054***	0.053***
		(0.012)	(0.012)	(0.012)
Reading hours		0.027***	0.027***	0.027***
		(0.002)	(0.002)	(0.001)
TV hours		0.002	0.002	0.002

Variable	*Model 1* Unconditioned	*Model 2* Student characteristics	*Model 3* Race/Pov cohorts	*Model 4* All variables
		(0.002)	(0.002)	(0.001)
Computer hours		-0.013***	-0.013***	-0.013***
		(0.002)	(0.002)	(0.001)
Homework hours		0.031***	0.031***	0.031***
		(0.002)	(0.002)	(0.001)
Parent education		0.064***	0.065***	0.065***
		(0.002)	(0.002)	(0.002)
Free lunch		-0.056***	-0.054***	-0.053***
		(0.004)	(0.004)	(0.004)
Fourth grade math score		0.704***	0.705***	0.705***
		(0.003)	(0.003)	(0.002)
Gifted		0.300***	0.298***	0.298***
		(0.007)	(0.008)	(0.006)
τ_{00}	.163	0.142	0.080	0.082
		0.258	0.364	0.258
		0.965	0.924	0.941
σ^2	.840	-0.038**	-0.038*	-0.034*
Reliability	.908	(.011)	(.015)	(.013)

* $p<.05$; ** $p<.01$; *** $p<.001$
RIW: racially-imbalanced White
RIM: racially-imbalanced minority
RB: racially balanced
Source: North Carolina Educational Research Center at Duke University public use files.

Table A-5.
HLM, sixth grade North Carolina reading achievement (2003/2004)

Variable	*Model 1* Unconditioned	*Model 2* Student characteristics	*Model 3* Race/Pov cohorts	*Model 4* All variables
Intercept	-0.018	-0.003	0.009	0.013
	(0.015)	(0.013)	(0.014)	(0.014)
School characteristics				
RIW/high poverty			0.028	-0.072
			(0.187)	(0.179)
RIW/mid poverty			0.146***	0.101***
			(0.022)	(0.019)
RIW/low poverty			0.383***	0.336***
			(0.038)	(0.037)
RIM/high poverty			0.401***	-0.318***
			(0.032)	(0.041)
RIM/mid poverty			-0.289***	-0.236***
			(0.046)	(0.042)
RB/high poverty			-0.242***	-0.164***
			(0.039)	(0.043)
RB/low poverty			0.431***	0.357***
			(0.052)	(0.044)
Per-pupil expenditures				-0.049***
				(0.010)
Class size				-0.022*
				(0.008)
% teachers <3 yrs exp.				0.003
				(0.011)
% licensed teachers				0.050***
				(0.011)
% teach w/ adv. deg.				0.020*
				(0.009)
White male		-0.049***	-0.054***	-0.054***
		(0.005)	(0.006)	(0.005)
Black male		-0.236***	-0.233***	-0.232***
		(0.009)	(0.008)	(0.009)
Black female		-0.158***	-0.155***	-0.154***
		(0.009)	(0.008)	(0.009)
Hispanic male		0.005	0.004	0.003
		(0.021)	(0.017)	(0.021)
Hispanic female		0.062***	0 0.061***	0.061**
		(0.017)	(0.016)	(0.017)
Other male		-0.051**	-0.049**	-0.050**
		(0.016)	(0.015)	(0.016)
Other female		-0.003	0.006	0.001
		(0.015)	(0.015)	(0.015)
Reading hours		0.077***	0.077***	0.077***
		(0.002)	(0.002)	(0.002)

Variable	*Model 1* Unconditioned	*Model 2* Student characteristics	*Model 3* Race/Pov cohorts	*Model 4* All variables
TV hours		-0.002	-0.003	-0.003
		(0.002)	(0.002)	(0.002)
Computer hours		-0.011***	-0.011***	-0.011***
		(0.002)	(0.002)	(0.002)
Homework hours		0.043***	0.003	0.003
		(0.002)	(0.002)	(0.002)
Parent education		0.819***	0.082***	0.082***
		(0.003)	(0.003)	(0.003)
Free lunch		-0.097***	-0.094***	-0.093***
		(0.005)	(0.005)	(0.005)
Sixth grade reading score		0.552***	0.553***	0.553***
		(0.003)	(0.003)	(0.003)
Gifted		0.369***	0.369***	0.371***
		(0.007)	(0.008)	(0.008)
τ_{00}	.124	.085	.041	.038
σ^2	.882	.388	.388	.388
Reliability	.914	.941	.892	.884

* $p<.05$; ** $p<.01$; *** $p<.001$

RIW: racially-imbalanced White

RIM: racially-imbalanced minority

RB: racially balanced

Source: North Carolina Educational Research Center at Duke University public use files.

