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Examining the Characteristics of High Schools in Which Black Students Achieve in Mathematics

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EXAMINING THE CHARACTERISTICS OF HIGH SCHOOLS IN WHICH BLACK STUDENTS ACHIEVE IN MATHEMATICS

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Black students' performance in mathematics on standardized examinations compared to White students is dismal; however, previous research has shown that there are highly effective high schools for Black students as defined by high levels of mathematics performance. Underachievement in upper-level high-school mathematics courses is a barrier for Black students' access to many postsecondary education opportunities and contributes to an underrepresentation of Black students in the science, technology, engineering, and mathematics college majors and related careers. This dissertation examines the multilevel characteristics (student, teacher, department, and school factors) of high school mathematics programs as measured by Black students' performance on standardized tests in 12th grade. The data for this study were taken from the Education Longitudinal Study (ELS) of 2002 from the National Center for Education Statistics of the U.S. Department of Education. Results indicated that the 12th grade achievement in mathematics of Black students is positively related to prior mathematics achievement, family SES, and the interaction between the teaching practices of mathematics teachers and students' collective sense of safety. A surprising interaction effect indicated that in schools where there is collective sense about lack of safety and where students report low-quality mathematics teaching practices, Blacks are more likely to exhibit high

student-achievement in mathematics than schools where the collective sense about safety is mixed (or where it is high) or where there is student consensus of good quality teaching practices.

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CHAPTER I

INTRODUCTION

The purpose of this study was to investigate the characteristics of high-school mathematics programs and how those characteristics are related to 12th-grade Black-student mathematics achievement on standardized assessments. I examined how student, teacher, department and school factors facilitate mathematics achievement for Black students. Ideally, a study of this nature should utilize a three- or a four-level model of achievement for subject selection and for data analysis; that is, we should nest students within classrooms; nest classrooms within departments; and if possible, nest departments within schools. However, because large nationally-representative datasets [e.g., National Longitudinal Study of 1972 (NLS-72), High School and Beyond (HS&B), National Education Longitudinal Study of 1988 (NELS:88), and Education Longitudinal Study of 2002 (ELS)][1] typically first select a random sample of schools and then select a random sample of students within schools (Konstantopoulos, 2006), I used a two-level model (students nested within schools) that mimics how selection took place in the ELS dataset. Then, I created two sets of predictors at each level (see chapter 3).

The student factors that I used as predictors of 12th-grade mathematics achievement are (a) 10th grade mathematics achievement, (b) gender, (c) socioeconomic status, and (d) students' perceptions of school safety. Teacher factors were (a) teaching practice, (b) number of years of teaching mathematics (i.e., experience), and (c) teachers'

[1] The sampling description can be found at the respective website for each dataset: NLS-72 (http://nces.ed.gov/surveys/nls72/), HS&B (http://nces.ed.gov/surveys/hsb/), NELS:88 (http://nces.ed.gov/surveys/nels88/design.asp), and ELS (http://nces.ed.gov/surveys/els2002/surveydesign.asp).

highest degree level. The department characteristics were (a) department size, and (b) teachers' collective responsibility for student learning. The school factors were (a) principal influence, (b) principal perceptions of school safety, and (c) school segregation.

Why Study Black[2] Students Only?

My focus on Black students' achievement came from the literature documenting an achievement gap between Black and White students, where Black students are the underachieving group (Barton & Coley, 2010; Braun, Wang, Jenkins, & Weinbaum, 2006; Lee, 2004; Lubienski, 2002) and where they are underrepresented in the science, technology, engineering, and mathematics (STEM) fields (Lewis, Menzies, Najera, & Page, 2009; Maton & Hrabowski, 2004; Palmer, Davis, & Thompson, 2010; Suitts, 2003; Tyson, Lee, Borman, & Hanson, 2007). The low number of Black students doing well in the sciences, technology, engineering, and mathematics fields suggests that there is a compelling need to better understand those malleable characteristics of schools where policy initiatives might improve the educational opportunities that are provided to this nation's Black students.

Sixty-three percent of Black 12th grade students failed to pass the National Assessment of Educational Progress (NAEP) mathematics assessment in 2009, meaning they performed below basic levels of proficiency (U.S. Department of Education, 2009). Therefore, thirty-seven percent were at or above basic level, and only six percent were at or above proficient level while less than 1 percent were passing at the advanced level. In contrast, 25% of White 12th grade students performed below basic levels of proficiency,

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[2] In this study, I use the term "Black" students since that is the racial term that is used in most large data sets such as High-School and Beyond; NELS:88; NAEP and the one I used in this study (ELS). Recognizing the possibility of confusion were I to force this same terminology on research that uses other terms, for example African-American, I have opted to use the terminology that is used in each study that I cite.

75% at or above basic, 33% were at or above proficient, and 3% were passing at the advanced level. Hence, Black students performed below White students in mathematics. The NAEP in mathematics assesses students in five content areas: (1) number properties and operations, (2) measurement, (3) geometry, (4) data analysis and probability, and (5) algebra. Failure in these content areas has been directly tied to low representation of Blacks in STEM majors in college. Yet even with these dismal statistics, there are isolated cases of success in which Black high school students have performed on par with or better than their White peers. Gutierrez (2000) studied an urban high school serving primarily working-class African-American students and the mathematics department's success in getting students to take advanced mathematics courses. Gutierrez found that Monterey High School was successful in advancing its students in mathematics because the mathematics department provided a rigorous curriculum and the teachers in the department worked together as a collective unit to help students to maneuver through it. The teachers shared a common goal to foster student advancement and usually held similar beliefs and practices. They also had a strong commitment to their students and they experimented with the curriculum to motivate student learning.

This study is similar to parts of Lee and Smith's (2001) "restructuring high schools for equity and excellence" study that uses a representative sample of 8th, 10th, and 12th students from the NELS data. However, this dissertation looks at a representative sample of Black students across the varied contexts in which they are educated in this country. Specifically, the study focuses on Black students' 12th grade mathematics achievement across varying degrees of segregation using the ELS datasets. My focus on Black student achievement also finds support from Ladson-Billings and Tate's (1995) claim that “Race is still a significant factor in determining inequity in the United States” (p. 48). The continuing importance of race in determining American inequality provides an impetus for seeking to understand school inequity from the inside, that is, from the perspectives of individuals who experience the insidious outcomes of institutional racism. This inequity can be easily seen in statistical and demographic data which show that Blacks in the U.S. have higher dropout rates than Whites (U.S. Department of Education, 2010), Black males are incarcerated at higher rates than Whites (Western, 2008), and Black students consistently perform below their White peers (U.S. Department of Education, 2009). Race also predicts the poverty rate in the United States. In 2009, 14.3% of this nation’s population lived in poverty; however, only 9.4% of White non-Hispanics as compared to 25.8% of Blacks lived in poverty (U.S. Census Bureau, 2010). Another way of looking at this statistic is that one out of every four Blacks is living in poverty.

Class and gender differences alone do not explain all the educational inequities in schools. For example, middle-class Black students do not perform as well as middle-class White students. Even though poor and minority students are more likely to be placed in low-track classes, we need to better understand how race and class function together to create their variable outcomes. Females receive better grades than do their male counterparts but they are encouraged less by teachers to take advanced-level mathematics courses (Ladson-Billings & Tate, 1995). Although class and gender are important factors of educational inequities, there is a need to examine how race interacts with these factors.

This study adds to the growing number of studies examining the settings in which Black students are educated and by trying to distinguish those settings in which they succeed academically from settings in which Black student achievement is narrowing

(Carter, 2008; Harper, 2009; Lynn, 2006). It extends that work by using quantitative methods to better understand the factors that impact mathematics achievement and by incorporating concerns for gender and social-class differences within (as opposed to "in-competition-with") the Black experience of schooling.

Mathematics and Black High School Students

The majority of Black students who graduate from high school and enter college are placed in remedial mathematics courses because they lack basic mathematics skills (Lee & Ready, 2009; Moses & Cobb, 2001) and are considered mathematically illiterate. Although mathematics illiteracy is not unique to Black students, it affects them and other minorities more intensely than it does White and Asian students (Moses & Cobb, 2001). Ultimately, mathematics illiteracy renders Black students less likely to participate fully in the information age in a systemic manner that is similar to how previous generations of Blacks were limited by their reading and writing skills during the industrial revolution. Reading and writing are very important to the overall academic success of students; however proficiency in higher-level mathematics courses remains the gate keeping subject for postsecondary education access in the STEM fields (Crisp, Nora, & Taggart, 2009; Howard, 2010). Therefore, Black students' mathematical illiteracy limits them to employment in low-level positions that require less knowledge than is required by postsecondary STEM majors.

In high school, African American students are underrepresented in upper-level mathematics classes and perform below their White and Asian peers on standardized tests in mathematics (Martin, 2000). Mathematics illiteracy also affects students' ability to fulfill the requirements needed to graduate from high school. African American students have lower high-school graduation rates and higher dropout rates than White students (Ladson-Billings, 1994; Lee & Ready, 2009) despite the fact that many intervention studies incorporating counseling, curriculum change, student motivation, positive mathematical identity, experiential learning, and effective teaching have been shown to improve Black students' success in mathematics and on mathematics standardized tests (Berry, 2008; Bruce, Getch, & Ziomek-Daigle, 2009; Martin, 2000; Moses & Cobb, 2001). While these studies document Black students' successes, Black students still face large-scale and systematic inequities in the school system. Hence this study examined characteristics of high schools that enhance mathematics achievement for Black students.

As a result of *No Child Left Behind* (NCLB, 2001) legislation and similar state-level policy initiatives, high schools have been experiencing accountability measures that focus on student achievement and graduation. With the importance being placed on the results of standardized testing and with the need for schools to maximize students' performance, schools are being forced to reduce the stratification of course taking; in turn, this reduction in tracking is affording Black students increased opportunities to take high-level college preparatory courses (Kelly, 2009).

No Child Left Behind Policies

In 2001, the Elementary and Secondary Education Act (ESEA) was reauthorized as the *No Child Left Behind* Act and was rewritten in a way that required states, school districts, and schools to be accountable for meeting state academic achievement standards, with the long-term goal that all students would be proficient in all academic subjects by 2013-14. Each year, schools, school districts, and states have to evaluate the performance of all students in the categories of race/ethnicity, socioeconomic status, disability, and English proficiency in all public schools and they must determine whether the students have made adequate yearly progress (AYP). A school's AYP is determined by students' performance on standardized testing in grades three through eight and at least once during high school. With an accountability requirement that includes all students, NCLB seeks to link federal education funding directly to improvements in students' test scores (NCLB, 2001). In spite of the legislation's well-meaning intentions, students' performance on standardized testing seems to be negatively impacted by state and district policies that are being promulgated in response to NCLB (Darling-Hammond, 2010). The NCLB (2001) requires that schools educate every student, no matter that student's intellectual ability, social status, gender, or race/ethnicity, to high academic standards. NCLB requirements also represent a significant challenge to schools' long-term practice of tracking students because all students are required to reach proficiency. Many schools have been eliminating tracking by including gifted students and students with disabilities in regular classes. Oakes and Lipton (2007) have argued that, through de-tracking, more students are being given the opportunity to learn.