Table A-6.
HLM, North Carolina sixth grade math achievement (2003/2004)

Variable	*Model 1* Unconditioned	*Model 2* Student characteristics	*Model 3* Race/Pov cohorts	*Model 4* All variables
Intercept	-0.032	-0.057***	-0.078***	-0.075***
	(0.017)	(0.016)	(0.019)	(0.018)
School characteristics				
RIW/high poverty			-0.238*	-0.305*
			(0.113)	(0.080)
RIW/mid poverty			0.163***	0.116***
			(0.027)	(0.026)
RIW/low poverty			0.495***	0.440***
			(0.048)	(0.046)
RIM/high poverty			-0.448***	-0.352***
			(0.039)	(0.043)
RIM/mid poverty			-0.344***	-0.282***
			(0.048)	(0.048)
RB/high poverty			-0.286***	-0.201***
			(0.056)	(0.054)
RB/low poverty			0.474***	0.393***
			(0.070)	(0.068)
Per-pupil expenditures				-0.052***
				(0.012)
Class size				-0.016
				(0.011)
% teachers <3 yrs exp.				0.021
				(0.015)
% licensed teachers				0.070***
				(0.015)
% teach w/ adv. deg.				0.031*
				(0.012)
White male		-0.014*	-0.014*	-0.014*
		(0.005)	(0.005)	(0.005)
Black male		-0.101***	-0.094***	-0.094***
		(0.008)	(0.008)	(0.008)
Black female		-0.029*	-0.023*	-0.022*
		(0.008)	(0.008)	(0.008)
Hispanic male		0.141***	0.144***	0.144***
		(0.017)	(0.017)	(0.017)
Hispanic female		0.198***	0.202***	0.202***
		(0.015)	(0.015)	(0.015)
Other male		0.098***	0.103***	0.102***
		(0.018)	(0.018)	(0.018)
Other female		0.133***	0.138***	0.137***
		(0.016)	(0.016)	(0.016)
Reading hours		0.019***	0.019***	0.019***
		(0.002)	(0.002)	(0.002)

Variable	*Model 1* Unconditioned	*Model 2* Student characteristics	*Model 3* Race/Pov cohorts	*Model 4* All variables
TV hours		-0.002	-0.002	-0.002
		(0.002)	(0.002)	(0.002)
Computer hours		0.003	0.003	0.003
		(0.002)	(0.002)	(0.002)
Homework hours		0.049***	0.049***	0.049***
		(0.002)	(0.002)	(0.002)
Parent education		0.082***	0.083***	0.083***
		(0.003)	(0.003)	(0.003)
Free lunch		-0.084***	-0.082***	-0.082***
		(0.005)	(0.005)	(0.005)
Sixth grade math score		0.626***	0.627***	0.627***
		(0.004)	(0.004)	(0.004)
Gifted		0.345***	0.344***	0.344***
		(0.009)	(0.009)	(0.009)
τ_{00}	0.151	0.123	0.069	0.068
σ^2	0.848	0.314	0.310	0.264
Reliability	0.929	0.965	0.942	0.949

* $p<.05$; ** $p<.01$; *** $p<.001$

RIW: racially-imbalanced White

RIM: racially-imbalanced minority

RB: racially balanced

Source: North Carolina Educational Research Center at Duke University public use files.

Table A-7.
HLM, eighth grade North Carolina reading achievement 2005/2006

Variable	*Model 1* Unconditioned	*Model 2* Student characteristics	*Model 3* Race/Pov cohorts	*Model 4* All variables
Intercept	-0.015	0.007	-0.011	-0.000
	(0.015)	(0.013)	(0.014)	(0.014)
School characteristics				
RIW/high poverty			-0.087	-0.048
			(318)	(0.315)
RIW/mid poverty			0.135***	0.090***
			(0.022)	(0.023)
RIW/low poverty			0.363***	0.304***
			(0.040)	(0.040)
RIM/high poverty			-0.380***	-0.335***
			(0.036)	(0.038)
RIM/mid poverty			-0.298***	-0.271***
			(0.036)	(0.035)
RB/high poverty			-0.211**	-0.185**
			(0.070)	(0.068)
RB/low poverty			0.343***	0.268***
			(0.051)	(0.050)
Per-pupil expenditures				0.008
				(0.009)
Class size				-0.011
				(0.008)
% teachers <3 yrs exp.				-0.000
				(0.011)
% licensed teachers				0.030*
				(0.012)
% teach w/ adv. deg.				0.048***
				(0.010)
White male		-0.018**	-0.018**	-0.018**
		(0.006)	(0.006)	(0.006)
Black male		-0.214***	-0.201***	-0.200***
		(0.010)	(0.010)	(0.010)
Black female		-0.191***	-0.178***	-0.177***
		(0.009)	(0.009)	(0.009)
Hispanic male		0.125***	0.134***	0.134***
		(0.020)	(0.020)	(0.020)
Hispanic female		0.069***	0.077***	0.077***
		(0.018)	(0.018)	(0.018)
Other male		0.042*	0.049**	0.048**
		(0.017)	(0.017)	(0.017)
Other female		0.030	0.037*	0.037*
		(0.017)	(0.017)	(0.017)
Reading hours		0.081***	0.081***	0.081***
		(0.002)	(0.002)	(0.002)