High-Stakes Testing as Part of NCLB

There are valid arguments regarding the benefits that high-stake tests have had including increased professional development, access to quality assessments, and accommodations for students who require them (Cizek, 2001). Teachers are being provided professional development on content knowledge, teaching strategies, and uses of technology to enhance student learning and ultimately student performance on high stakes tests. High-stakes assessments are of greater quality today with all the scrutiny that they have received. Students with disabilities and English language learners have greater access to accommodations (e.g., more time or larger print) as appropriate. Also, since schools are being held accountable for the performance of all students, minority students who previously had been placed in remedial courses and passed through school unnoticed are now being taught the curriculum of the high-stakes test. Even though teaching to the test is narrowing the curriculum, at least these students are learning more than the watered down basics that are too often taught in remedial courses (Cizek, 2001; Roderick & Engel, 2001).

The policies of the NCLB Act (2001) require that all students be proficient in mathematics. In order for this to happen, students need to perform at or above grade level on high-stakes tests. However, beyond performance on high-stakes tests, mathematics knowledge (or its lack) can be used as a tool of liberation (or oppression); mathematics is a gatekeeper for higher education, economic opportunity, and full participation in an increasingly technological society (Moses & Cobb, 2001). Most college majors require students to take and pass a mathematics class. With the growing importance of technology in our society, an increasing number of careers require more-advanced understanding of mathematics than at any previous time in our nation's history (Moses & Cobb, 2001). However, Black students continue to fall short of their White counterparts. In any major assessment in mathematics, such as the NAEP, ACT, or SAT, Black students' scores are consistently lower than their White counterparts (Gutstein, 2006; Ladson-Billings, 1994; Martin, 2000). Black students are not only performing below Whites on mathematics tests; but also, they are underrepresented in all majors and careers that require advanced knowledge of some combination of science, technology, engineering and mathematics (Lewis et al., 2009; National Center for Educational Statistics, 1997).

The STEM Pipeline

Our society needs more Black students to be successful in STEM majors in college and to pursue careers in the STEM fields. For our society to prosper in this increasingly technological economy, more of our U.S. citizens need to have an understanding of the STEM fields (Romberg, Carpenter, & Dremock, 2005). Black students need to do well in mathematics on state standardized-achievement tests because Black students need to receive a fair chance at being successful in society. These students deserve to graduate from high school with real knowledge of content that they were expected to learn, and they need to attend and to graduate from colleges and universities with the option of taking courses in the STEM majors. According to the digest of education statistics, the percentage of total bachelor degrees conferred in 2006-07 to Whites is 72.2% and Blacks is 9.6% in the U.S. The percentage of mathematics and statistics bachelor degrees conferred to Whites is 73.3% and Blacks is 5.7%, and the percentage of business bachelor degrees conferred to Whites is 68.2% and Blacks is 11.3%. As shown by these numbers, there is an underrepresentation of Blacks receiving bachelor degrees in mathematics and statistics but an overrepresentation of Blacks receiving bachelor degrees in business (U.S. Department of Education, 2008).

Minorities in STEM Majors

In spite of repeated calls to increase the number of Black students who enroll in and are successful at completing calculus, a course that serves as the gatekeeper to STEM majors (Griffith, 2010; Palmer et al., 2010; Tyson et al., 2007), minority students usually do not attend college with the intention of majoring in STEM fields and the few who do have such initial aspirations frequently change their majors to non-STEM majors (Griffith, 2010). Griffith examined minority-student experiences in STEM departments and found that receiving higher grades in the STEM courses than in non-STEM courses during their first year of study can have an impact on students' decision to stay in the STEM fields during college. An implication of Griffith's findings is that, in order for Black students to persist in the STEM pipeline towards degree attainment and subsequent careers in related fields, they should enroll in and successfully complete the highest-level courses in high-school mathematics and science (Tyson et al., 2007). This implies that racial disparities occur because fewer Black students are prepared for the STEM field in high school.

My concern about such social and educational inequities for Black students in mathematics and other academic areas provides a major impetus for this study. My reading of the literature documenting the underrepresentation of Black students in high-level courses in the STEM fields and my reading about racial inequities in schools as they relate to high-stakes testing under NCLB (2001) have led me to explore characteristics of students, of their mathematics teachers, of their mathematics departments, and of their schools that are associated with higher achievement for Black students in the area of mathematics in high schools.

Purpose of the Study

In spite of previous research on the practices of successful teachers of African American students (Ladson-Billings, 1994), there remains a gap in the opportunities that this society provides to White versus to Black students. The purpose of this study is to examine the characteristics of high schools that exert a positive influence on the mathematics achievement of Black students on 12th-grade mathematics tests. Through this study, I hope to develop a better understanding of how student, teacher, department, and school factors work together to influence Black students' mathematics achievement. As a practical matter, through this study, I hope to be able to inform how to train mathematics teachers to be more successful educators of all students, especially Black students (Rodriguez & Kitchen, 2005). To do this, I investigated teacher factors that seemed to influence Black-students' mathematics achievement.

Examining teacher factors in isolation does not provide the whole picture; nor for that matter, is teacher training, alone, adequate for improving the opportunities that are provided to this nation's Black students. Research also must examine department and school factors that may influence students' performance (Gutierrez, 1998; Teddlie, 1994) so that policy may be developed to help teachers and to support students. Hence, this study examined high schools to see the type of teacher, department, and school factors that lead to Black students doing well on standardized mathematics tests, and being well prepared for college/university mathematics courses (Gutierrez, 2000). Again as a practical matter, I hope to eventually use these predictors of student achievement to inform policy and the practices of high schools to improve the mathematics achievement of Black students. This research topic is urgent as high-stakes assessment and accountability policies are impacting more and more students, especially those who have traditionally been underserved in mathematics (Kitchen, Lee, Roy, & Secada, 2009).

CHAPTER II

RELATED LITERATURE

This review is organized into two main sections: studies of Black students' achievement in mathematics; and studies that focus on how student, teacher, department, and school factors affect student outcomes. I explore the relationship between student characteristics and achievement in particular social class, gender, prior mathematics achievement, and students' perceptions of school safety. I also review the research on the effectiveness of teachers in the classroom through their teaching practices, their number of years of teaching mathematics (i.e., experience), and their highest degree. Next, I examine the research on the impact of the department by analyzing mathematics teachers' collective responsibility for learning as well as the department size and its impact on mathematics achievement. Another factor that I review is the effectiveness of the school in maintaining an environment that is conducive to learning by examining the relationships among the influence of the principal, the principal perceptions of school safety, and the level of school segregation and how these three factors relate to mathematics achievement.

Overarching Framing of this Study

The goal of this study is to understand the high school settings of Blacks students in terms of their 12th-grade mathematics achievement. For this study, I found it helpful to use Bronfenbrenner's (1977) ecological systems as a way of thinking about how schools, departments, and teachers might influence Black students' learning of mathematics and, eventually, come to influence their academic achievement. According to Bronfenbrenner, an ecological environment is a "nested arrangement of structures, each contained within the next" (p. 514). Bronfenbrenner's four nested structures are the microsystem, the mesosystem, the exosystem, and the macrosystem. The microsystem is the immediate setting containing the person and the complex relationships between that individual and her/his immediate setting. The mesosystem is the interaction between setting which contains the person (e.g., an interaction between the family and the school). The exosystem is the formal and informal social structures that do not contain the person but impose upon the immediate setting containing the person (e.g., media, church, the world of work, local and state agencies). Lastly, the macrosystem is the institutional patterns existing in the culture or subculture that reflect the structures and activities occurring at the concrete level (e.g., the culture of power). The primary focus of this research is on the first level in Bronfenbrenner's classification, namely, the school's microsystem; more specifically, the focus is on the innermost aspect of the microsystem – a nested arrangement of factors within the school. The nested factors are the student and teacher factors nested within the department and school factors.

This study is informed by Bronfenbrenner's (1977) framework because human development (in this study, Black students' development) is thought of as taking place within the immediate settings in which the student is located (in this study, the students' classrooms, departments and schools) and the complex relationships between student and her/his setting. That is, this study examines how student, teacher, department, and school factors relate to Black students' mathematics achievement in 12th grade.

Black High School Students' Mathematics Achievement

The literature for this section was found by searching the ERIC and PsycINFO databases using the keywords – mathematics achievement, Black, high school students and peer reviewed journals. I further read through the abstracts to identify studies that focus on Black high-school students' mathematics achievement and found three studies that fit my criteria. These research studies argued that several factors within the school environment affect the failure or success of students. For example, commitment to a collective enterprise, instructional practices, and the demographics of the student body (e.g., socioeconomic status and gender) all influence mathematics achievement (Gutierrez, 2000; Rech & Stevens, 1996; Strayhorn, 2010).

Rech and Stevens (1996) investigated how mathematics attitude, self-concept, learning style, and economic status affect mathematics achievement. Rech and Stevens examined 251 fourth and eighth grade inner-city Black students' mathematics achievement using multivariate analysis of variance and stepwise regression. Rech and Stevens found that fourth graders had a more field-dependent learning style relative to eighth graders; and also they received higher mathematics-achievement scores than eight graders. Significant predictors of eight graders' mathematics achievement were learning style and gender. That is, Black eighth-grade students have a more field dependent learning style; they need a variety of concrete experiences involving active engagement of the individual. Also Black girls obtained higher scores than did Black boys.

Gutierrez (2000) collected data through interviews, surveys, school documents, and general school-observations by examining a high-school mathematics department serving primarily working-class African American students that was successful in getting students to take advanced mathematics courses. Five components were found to support African American students taking advanced mathematics courses: (1) a rigorous and common curriculum and the support to maneuver through it; (2) active commitment to students; (3) commitment to a collective enterprise; (4) innovative practices; and (5) a resourceful and empowering chairperson. Gutierrez argued that in order to increase the number of students taking advanced mathematics classes (and consequently improve test scores) a mathematics department needs to be organized for advancement. This is achieved through “teachers belonging to a community that collectively shares the responsibility for teaching lower-level courses and actively discusses strategies for supporting students who need extra help” (Gutierrez, 2000). The teachers in the Gutierrez study consistently reported that a strong influence of their department success was the moral support provided by the district. The district’s emphasis on getting rid of lower-level mathematics courses provided the justification for the teachers to engage in changes they wanted to make (i.e., more students taking advanced mathematics courses). The teachers in Gutierrez’s study believed that a group of teachers working collectively together could achieve more for their students than any one teacher working in isolation. These teachers’ beliefs were reflected in their practices.

Strayhorn (2010) used hierarchical regression analysis to examine the impact of three sets of predictors on mathematics achievement. The predictors were (1) individual related factors that include background traits and characteristics (e.g., gender and parent’s level of education); (2) family related factors that include measures of family influences (i.e., parental involvement); and (3) school related factors which was operationalized to measure the students’ attitudes and perceptions of their mathematics teachers (e.g., item:

"teacher praises my effort"). Strayhorn used a nationally representative sample of 1766 Black students from the NELS: 88/00 where the students were in eighth grade in 1988 and eight years out of high school in 2000. Strayhorn found that gender (male), parent's level of education, prior mathematics achievement, and locus of control were the individual factors that significantly predict Black high-school students' mathematics achievement.

Characteristics that Influence Student Outcomes

To improve the quality of teaching and learning for all students by creating a culture of academic achievement, schools need to make major changes from their typical practices and expectations; that is, schools need to restructure (Newmann & Associates, 1996). Newmann and associates (1996) found that schools that were successful at restructuring constantly worked at advancing the intellectual quality of student learning and promoting a professional community in the school. School restructuring is meant to bring about profound changes in the schools' goals, structure, and role of those who work in them (Lee & Smith, 2001). Lee and Smith (2001) argued that 'good high schools' should be simultaneously effective (students learn more) and equitable (students' learning is not differentiated according to their social background) for all students.

Next I describe the literature that focuses on how student, teacher, department, and school factors affect student outcomes. This was done by searching the ERIC and PsycINFO database with each factor and academic achievement as keywords. Peer review was used as a limiter and then the abstracts were read for relevance pertaining to the keywords.

Student Factors

In this section I will describe the results of the literature that addresses the impact of prior mathematics achievement, social class, gender, and students' perception of school safety on the academic achievement of students.

Prior mathematics achievement. Not surprisingly, prior mathematics achievement has a statistically-significant relationship to later academic outcomes (Adam & Singh, 1998; Davis & Shih, 2007; Mickelson & Greene, 2006). Tate (1997) stated that prior mathematics achievement is strongly positively correlated with later mathematics achievement, especially for Black students (Adam & Singh, 1998; Strayhorn, 2010).

Gender. Davis & Shih (2007) found that male students outperformed female students on mathematics (Fan, Chen, & Matsumoto, 1997; Mau & Lynn, 2000). Strayhorn (2010) found that Black women scored lower on the 8^{th} and 10^{th} grade mathematics examinations than did Black males.

Social class. The ground breaking *Coleman Report* (Coleman et al., 1966) documented rather conclusively that different levels of SES have a statistically significant relationship to achievement outcomes; that is, students from low SES backgrounds have lower grades and test scores than students from higher SES backgrounds (Adam & Singh, 1998; Lee & Smith, 2001). In contrast, Mickelson and Greene (2006) found that family SES has no direct effect on Black students' test scores.

Students' perceptions of school safety. Milam, Furr-Holden, and Leaf (2010) found that the academic achievement of children in third to fifth grade in an urban public school system was associated with their perceived safety in school no matter their poverty level. Gresham's (2008) dissertation study found that schools with higher percentage of students feeling unsafe will have lower percentage of students passing standardized achievement tests.

Teacher Factors

The main work of schools – teaching and learning – revolves around teachers. Research has focused on the value-added impact of teachers on student learning (Stronge, Ward, Tucker, & Hindman, 2007). Darling-Hammond and Youngs (2002) argued that the key to school improvement is the role of the teacher. The value-added research findings indicate that effective teachers are essential for student success (Mendro, 1998; Nye, Konstantopoulos, & Hedges, 2004; Wright, Horn, & Sanders, 1997). Nye et al. (2004) defined effective teachers as having the ability to produce achievement gains in their students. That is, if teacher effects were normally distributed, Nye et al. computed the difference in mathematics achievement gains between having a 25th percentile teacher (not effective) and having a 75th percentile teacher (effective) as being around half a standard deviation. Stronge et al. (2007) found that differentiation and complexity of strategies distinguish the practices of effective teachers (as defined by greater than expected learning gains for students) compared to ineffective teachers' practices (lower than expected learning gains for students).

Shulman (1987) argued that many in-service teachers lack the knowledge (i.e., pedagogical content knowledge) that is required to sustain classrooms that promote mathematical discovery, inquiry, and connection. Ladson-Billings' (1994) study of successful teachers of African American children found that the majority of these teachers were also African American and/or their culture of reference was Black or bicultural. Teachers of African American students who are most effective at communicating with their students will change their communication styles, speech patterns, and participation structures to reflect the students' own culture. While communicating with African American students is important, in itself, this is not enough; teachers also need to help African American students gain a deep understanding of the mathematics curriculum.

Wright et al. (1997) found that teachers' teaching is the most important factor affecting students' academic gains at all achievement levels in grades three, four, and five in five subject areas (including math) on state standardized tests. Wright et al. also found that heterogeneity among students in the classroom and classroom sizes had little influence on students' academic gain. Stronge et al. (2007) found that effective teachers of third grade students who make increases in student mathematics learning put into practice differentiated and complex practices, ask higher level questions, and experience a lower level of disruptive student behavior than ineffective teachers. This study explored salient teacher factors: teaching practice [a subset of items used by Lee & Smith (2001) when creating their authentic practices predictor], teaching experience (which can be thought of as a proxy for pedagogical knowledge), and teacher's highest degree (which usually serves as a proxy for content knowledge) that might affect student mathematics achievement.

Teaching practice/active mathematics learning. Good teaching is said to result in students who engage in active learning in which they exert more initiative in their own learning within the classroom (Wehlage, Newmann, & Secada, 1996). The National Council of Teachers of Mathematics (NCTM, 2000) has argued that mathematics practices should be centered around classroom interactions and discourse, and can be developed through students' collaborative problem solving, reasoning, and mathematical communication (both verbal and written). Using the 2000 main NAEP data, Lubienski (2006) found that students in both fourth and eighth grade demonstrated a significantly positive relationship between their achievement and the NCTM-based practices given to them. High-SES students' achievement positively correlates with NCTM-based practices more so than is the case for low-SES students (Lubienski, 2006).

Boaler (2002) studied reform-oriented practices compared to traditional-based practices in her three-year ethnographic study of the mathematical environments in two schools in England with students aged thirteen to sixteen years old. She found that students who learn through reformed-oriented practices (similar to NCTM-based practices) that focuses on conceptual understanding learn more but different mathematics than students who learn through traditional practices that focus on skills development. Students learning through traditional practices saw no use for mathematics learned in class in the real world; however, students learning through reform-oriented practices viewed mathematics learned in class as very useful in the real world.

Teaching experience. The number of years of teaching (i.e., experience) is the driving force behind the teachers' salary schedules and transfer policies, which is a major source of inequity across schools. However, the greatest productivity gains for teachers happen in their first few years of teaching, after which their performance (as measured by student achievement) tends to level off (Rice, 2010). As teachers move from their first year of teaching to having one full year of teaching experience, their students show the largest gains in mathematics achievement; teachers with six or more years of teaching experience show no further growth in students' achievement gains beyond what they produced during their first few years (Boyd, Lankford, Loeb, Rockoff, & Wyckoff, 2007). Teachers with more than 20 years of experience are more effective on improving students' mathematics achievement than teachers with no experience; and they are slightly more effective than teachers with five years of experience (Rice, 2010).

There is little evidence of the impact of teaching experience among high-school mathematics teachers in their early years. However, high-school mathematics teachers experience beyond the first several years have been shown not to be effective on high-school students' achievement. Teachers who have been shown to be the least effective on average are teachers with less than three years of experience who are teaching in high poverty schools, as measured by the percentage of students qualifying for free and reduced lunch (Rice, 2010).

Teachers' highest degree. The licensing of mathematics teachers in the United States is the responsibility of each state; not surprisingly, variations in licensing requirement can be found across states. For example, in the state of Florida there are two types of educator certifications: temporary and professional. To receive the temporary certification, prospective teachers need a bachelor's degree with a 2.5 GPA for the specific subject, while to receive the professional, prospective teachers need a bachelor's degree and must demonstrate mastery of (1) subject area knowledge, (2) general knowledge, and (3) professional preparation and education competence (Florida Department of Education, 2011). However, in the state of Massachusetts there are four types of educator certifications: temporary, preliminary, initial, and professional. The temporary is for experienced teachers from other states valid for one year. The preliminary is for prospective teachers who have not completed an approved educator preparation program; to receive this certification, prospective teachers need a bachelor's degree, a passing score on the Massachusetts Tests for Educator Licensure (MTEL), and in some cases additional coursework. To receive the initial license, prospective teachers need a bachelor's degree, passing score on the MTEL, and completion of an educator preparation program post bachelor; however, to receive the professional license, prospective teachers need three years of employment under initial license, completion of a teacher induction program, and one of the options for the professional license (Massachusetts Department of Elementary and Secondary Education, 2011).

Prior research has argued that students' achievement is positively related to teachers with higher-level degrees (Borg, Plumlee, & Stranahan, 2007; Croninger, Rice, Rathbun, & Nishio, 2007; Leak & Farkas, 2011). However, Palardy and Rumberger (2008) found that teacher background qualifications compared to instructional practices have less robust associations with achievement gains for first graders.

Department Factors

In spite of what is known about effective teaching practices for Black students, their performance on standardized tests remains below that of White students (Barton & Coley, 2010). Research that focuses on the effective practices of individual teachers, while important, fails to describe their students' learning experiences across the students' four years of high school. Even if a student has four years of good teaching, Gutierrez's (1998) work documents the importance of the mathematics department in promoting student learning of mathematics. Gutierrez argued that the most appropriate approach for understanding and reforming secondary teachers' work is to make the department the unit of analysis. However, the wide variations that can be found in teachers' practices within the same mathematics department is one of Gutierrez's (1998) a key criticisms of departmental analysis.

According to Gutierrez (1996), the largest obstacle to mathematics departments' efforts in becoming successful in improving students' mathematical performance is the teachers' system of beliefs. Do teachers believe that a student's home background or intellectual ability will affect the student's achievement in mathematics, or are teachers collectively taking responsibility for their students' learning? When teachers hold the belief that students' achievement is not solely affected by students' home background or intellectual ability, then teachers assume responsibility for students' learning and as a result, students learn more.