Variable	*Model 1* Unconditioned	*Model 2* Student characteristics	*Model 3* Race/Pov cohorts	*Model 4* All variables
TV hours		-0.007*	-0.008**	-0.008***
		(0.002)	(0.002)	(0.002)
Computer hours		-0.009**	-0.009**	-0.008***
		(0.002)	(0.002)	(0.002)
Homework hours		0.041***	0.041***	0.042***
		(0.002)	(0.002)	(0.002)
Parent education		0.090***	0.090***	0.090***
		(0.003)	(0.003)	(0.003)
Free lunch		-0.106***	-0.104***	-0.104***
		(0.006)	(0.006)	(0.006)
Eighth grade reading score		0.511***	0.513***	0.513***
		(0.003)	(0.003)	(0.003)
Gifted		0.408***	0.408***	0.408***
		(0.008)	(0.008)	(0.008)
τ_{00}	.118	.080	.039	.036
σ^2	.890	.430	.428	.428
Reliability	.891	.915	.860	.850

* $p<.05$; ** $p<.01$; *** $p<.001$
RIW: racially-imbalanced White
RIM: racially-imbalanced minority
RB: racially balanced
Source: North Carolina Educational Research Center at Duke University public use files.

Table A-8.
HLM, eighth grade North Carolina math achievement (2005/2006)

Variable	*Model 1* Unconditioned	*Model 2* Student characteristics	*Model 3* Race/Pov cohorts	*Model 4* All variables
Intercept	-0.031	-0.086***	-0.115***	-0.100***
	(0.018)	(0.017)	(0.019)	(0.019)
School characteristics				
RIW/high poverty			-0.423	-0.307
			(0.364)	(0.363)
RIW/mid poverty			0.165***	0.114**
			(0.031)	(0.031)
RIW/low poverty			0.528***	0.450***
			(0.055)	(0.056)
RIM/high poverty			-0.381***	-0.330***
			(0.049)	(0.052)
RIM/mid poverty			-0.347***	-0.318***
			(0.049)	(0.049)
RB/high poverty			-0.294**	-0.264**
			(0.094)	(0.094)
RB/low poverty			0.375***	0.298***
			(0.070)	(0.070)
Per-pupil expenditures				-0.001
				(0.013)
Class size				-0.007
				(0.011)
% teachers <3 yrs exp.				-0.003
				(0.015)
% licensed teachers				0.010
				(0.017)
% teach w/ adv. deg.				0.071***
				(0.013)
White male		0.002	0.002	0.001
		(0.006)	(0.006)	(0.006)
Black male		-0.106***	-0.099***	-0.098***
		(0.010)	(0.009)	(0.009)
Black female		-0.036***	-0.029**	-0.028***
		(0.010)	(0.008)	(0.008)
Hispanic male		0.155***	0.160***	0.160***
		(0.023)	(0.018)	(0.018)
Hispanic female		0.221***	0.226***	0.226***
		(0.019)	(0.017)	(0.017)
Other male		0.105***	0.226***	0.110***
		(0.021)	(0.017)	(0.016)
Other female		0.132***	0.137***	0.136***
		(0.020)	(0.015)	(0.015)
Reading hours		0.010***	0.010***	0.010***
		(0.002)	(0.002)	(0.002)

Variable	*Model 1* Unconditioned	*Model 2* Student characteristics	*Model 3* Race/Pov cohorts	*Model 4* All variables
TV hours		-0.009**	-0.010***	-0.010***
		(0.002)	(0.002)	(0.002)
Computer hours		0.008**	0.008**	0.008**
		(0.002)	(0.002)	(0.002)
Homework hours		0.055***	0.055***	0.055***
		(0.002)	(0.022)	(0.002)
Parent education		0.102***	0.102***	0.102***
		(0.003)	(0.002)	(0.002)
Free lunch		-0.070***	-0.069***	-0.069***
		(0.006)	(0.005)	(0.005)
Eighth grade math score		0.533***	0.534***	0.537***
		(0.004)	(0.003)	(0.003)
Gifted		0.452***	0.451***	0.454***
		(0.011)	(0.007)	(0.007)
τ_{00}	0.160	0.131	0.080	0.074
σ^2	0.843	0.364	0.364	0.364
Reliability	0.916	0.948	0.924	0.920

* $p<.05$; ** $p<.01$; *** $p<.001$
RIW: racially-imbalanced White
RIM: racially-imbalanced minority
RB: racially balanced
Source: North Carolina Educational Research Center at Duke University public use files.

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