Collective responsibility for student learning. Lee and Smith (2001) analyzed data from the NELS (1988) for students' mathematics achievement gains from 8^{th} to 10^{th} and onto 12^{th} grade. The authors found that the greater a mathematics department's consensus on teachers' assuming responsibility for their students' learning, the more students learned between eighth and 12th grades; that is, the school is more effective and more equitable, in term of student learning. A department's consensus was based on the aggregation of teachers' individual self-reports that she or he has some responsibility for the learning of her or his students; consensus was based on all or most teachers reporting similarly-high degrees of responsibility. Socioeconomic status made no difference in determining the level of mathematics students learned in schools where teachers assumed more collective responsibility for student learning, even though teachers usually work isolated in their classroom without input from others (Lee & Smith, 2001).

Collegiality among teachers also relates to student achievement (Gutierrez 1996; 1999; 2000; Lee & Smith, 2001; Marzano, 2003). Teachers working together in a mathematics department can make a difference in students' mathematics achievement. Also, teachers' beliefs about students can foster student advancement (Gutierrez, 2000). African American students performed better in mathematics when teachers believed that all students can succeed at something (Love & Kruger, 2005).

Department size. Department size can be thought of as a proxy for school size. Students in large schools are usually not well known by their teachers, and usually do not have the same teachers for more than one year (Ready, Lee, & Welner, 2004). Darling-Hammond, Rose, and Milliken (2007) found that very large high schools usually serve students of color and those in low socioeconomic conditions poorly. Stewart's (2009) study of all public high-schools in Texas found that students in smaller rural schools scored better than students in larger urban and suburban schools on the state's 11th grade assessment. Darling-Hammond et al. (2007) argued that students of color and low-socioeconomic students in small schools achieved higher grades and stayed in school at higher rates when these schools were focused on strong support for learning and a common academic curriculum.

Lee and Smith (2001) found that high schools ranging from 600 to 900 students learn more mathematics and reading than other sized high schools after adjusting for social background, ability level, school social composition, and school sector. High schools with fewer than 600 students are more equitable in terms of social distribution of learning and that school size was related to other factors of schools. For example, (1) catholic and private high-schools are usually smaller than public high-schools, (2) schools that enroll more disadvantaged students are usually larger than their counterpart schools that enroll more advantaged students, and (3) the common features of effective schools are usually found in smaller schools. Hence, Lee and Smith's (2001) study found that students (especially disadvantaged students) learn more in smaller schools with smaller departments and achievement is generally less determined by students' family background in smaller schools.

Although teachers working together as a department is a good practice, this is still not enough to create a culture of academic achievement. Teachers need the support of the school's principal and personnel to achieve this culture within the school. Students learn best in a school that is committed to them and that provides a climate of learning where achievement is the prevailing norm of the school (Zigarelli, 1996).

School Factors

Researchers in the 1970s to 2000s studied effective schools and their relationship to student achievement (Edmonds, 1979; Marzano, 2003; Purkey & Smith, 1983; Zigarelli, 1996). These "effective schools" studies have concluded that schools do make a difference in students' achievement and that schools should not be dismissed as quickly as seems to have happened because of the results of the *Coleman Report*. The *Coleman Report* (Coleman et al., 1966) found that only 10% of the variance in students' achievement was due to school effects, and that 90% of the variance in student achievement was attributed to students' background factors. The authors concluded that a student's background is the most significant predictor of achievement. Although school factors contribute much less to student achievement than students' background factors, school factors (unlike student background factors) are potentially malleable and should therefore be given careful consideration.

Edmonds' (1979) synthesis of the effective schools research in the 1970s concluded that urban schools can do a good job teaching poor children provided they have two main characteristics: strong leadership and a belief that all students can learn. In 1983, Purkey and Smith critically reviewed literature on school effectiveness in order to compose a portrait of an effective school; they too concluded that school-level factors can create a school culture that is conducive to student learning in the classroom. Zigarelli's (1996) found that principals' autonomy (in hiring and firing teachers) is an important factor in school effectiveness. In 2003, Marzano synthesized the research over the last 35 years and found that a safe environment affects student achievement and that highly-effective schools can overcome the effects of student background. Clewell, Campbell, and Perlman (2007) found that a good school climate differentiated highly-effective elementary schools from typical elementary schools serving low income minority students. Next, I will describe the results of the literature that addresses the impact of the school factors: principal influence, school safety, and school segregation on the academic achievement of students.

Principal influence. Principals may influence individual students directly by serving as mentors or principals may indirectly influence all students by ensuring that schools run efficiently. Brewer (1993) used data from the High School and Beyond dataset and examine how principal influence over practices and curriculum impacts students achievement gains from 1980 to 1982. Brewer (1993) found that principals make a difference in students' achievement gains.

School safety. Bowen and Bowen (1999) analyzed data collected from middle and high school students who completed the National School Success Profile. According to Bowen and Bowen (1999) crime and violence in school settings create a poor environment for academic involvement and performance. Crime (even if it takes place in the neighborhood outside of the school) and violence among students affects academic performance by obstructing teaching and learning in the classroom.

School segregation. The *Coleman Report* found that academic outcomes were better for Black students who attended integrated schools. Brown's (2004) analysis of the 1990 NELS data found that high schools with enrollments of 44% to 75% White and/or Asian American students show the highest average academic achievement for all racial groups and the smallest gap between the races in test scores. In addition, research indicates negative effects of school segregation on academic achievement outcomes (Rumberger & Palardy, 2005; Borman et al., 2005).

Summary

The goal of this study is to understand the high school settings of Black students in terms of their mathematics achievement. This study uses aspects of Bronfenbrenner's (1977) ecological systems theory to organize how schools, departments, teachers, and individual characteristics of Black students are related to their 12th grade mathematics achievements. This review was organized into two main sections: Black students' achievement in mathematics; and studies that focus on how student, teacher, department, and school factors affect student outcomes.

Several factors within the school environment affect the failure or success of students. For example, the school's academic climate (principal's influence, principal's perception of school safety, and school segregation); the department (department size, and teacher's collective responsibility for learning); the teacher (teaching practices, teaching experience, teacher's highest degree); and the demographics of the student body (e.g., prior mathematics achievement, socioeconomic status, gender, and students' perceptions of school safety) all influence academic outcomes (Adam & Singh, 1998; Bowen & Bowen, 1999; Brewer, 1993; Brown, 2004; Leak & Farkas, 2011; Lee & Smith, 2001; Lubienski, 2006; Milam et al., 2010; Rice, 2010; Stewart, 2009; Strayhorn, 2010).

However, we do not know the simultaneous influence of these factors on high school mathematics achievement among Black students. This study contributes to the literature on effective schools by simultaneously examining how student, teacher, department, and school factors work together in order to facilitate achievement in mathematics for Black students by (1) examining the effect of having all these variables in one study, and (2) examining the interactions between these variables.

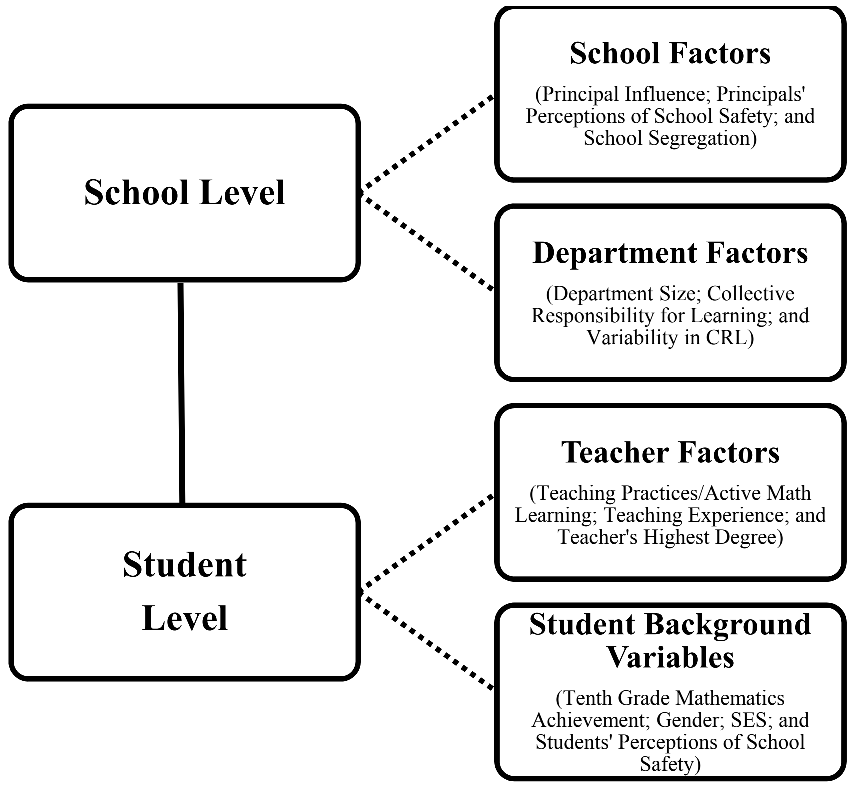
CHAPTER III

METHODOLOGY

This chapter describes the methods I used to examine the high school settings of Black students. This study examined the characteristics of high-school mathematics programs for Black students that predict their mathematics achievement on standardized assessments. The purpose of the study was to describe the student, teacher, department, and school factors that predict higher levels of academic achievement by Black students at the end of secondary school (i.e., 12th grade).

As previously mentioned, the ideal study would examine a four (or three) level model for achievement outcomes; however, because of how large nationally-representative datasets are gathered (e.g., NLS-72, HS&B, NELS:88, ELS), I used a two level model that nested students within schools, I then used two sets of predictors at each level. The database was designed in such a way that there was a one-to-one correspondence of the mathematics teacher reports to the student reports, therefore the student and teacher factors were imposed at the student level. Also, since there should only be one mathematics department in every high school, the department and school factors were imposed at the school level, as shown in figure 1.

Figure 1. Diagram displaying the Group of Variables at each Level of Data Analysis.



Note. The diagram shows that there are two levels of data analysis, students nested within schools. The diagram also shows that the student and teacher factors are imposed at the student level, while the department and school factors are imposed at the school level.

A practical outcome of this research would be to provide a template for an ideal high school, which, if adhered to, would make it possible for more Blacks to complete high school well prepared for college level mathematics, to enter college, and to pursue STEM majors and careers. In order to gain an understanding of the teacher, department, and school factors that may influence Black students performance on mathematics standardized tests in high school, I investigated the following research questions:

1. How do mathematics achievement in 12th grade for Black high school students vary, both across and within schools?

2. How do student factors (i.e., 10th grade mathematics achievement, gender, SES, and students' perceptions of school safety); teacher factors (i.e., teaching practices, teaching experience, teacher's highest degree); and the student-level interactions (gender and SES, gender and prior math, SES and practices) impact Black students' 12th grade mathematics achievement in high school?
3. How do department factors (i.e., department size and collective responsibility for learning); school factors (i.e., principal's influence, principals' perceptions of school safety, and school segregation); and the cross-level interactions impact Black students' 12th grade mathematics achievement in high school?

Methods

The goal of this study is to understand the core features that contribute to improving Black students' performance on mathematics standardized tests across schools. Given the nested nature of the sample (i.e., students nested within schools), a multilevel model is most appropriate to analyze the data while simultaneously handling student and school level factors. Multilevel modeling was used to examine the relative importance of student, teacher, department, and school factors in predicting the schools' mean measures on mathematics standardized tests of Black high school students.

Sample and Design

The sample is a representative group of Black students in the 10th grade and their mathematics teachers in public, Catholic, and other private schools throughout the United States (U.S.) during the 2001-2002 school year. The data were taken from the Education Longitudinal Study (ELS) of 2002 from the National Center for Education Statistics (NCES) of the U.S. Department of Education. The ELS is a longitudinal survey study that monitored a national sample of 10th grade students as they progressed from 10th through 12th grade and then on into the labor market. ELS data were collected in its base year (2001-2002) from students, parents, teachers, librarians, and school administrators about their experiences and background. Data are also available from 2004, the students' senior year, and in 2006 (postsecondary education). Data were collected from approximately 752 schools and 15,362 students randomly selected within these schools.

My research study used a subsample of the base year data of the ELS (2002) which included 2020 Black students when the students were in their sophomore year. The dependent variable was taken from the first wave of follow-up data collected in 2004, during the students' senior year or would have been senior year. Only students who were still enrolled in high school during the first follow up were included in this study (including retained students). Since some students were not included in the study in 2004 for a variety of reasons (i.e., homeschooled, early graduate, dropout, out of scope, or status unknown), issues of selection bias in the sample cannot be ruled out conclusively. Hence the study sample is 1607 Black students across 432 schools. Table 1 shows the number of Black students that were sampled in each school. The variation in the Black student sample size is a result of the different levels of segregation across schools. As shown in Table 1, 54% of the school-sample has only 1 or 2 Black students nested within their respective school student-samples. However, 46% of the school-sample has 3 to 20 Black students nested within the school student-sample; and 28% of the school-sample has 5 to 20 Black students nested within their respective student-samples. The small numbers of Black students sampled in some schools were handled in the data analysis section by fixing random effects (see Model B under Multilevel Modeling).

Table 1

The Frequency and Percentage of Blacks Sample Size within Schools

Black Students Sample Size in a given School	Frequency of the Number of Schools	Percentage of Schools
1	164	38.0
2	69	16.0
3	39	9.0
4	39	9.0
5	23	5.3
6	26	6.0
7	16	3.7
8	17	3.9
9	7	1.6
10	4	0.9
11	7	1.6
12	2	0.5
13	5	1.2
14	1	0.2
15	3	0.7
17	3	0.7
18	1	0.2
19	4	0.9
20	2	0.5
Total	432	100.0

Given that the students were randomly selected within the schools, the mathematics achievement of the Black students in the sample was used to represent the mathematics achievement of the population of Black students in the high school. In this sample, the student level demographics were as follows: 52.2% of the Black students were female, 47.8% were male students. The teacher[3] level demographics were as follows: 52.3% of the mathematics teachers were female, 35.4% of the teachers were male, and 12.3% of the teachers were missing gender information in the dataset. The racial/ethnicity breakdown of the mathematics teachers were 62.1% White, 18.9% Black, 3.2% Hispanic, 3.4% other, and 12.5% missing. At the school level, the school control was as follows: 80.3% were publicly controlled, 12.7% Catholic controlled, and 6.9% were controlled by private entities. The location of the schools were as follows: 40.3% in an urban area, 46.3% were in a suburban area, and 13.4% were in a rural area, while 17.4% of the schools were located in the Northeast, 19.7% were located in the Midwest, 48.1% were located in the South, and 14.8% were located in the West. The level of the 10th grade student poverty across the schools can be described as 46.2% of the schools had 0-20% of their 10th graders receiving free-lunch, 26.4% of the schools had 21-50% of their 10th graders receiving free-lunch, 18.5% of the schools had 51-100% of their 10th graders receiving free-lunch, and 8.8% of the schools were missing the data.

Variables

This study looked at student, teacher, department, and school factors. The variables in this study were taken from student, mathematics teacher, and administrator questionnaires from the publicly available ELS database. Some variables were

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[3] Total teachers in the Black students' sample, after removing duplicates cases, are 472 across 432 schools. Teacher demographics, race/ethnicity and gender, were computed using unique teacher data.

composites from multiple questionnaires. All variables with the exception of the dependent variable were measured in the students' 10th grade year, that is, in the 2001-2002 school year. Students in this study could be traced to their respective schools; but mathematics teachers were not identified in this dataset, and could not be linked to specific students. Therefore, students could not be matched to a specific mathematics teacher and the number of mathematics teachers within each department in the sample is unknown. However, for each student randomly selected at a school, a mathematics teacher was asked to fill out a teacher questionnaire. Thus, a mathematics teacher could have filled out the questionnaire for as many students in the study as he/she taught. The ELS database variable names and item descriptions of the constructed variables that were used are located in Appendix A. Also, Appendix B contains the Rasch analysis and results of how the variables were constructed. According to Lubienski (2006), when designing a survey and developing item clusters, Cronbach's alphas need to be between .7 and .9. However, lower values of Cronbach's alpha were considered acceptable when the goal of the study is not to design a new survey, but to create composites of existing survey items that capture various aspects of a construct, which is the case in this study. In addition, the items in ELS database were validated by the test developers; in addition, when I was developing the above-referenced five constructs, a mathematics education expert and I discussed which items to include and which to exclude (see appendix A).

Dependent variable. The dependent variable, mathematics achievement, measures Black students' mathematics achievement in their senior year of high school (or what would have been their senior year). This standardized T score provides a norm-referenced measurement of achievement (i.e., an estimate of achievement relative to the entire 12th grade population in spring 2004). This score is a transformation of the IRT theta estimate, which rescales to a mean of 50 and standard deviation of 10. The items on the test cover arithmetic, algebra, geometry, data/probability, and advanced topics at three process categories: skill/knowledge, understanding/comprehension, and problem solving. However, this test placed emphasis on practical applications and problem solving. All the questions were multiple-choice.

Independent variables: student factors. The student factors included in this study were student characteristics, that is: 10th grade mathematics achievement, gender, socio-economic status (SES), and students' perceptions of school safety. Tenth grade mathematics achievement is the mathematics-achievement score gathered during the student's sophomore year in 2002. This standardized T score provides a norm-referenced measurement of achievement (i.e., an estimate of achievement relative to the entire 10th grade population in spring 2002). This score is a transformation of the IRT theta estimate, which rescales to a mean of 50 and standard deviation of 10. About 10% of the questions on the mathematics assessment were open ended; their scores were included in the total score. Tenth-grade mathematics achievement was also aggregated (mean) to the school level to measure the 10th-grade mathematics achievement of the school. SES is a composite of five equally weighted standardized components: father's education, mother's education, family income, father's occupation, and mother's occupation. Family SES was also aggregated (mean) to the school level to measure the SES level of the school. Gender was coded as male or female based on the students' self-report of their biological sex; if missing, student gender was taken from other questionnaires. The fourth factor, students' perceptions of school safety, was defined as each student's awareness of violence at her/his school. Students' perceptions of school safety were constructed using 3 items reported by students from the ELS data. The items are coded as 1 (strongly agree), 2 (agree), 3 (disagree), and 4 (strongly disagree). The Cronbach's alpha for students' perceptions of school safety is 0.77. Higher values represent students' perceptions of greater school safety. Students' perceptions of school safety were also aggregated (mean) to the school level to measure the collective sense of safety within the school.

Independent variables: teacher factors. Teaching practice/active mathematics learning is a teacher factor that was reported *by students*. Teaching practice/active mathematics learning was defined as the frequency with which students reported reviewing their work; copying teachers' notes from board; doing problem-solving; explaining their work to class orally; and participating in student discussions in mathematics class. Teaching practice/active mathematics learning is thought of as a teacher, as opposed to a student, factor because teachers set/create the classrooms, set the expectations, and engage students in the above-reference experiences. Students may report experiencing each of the above five, but they experience them because of teacher practices. For example, students do problems because teachers assign them either in class or for homework. Teaching practice/active mathematics learning was constructed using 5 items from the ELS data. Item coding reflects students' assessment of the frequency with which they engaged in each classroom behavior, coded as 1 (never), 2 (rarely), 3 (less than once a week), 4 (once or twice a week), and 5 (every day or almost every day). The Cronbach's alpha for teaching practice is 0.60. Higher values on this variable represent higher levels of teaching practice/active mathematics learning. Teaching practice/active mathematics learning was also aggregated (mean) to the school level to measure the broad consensus of teaching practices within the school.

The second teacher factor, teaching experience, is the mathematics teacher's total years teaching in the K-12 educational system. Teaching experience was also aggregated (mean) to the school level to measure the average teaching experience within the school. The third teacher factor, teacher's highest degree, is defined as the highest degree held by the mathematics teacher. This variable was a composite of 7 items from the ELS database coded as 0 = No degree; 1 = Associate degree; 2 = Bachelor's degree; 3 = Education specialist/professional diploma[4]; 4 = Master's degree; 5 = Doctorate degree[5]; and 6 = First Professional degree[6]. All teachers in my sample had at least an Associate degree. Teacher's highest degree was also aggregated (mean) to the school level to measure the degree level of the teachers within the school.

Independent variables: department factors. The first department factor, department size, was measured according to the number of full-time mathematics teachers employed at the school as reported by the school administrator. The second department factor, collective responsibility for learning[7] (CRL) was constructed using 8 items reported by the mathematics teachers from the ELS data. CRL is defined to be "teachers' internalized responsibility for the learning of their students rather than attributing learning difficulties to weak students or deficient home conditions, a belief that teachers can teach all students; and a willingness to alter teaching methods in

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[4] A professional diploma includes courses taken above the bachelor level, but not masters.
[5] Doctorate includes Doctor of Philosophy, Doctor of Education, and Doctor of Public Health.
[6] First professional includes Medical Doctor, Dentist, and Lawyers.
[7] Even though collective responsibility for learning was reported by mathematics teachers, this variable was included with the department factors instead of reported with the teacher factors at the student level because teachers were not identified in this dataset and the data for this variable would be duplicated at the student level.

response to students' difficulties and successes" (Lee & Smith, 2001, p. 87). The Cronbach's alpha for CRL is 0.66. Higher values on this variable represent beliefs of greater responsibility for student learning by the teachers in the department as a whole. The first six items reflect the importance of different factors to student success in mathematics and are coded as 1 (extremely important), 2 (very important), 3 (not very important), and 4 (not at all important). The last two items reflect the source of student mathematics ability and are coded as 1 (strongly agree), 2 (agree), 3 (disagree), and 4 (strongly disagree). Some items were re-coded (see Appendix A). Before this variable was constructed, all duplicated responses across the eight items within schools were removed to gain a more sensitive measure of teacher responses. This constructed variable was then aggregated (i.e., computing the mean measure and the standard deviation for the department) to the school level. The mean measure is the departmental sense of collective responsibility. The standard deviation is the within department variability and measures the extent to which these attitudes are shared by the teachers in the same department. Aggregation where the teacher information was reported by just a single teacher resulted in a standard deviation equal to zero.

Independent variables: school factors. Principal influence is a school factor that was constructed using 8 items reported by school principals from the ELS data. Principal influence is defined as principals' perceptions of their actual influence on school curriculum, practices, and supervisory decisions. The activities included are (a) hiring/firing teachers, (b) grouping students, (c) course offerings, (d) instructional materials, (e) curricular guidance, (f) grading and evaluation, (g) discipline policies, and (h) school funds. These items are coded as 1 (no influence), 2 (some influence), and 3 (major influence). The Cronbach's alpha for principal influence is 0.80. Higher values represent greater influence by the principal. The second school factor is principals' perceptions of school safety and is defined as the principal's perceptions of the school safety level. This variable incorporates the frequency of violence at the school and student victimization (both property and person) being a problem at the school. Principal's perceptions of school safety were constructed using 9 items reported by the school principal from the ELS data. The items are coded as 1 (happens daily), 2 (happens at least once a week), 3 (happens at least once a month), 4 (happens on occasion), and 5 (never happens). The Cronbach's alpha for principals' perceptions of school safety is 0.83. Higher values represent principal perceptions of greater school safety. The third school factor, school segregation was measured by computing the percentage of Blacks in the sample and since ELS did not over-sample or under-sample Black students in the school, this percentage was used to represent the percentage of Blacks within the school.

Descriptive Statistics

The descriptive statistics and abbreviations for the student level variables (student and teacher factors) are displayed in table 2. Table 2 also contains the descriptive statistics and abbreviations for the dependent variable, 12th grade mathematics achievement. The mean is given for all the variables except for gender where the proportion is given. The values, that is, range and standard deviation (SD) are also given for all the variables. The number of valid cases for each variable is also given in the table. After adjusting for missing data at both levels (list wise deletion), the sample size for the student level variables were 881. The descriptive statistics were computed using the list wise deletion sample size. The mean 12th grade mathematics achievement for students in the sample was 44.78 (SD = 8.41), and the range of the scores were 25.76 to 73.68.

TABLE 2

Descriptive Statistics for Student Level Variables

Variable	Abbreviation	N	Values	*P/M*[a]	*SD*
12th Grade Math Achievement	Math	1607	25.8 – 73.7	44.78	8.41
10th Grade Math Achievement	Prior Math	1607	22.3 – 70.8	45.33	8.41
Gender	Gender	1607	0=Male,1=Female	0.53	0.50
Socio-Economic Status	SES	1607	-1.7 – 1.9	-0.15	0.70
School Safety[b]	S-safety	1530	-4.5 – 5.2	1.52	2.16
Teaching Practices/Active Math Learning	Practice	1518	-3.8 – 3.4	0.24	0.54
Teaching Experience (years)	Experience	1245	1 - 40	15.65	11.23
Teacher's Highest Degree	Degree	1261	1 - 6	3.04	1.04

Note. [a]For categorical variables, this refers to the proportion and for continuous variables this refers to the mean.
[b]School Safety is Students' perceptions of School Safety.

Similarly, the descriptive statistics and abbreviations for the school level variables (department and school factors) are displayed in table 3. The mean, standard deviation, and range are given for all the school level variables. The number of valid cases for each variable is also given in the table. After adjusting for missing data at both levels (list wise deletion), the sample size for the school level variables for the analysis was 293. The descriptive statistics were computed using the list wise deletion sample size. On average the school segregation variable, which measured the percentage of Black students in the school, ranged from 2 to 100 percent with a mean of 20.91 (SD = 20.63).

TABLE 3

Descriptive Statistics for School Level Variables

Variable	Abbreviation	N	Range of Values	M	SD
Department Size	Size	349	0 – 30	10.15	5.63
Collective Resp.[a] for Learning	CRL	418	0.2 – 3.1	1.52	0.49
Variability in CRL	Variability	400	0 – 2.5	0.99	0.39
Principal Influence	Principal	335	-2.1 – 6.9	3.38	2.11
School Safety[b]	P-safety	337	-2.6 – 7.3	2.87	1.63
School Segregation	Segregation	432	2 – 100	20.91	20.63
School 10th grade Math Ach.[c]	School Prior Math	432	22.3 – 69.4	46.41	7.23
School Socioeconomic Status	School SES	432	-1.7 – 1.7	-0.05	0.56
Collective Sense of Safety	School S-safety	432	-2.2 – 5.2	1.43	1.30
School Teaching Practices	School Practice	426	-3.6 – 3.3	0.38	0.68
School Teaching Experience	School Experience	390	1 - 40	15.24	9.21
School Teacher's Highest Degree	School Degree	391	1.5 - 6	3.05	0.88

Note. [a]Resp. is for Responsibility.
[b]School Safety is Principal's perceptions of School Safety.
[c]Ach. is Achievement.

Data Analysis

Student-level and school-level weights were used in the data analysis to ensure that each case was counted relative to its representation in the population of 10th grade students in the U.S. The data in multilevel analysis are not a simple random sample (SRS); it was designed to be nationally representative. Given that standard errors (SE) indicate levels of certainty of the estimate (i.e., smaller SE indicates more certainty), and software designed for SRS tends to underestimate SE in complex samples (because cases within sample groups tend to be similar to one another), I accounted for the effect of my complex sample on my variance estimation within my multilevel modeling. Data analysis took place in three stages. The first stage was data preparation which was done using the SPSS Statistics 17.0 software. The second stage was to conduct an intercorrelational analysis to examine the data. The final stage was performing a multilevel analysis of the data using the HLM 6.06 software for 12th grade mathematics achievement. Next, I describe the data preparation, the intercorrelational analysis, and the multilevel modeling approaches.

Data Preparation

The data were downloaded from the ELS website for use in my data analysis. With over three-thousand variables available in the ELS dataset, I filtered the variables of interest to a new file. I recoded the missing values (coded as negative values) to system missing. The rest of the data preparation took place in three steps. Step 1: The creation of the school level segregation variable. The school segregation variable was created by computing the percentage of Blacks in each school sample. Step 2: The construction of five composite variables through item response theory (more specifically, rating scale modeling) was completed using the Winsteps (version 3.66.0) software. The construction of the variables was computed over the entire ELS sample. The five factors that the rating scale model used to construct are teaching practices, collective responsibility for learning, principal influence, principal’s perceptions of school safety, and students’ perceptions of school safety (more information can be found on the data analysis and results in Appendix B). These variables were then used in the multilevel analysis. Step 3: The creation of the department level "collective responsibility for learning" variable. Before this variable was constructed, all duplicated responses across the eight items within schools were removed to gain a more sensitive measure of teacher responses. This variable was constructed by aggregating (i.e., computing the mean measure and within-department standard deviation) the teacher level variable to the school level. The mean measure is the department collective responsibility for learning and the standard deviation is the variability within the department.

Intercorrelational Analysis

The intercorrelations of the student and teacher factors are displayed in table 4, and the intercorrelations of the department and school factors are displayed in table 5.

Multilevel Modeling

Student data is nested within schools, so the data were analyzed using a multilevel modeling technique. This type of analysis allows modeling of two levels of data (i.e., student level and school level); the intercepts and slopes of the student-level model were the outcome variables at the school level.

Model A: unconditional means model. An unconditional multilevel model, in which no factors (either at the student level or the school level) were included except for the schools themselves, was imposed first (Research Question 1). This model provides the intraclass correlation coefficient (ICC). The ICC estimates the proportion of the variance in 12th grade mathematics achievement that is attributed to school level differences. The ICC can be calculated using the following:

$$\frac{\tau_{00}}{\tau_{00} + \sigma^2}$$

where σ^2 is the estimated student level variance for the model and τ_{00} is the estimated school level variance for the model.

There are two main models in this analysis: the student level model and the school level model. The student and teacher factors were entered into the student level model and then the department and school factors were entered into the school level model. Data analysis occurred in a sequential order to match the analyses with the research questions and build the complex model in a careful and purposeful way. The effect of each group of factors was examined.

Model B: student level (within-school) model. The student level model was built by entering all student and teacher factors as group mean centered factors except for gender (Research Question 2). To group-mean center a variable, the school-level mean has to be subtracted from all scores within that school. This new score represents a student's standing relative to the school sample of Black students in 10^{th} grade. I decided to center my variables by checking whether or not a value of zero on each variable is meaningful. If a zero value is not meaningful then I decided to group-mean center because the pure within-school effect of my student level variables on 12^{th} grade mathematics achievement was of interest (Raudenbush & Bryk, 2002). By group-mean centering these factors, the intercept (β_{0j}) becomes the unadjusted mean for school j. In the student level model imposed, I included the student factors (i.e., students' 10^{th} grade mathematics achievement, gender, SES, and students' perceptions of school safety), the teacher factors (i.e., teaching practices, teaching experience, and teacher's degree), and the three interaction terms that research has shown to be significant predictors of student outcome (i.e., Gender x Prior Math, SES x Practices, and Gender x SES). Initially, I allowed all level 1 coefficients to randomly vary. For each factor, the fixed effect and variance of the random effect were examined as recommended by Raudenbush and Bryk (2002). The unconditional variance of the random effect, τ_{qq}, was examined, and if it is not statistically significant (p>.05) then the effects were fixed across schools and examined. If τ_{qq} is not statistically significant then there is no significant variability among schools for that particular coefficient.

The models were compared using full maximum likelihood estimation (Raudenbush & Bryk, 2002). The likelihood ratio chi-square statistic, χ^2_{LR}, was used to calculate the relative fit of the models:

$$\chi^2_{\text{LR}} = D_{\text{baseline}} - D_{\text{fitted}} \qquad \text{and} \qquad df = r_{\text{fitted}} - r_{\text{baseline}}$$

where D is the deviance value and r is the number of parameters estimated (Raudenbush & Bryk, 2002). If the chi-square statistic is statistically significant, then the fitted model (i.e., the complex model with the random effect not fixed across schools) was retained; otherwise the baseline model (i.e., the simpler model with the random effect fixed across schools) was retained. The deviance is a measure of lack of fit of one model compared to another model and is defined as:

$$D = -2ln[likelihood\ ratio]$$

where the larger the value of deviance for a particular model, the poorer the fit for that model (Raudenbush & Bryk, 2002). If more than one random effect had variances that were not statistically significant, then the random effect with the highest p value was fixed across schools and using the procedures described above, the relative fit of this model was compared to the model where the effect was not fixed. This was an iterative process, repeated as necessary to remove one effect from the model at a time.

Once the final model for the student level factors was established, the proportion of within-school variance accounted for (PVAF) in mathematics achievement by the set of student factors, the set of teacher factors, and the set of interaction terms were computed to determine the amount of within-school variance they combined to explain separately. As stated by Raudenbush and Bryk (2002), the proportion of variance explained is defined as:

$$\frac{\sigma^2(baseline\ model) - \sigma^2(fitted\ model)}{\sigma^2(baseline\ model)}$$

where σ^2 is the estimated student level variance for the model within the parentheses. Also, the proportion of within-school variance uniquely accounted for (PVUAF) by each of the statistically significant student level variables was calculated by examining the change in σ^2 of the baseline model without a factor of interest compared to the fitted model with the factor of interest. The PVUAF provides a measure of effect size for each of the factors. The proportion of variance estimate is often referred to as a pseudo-R^2 (Raudenbush & Bryk, 2002). The R^2 can be interpreted as values of 0.01 being a small effect, 0.06 being a medium effect, and 0.15 being a large effect (Keppel & Wickens, 2004); therefore, the proportion of variance estimates can be interpreted using R^2 rules.

Model C: school level (intercepts as outcomes) model. The school-level model was built by entering all department and school factors as grand mean centered factors of the intercept (β_{0j}) and slopes except for department size and variability in collective responsibility for learning (Research Question 3). All variables without a meaningful zero value were grand-mean centered to maximize the interpretation of related intercept coefficients (Raudenbush & Bryk, 2002). By grand-mean centering these factors, the school level intercept (γ_{00}) becomes the expected mathematics achievement for a school with values equal to the grand mean on all of the school level factors except for the variables that are not centered. In the first school-level model, I imposed the department factors (i.e., department size, collective responsibility for learning, and variability in CRL), the school factors (i.e., principal influence, principals' perceptions of school safety, and school segregation), and the aggregated mean of the group centered student level variables (prior math mean, SES mean, school safety mean, teaching practices mean, teaching experience mean, teacher's highest degree mean) at the intercept only. The fixed effect for each factor was examined, and the proportion of between-school variance accounted for (PVAF) in 12th grade mathematics achievement by the set of department factors and school factors were computed to determine the amount of between-school variance they combined to explain. As stated by Raudenbush and Bryk (2002), the proportion of variance-explained estimate is defined as:

$$\frac{\tau_{00}(baseline\ model) - \tau_{00}(fitted\ model)}{\tau_{00}(baseline\ model)}$$

where τ_{00} is the estimated school-level variance for the model within the parentheses. Also, the proportion of between-school variance uniquely accounted for (PVUAF) by statistically significant department factors, school factors, and cross-level interactions was computed by examining the change in τ_{00} of the baseline model without a factor of interest compared to the fitted model with the factor of interest.

Model D: school level (intercepts and slopes as outcomes) model. In the next step, the department and school factors were added to the school-level model at the slopes with varying random effect (Research Question 3). The fixed effects for each factor were examined, and the final full model was created.

The equation below provides an uncombined equation representing the final full model for 12th grade mathematics achievement.

Student level model:

$$MATH_{ij} = \beta_{0j} + \beta_{1j}(Prior\ Math_{ij} - \overline{Prior\ Math_{.j}}) + \beta_{2j}(Gender_{ij})$$
$$+ \beta_{3j}(SES_{ij} - \overline{SES_{.j}}) + \beta_{4j}(S - safety_{ij} - \overline{S - safety_{.j}})$$
$$+ \beta_{5j}(Practice_{ij} - \overline{Practice_{.j}}) + \beta_{6j}(Experience_{ij} - \overline{Experience_{.j}})$$
$$+ \beta_{7j}(Degree_{ij} - \overline{Degree_{.j}}) + \beta_{8j}(Gender\ x\ Prior\ Math_{ij})$$
$$+ \beta_{9j}(SES\ x\ Practice_{ij}) + \beta_{10j}(Gender\ x\ SES_{ij}) + r_{ij}$$

School level model:

$$\beta_{0j} = \gamma_{00} + \gamma_{01}(Size_j) + \gamma_{02}(CRL_j - \overline{CRL_{..}}) + \gamma_{03}(Variability_j)$$
$$+ \gamma_{04}(Principal_j - \overline{Pincipal_{..}}) + \gamma_{05}(P - safety_j - \overline{P - safety_{..}})$$
$$+ \gamma_{06}(Segregation_j - \overline{Segregation_{..}}) + \gamma_{07}(School\ Prior\ Math_{ij}$$
$$- \overline{School\ Prior\ Math_{..}}) + \gamma_{08}(School\ SES_{ij} - \overline{School\ SES_{..}})$$
$$+ \gamma_{09}(School\ S - safety_{ij} - \overline{School\ S - safety_{..}})$$
$$+ \gamma_{010}(School\ Practice_{ij} - \overline{School\ Practice_{..}})$$
$$+ \gamma_{011}(School\ Experience_{ij} - \overline{School\ Experience_{..}})$$
$$+ \gamma_{012}(School\ Degree_{ij} - \overline{School\ Degree_{..}}) + u_{0j}$$

$$\beta_{1j} = \gamma_{10} + \gamma_{11}(Size_j) + \gamma_{12}(CRL_j - \overline{CRL_{..}}) + \gamma_{13}(Variability_j)$$
$$+ \gamma_{14}(Principal_j - \overline{Pincipal_{..}}) + \gamma_{15}(P - safety_j - \overline{P - safety_{..}})$$
$$+ \gamma_{16}(Segregation_j - \overline{Segregation_{..}}) + \gamma_{17}(School\ S - safety_{ij}$$
$$- \overline{School\ S - safety_{..}}) + u_{1j}$$

$$\beta_{2j} = \gamma_{20}$$

$$\beta_{3j} = \gamma_{30}$$

$$\beta_{4j} = \gamma_{40}$$

$$\beta_{5j} = \gamma_{50} + \gamma_{51}(Size_j) + \gamma_{52}(CRL_j - \overline{CRL_{..}}) + \gamma_{53}(Variability_j) + \gamma_{54}(Principal_j - \overline{Pincipal_{..}}) + \gamma_{55}(P-safety_j - \overline{P-safety_{..}}) + \gamma_{56}(Segregation_j - \overline{Segregation_{..}}) + \gamma_{57}(School\,S-safety_{ij} - \overline{School\,S-safety_{..}}) + u_{5j}$$

$$\beta_{6j} = \gamma_{60}$$

$$\beta_{7j} = \gamma_{70}$$

$$\beta_{8j} = \gamma_{80} + \gamma_{81}(Size_j) + \gamma_{82}(CRL_j - \overline{CRL_{..}}) + \gamma_{83}(Variability_j) + \gamma_{84}(Principal_j - \overline{Pincipal_{..}}) + \gamma_{85}(P-safety_j - \overline{P-safety_{..}}) + \gamma_{86}(Segregation_j - \overline{Segregation_{..}}) + \gamma_{87}(School\,S-safety_{ij} - \overline{School\,S-safety_{..}}) + u_{8j}$$

$$\beta_{9j} = \gamma_{90}$$

$$\beta_{10j} = \gamma_{100}$$

In the analysis, the student-level model expressed each student's 12th grade mathematics achievement ($MATH_{ij}$) as a function of the school-mean mathematics achievement (β_{0j}), a sequence of factors related to the student (β_{1j}, β_{2j}, β_{3j}, β_{4j}), the teacher (β_{5j}, β_{6j}, β_{7j}), interaction terms (β_{8j}, β_{9j}, β_{10j}), and the error (r_{ij}). The school level model specified the school-mean 12th-grade mathematics achievement (β_{0j}) as a function of the individual school-level mean mathematics achievement (γ_{00}), a series of factors related to the department (γ_{0j}), the school (γ_{0j}), and the error (u_{0j}). Similarly, the school-level model specified the slope parameters (β_{ij}) as a function of the average change in expected mathematics achievement given a one unit increase in the student level factor (γ_{i0}), a series of factors related to the department (γ_{ij}), the school (γ_{ij}), and the error (u_{ij}).

The assumptions of the multilevel model (homogeneity of level 1 variance, and normality at level 2) were tested. The homogeneity of the level 1 variance was tested in the HLM software and was not significant, 12th grade mathematics achievement: $\chi^2(51) = 55.19$, $p = .319$, hence we assume homogeneity. The normality at level 2 was tested by doing a scatter plot of CHIPCT against MDIST (variables in the residual file), and the line was examined to be at a 45 degree angle, hence establishing normality.

Summary

In summary, I analyzed the data to examine the student, teacher, department, and school factors that predict Black students' performance on 12th grade mathematics standardized tests in high school. The sample for this study was all Black students in the Education Longitudinal Study (ELS) of 2002, which accounts for 1,607 10th graders across 432 schools. Data analysis was completed in three stages. The first stage was data preparation and included the construction of five variables using a rating scale model. The second stage was to conduct an intercorrelational analysis of the data. The third stage was to analyze the data using multilevel modeling. The next chapter reports the results of these data analyses.

CHAPTER IV

RESULTS

In this chapter, I first report the results of the first order correlations and the finding of the multilevel analysis completed; and second, I summarize the findings for each of the research questions that were located at the beginning of chapter III. I report the student, teacher, department, and school factors that are shown to be statistically significant predictors for improving the academic achievement of Black students on mathematics standardized tests in high school.

First Order Correlations

Student level Intercorrelations

Twelfth-grade mathematics. The inter-correlations of the student level variables are displayed in table 4. The table shows that higher-achieving 12^{th} grade Black students also have higher 10^{th}-grade mathematics achievement, higher family-SES, greater level of school safety in 10^{th} grade, and report engaging in greater levels of what I have termed active mathematics learning.

Gender. Results also indicate that Black male students have higher 10^{th}-grade and 12^{th}-grade mathematics achievement than Black female students. Although males seem to be of higher-SES background than females, females report higher levels of school safety and experiencing greater levels of active mathematics learning than do males.

Socioeconomic status. Higher SES Black 10^{th} graders have higher levels of mathematics achievement in 10^{th} and 12^{th} grades. They also report higher levels of school safety.

School safety. School safety correlates with higher 10th and 12th grade mathematics achievement, and better quality of mathematics practices. Students whose teachers have more experience also report safer schools.

Teaching practices. Better quality of mathematics practices (as reported by students' higher levels of active mathematics learning) correlates with higher 10th and 12th grade mathematics achievement. Years of teaching experience is correlated with teacher degree: the longer someone has been teaching, the more likely that person is to have an advanced degree.

TABLE 4

Intercorrelations among Student Level Variables

	1	2	3	4	5	6	7	8
1. Math	1	.871**	-.089**	.345**	.176**	.074**	-.034	.039
2. Prior Math		1	-.077**	.300**	.175**	.073**	-.049	.046
3. Gender			1	-.050*	.062*	.061*	-.042	-.014
4. SES				1	.092**	-.014	-.032	.047
5. S-safety					1	.077**	.063**	-.006
6. Practices						1	-.009	-.001
7. Experience							1	.263**
8. Degree								1

** $p < .01$, * $p < .05$.

School level Intercorrelations

School size. Larger schools reports greater variability as regards to teachers' collective responsibility for learning, weaker principal influence, and larger schools are less safe than smaller schools as reported by both principals and students.

Collective responsibility for learning (CRL). More segregated schools report greater levels of CRL. Schools with lower 10th grade mathematics achievement also report greater levels of CRL. Higher levels of CRL are reported in schools where students report greater quality of teaching practices.

Principal influence. Principals report lower levels of influence in more segregated schools. Principals report higher level of influence in higher SES schools. When principals report higher levels of influence, they and the students also report greater levels of school safety.

Principal perceptions of school safety. Principals reports higher school safety in integrated schools, high achieving schools, high SES schools, and when students reports higher levels of school safety.

Segregation. Higher segregated schools correlate with lower achieving schools, lower SES schools, students' reports of lower school safety, and high quality of teaching practices.

TABLE 5

Intercorrelations among School Level Variables

	1	2	3	4	5	6	7	8	9	10	11	12
1. Size	1	-.030	.135*	-.120*	-.427**	-.092	.049	.050	-.497**	-.001	-.031	-.057
2. CRL		1	.026	-.082	.019	.111*	-.110*	.005	-.024	.117*	-.060	-.098
3. Variability			1	.038	-.152**	.047	-.093	-.004	-.055	.079	-.087	-.033
4. Principal				1	.283**	-.120*	.089	.112*	.275**	-.008	-.068	-.025
5. P-safety					1	-.168**	.237**	.196**	.605**	.067	.008	.061
6. Segregation						1	-.232**	-.244**	-.131**	.098*	.083	.078
7. Prior Math^{a}							1	.440**	.312**	.044	-.066	.053
8. SES^{a}								1	.251**	.042	-.073	.047
9. S-safety^{a}									1	.015	-.037	.005
10. Practices^{a}										1	-.098	-.065
11. Experience^{a}											1	.260**
12. Degree^{a}												1

Note. $^{**}p < .01$, $^{*}p < .05$.
^{a}Indicates aggregated school-level variables.

Multilevel Model Results

Next I describe multilevel model results for Black students' 12th grade mathematics achievement. Four models were imposed based on the research questions. Model A was imposed to investigate the first research question, and model B was imposed to investigate research question two, and models C and D were imposed to investigate research question three.

Model A provided an estimate of how much variance in school's 12th-grade mathematics achievement for Black students was due to between- and within-school differences; Model A also provided an estimate the grand mean of the outcome variables across schools and students.

Model B differs from Model A in that all the student-level variables and interaction terms were added to the model to determine if student-level variables explained within-school variability in 12th grade mathematics achievement. Due to the small within-school sample size, the data were unlikely to support all the random effects at the between-school level. Hence some of the random effects in model B were fixed. As a result, I was unable to examine the between-school variability for those predictors.

Model C differs from model B in that school-level variables and the aggregated school mean for student-level variables were added as predictors of the mean 12th grade mathematics achievement for Black male students in the given school (i.e., intercepts). The purpose of this model was to determine if any of the newly-added predictors explained between school variability in 12th grade mathematics achievement at the intercept.

Model D differs from Model C in that the school level variables and the aggregated school mean for students' perceptions of school safety were specified as predictors of the slopes in Black students' 12th grade mathematics achievement across schools where the student level predictors were allowed to vary across schools. This model was imposed to determine if any of the newly added predictors explained between-school variability in the slopes of the student level variables.

Model A: Unconditional Means Model

Results from the unconditional model (Model A) are displayed in table 6. The level 1 variance (σ^2) for the unconditional model was 46.71, and the level 2 variance (τ_{00}) was 17.81. The intraclass correlation coefficient (ICC) was computed as .276, that is, 27.6% of variance in Black students' 12th grade mathematics achievement was due to between-school differences, whereas 72.4% of the variance in Black students' 12th grade mathematics achievement was due to within-school differences. The variance of the intercept (u_{0j}) was statistically significant (χ^2[292] = 633.48, $p < .001$), that is a significant amount of variance in Black students' 12th grade mathematics achievement is between schools. The grand mean for Black students' 12th grade mathematics achievement across schools and students, β_{00}, was equal to 44.71 and was statistically significant, which means that the mean Black students' 12th grade mathematics achievement across schools and students was differentiable from zero.

TABLE 6

Results of Mathematics Achievement Multilevel Model

Fixed Effects	Parameter	Model A	Model B	Model C	Model D
Intercept, β_{0j}					
Intercept	γ_{00}	44.71***	45.21***	45.67***	45.57***
		0.504	0.575	0.550	0.594
School Prior Math	γ_{07}			0.87***	0.88***
				0.045	0.045
School SES	γ_{08}			1.23**	1.21**
				0.417	0.414

School Degree	γ_{012}		0.51	0.51*
			0.231	0.230
Prior Math, β_{1j}				
Intercept	γ_{10}	0.87***	0.85***	0.89***
		0.028	0.030	0.088
Segregation	γ_{16}			-0.00**
				0.001
SES, β_{3j}				
Intercept	γ_{30}	0.68*	0.76*	0.91**
		0.313	0.322	0.286
Practices, β_{5j}				
School S-safety	γ_{57}			0.68*
				0.306
Gender x Prior Math, β_{8j}				
School S-safety	γ_{87}			0.18**
				0.057
Gender x SES, β_{10j}				
Intercept	γ_{100}	1.41*	0.86	0.73
		0.540	0.479	0.504

Note. $^{***}p < .001$, $^{**}p < .01$, $^{*}p < .05$.
[a]P. Math is Prior Math.

Model B: Student Level (Within-School) Model

After examining the unconditional model, the student-level variables (i.e., student and teacher factors) and interaction terms were entered into the model. The variances of the random effects for the variables were not all significant; so a model comparison was conducted to determine whether the baseline[8] model fits the data significantly worse than does a fitted model. This was done for each non-significant random effect starting with the highest non-significant *p* value. Using the deviance and the number of parameters estimated, the likelihood-ratio chi-square statistic was used to calculate the relative fit of the model when fixing random effects. In summary, the only random effects that were included in the model were the intercept, 10th grade mathematics achievement, 10th grade teaching practice, and the interaction between gender and 10th grade mathematics achievement. These random effects were kept in the model because they were significant, which suggests that there is variability across schools in those specific predictors. The results of the final student level model are presented in table 6 (Model B).

The student factors (10th grade mathematics achievement, gender, SES, students' perceptions of school safety) combined to account for 73.7% of the student-level variation in 12th grade mathematics achievement. The teacher factors (teaching practice, teaching experience, teacher's highest degree) combined to account for 12.4% of the student-level variation in 12th grade mathematics achievement. The interaction terms (gender x 10th grade mathematics achievement, SES x 10th-grade teaching practice, and gender x SES) combined to account for 4.4% of the student-level variation in 12th grade mathematics achievement.

Model B found, in addition to model A, that Black students' 10th-grade mathematics achievement, SES, and the interaction between gender and SES were all

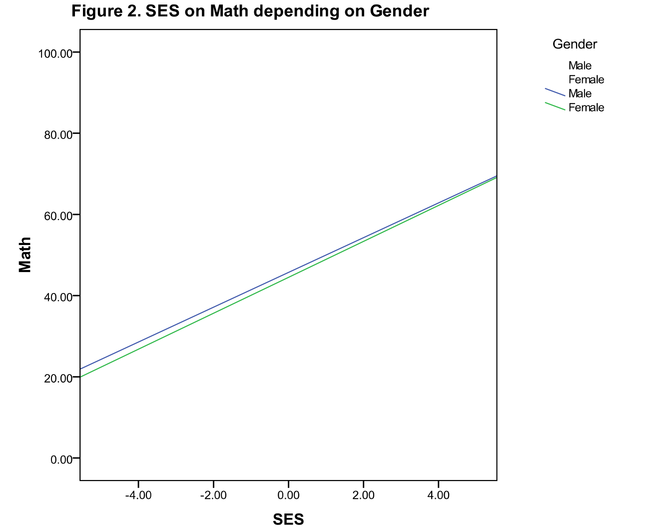
[8] The baseline model is where the effect is fixed across schools, and the fitted model is when the random effect is allowed to vary.

statistically significant predictors of the students' 12th-grade mathematics achievement; that is, these predictors explain significant within-school variability.

High-achieving Black students on 10th grade mathematics do better on 12th grade mathematics achievement than do low-achieving Black students ($\gamma = 0.87$). The effect size of 10th grade mathematics achievement was 0.73, which is considered very large. Black students with higher social-class backgrounds do better than Black students with lower social-class backgrounds on 12th grade mathematics achievement ($\gamma = 0.68$). On the other hand, the effect size of student SES was 0.01, which is considered small.

As shown in figure 2, the gender by social class interaction reveals that Black male students with lower social-class backgrounds do better than Black female students of similar backgrounds on twelfth grade mathematics achievement, and Black female students with higher social-class backgrounds perform similar to Black male students of similar backgrounds on twelfth grade mathematics achievement ($\gamma = 1.41$). The effect size of the interaction between gender and social class was 0.01, which is considered small.

Figure 2. SES on Math depending on Gender



Model C: School Level (Intercepts as Outcomes) Model

The school-level variables (department and school factors) and the aggregated mean of the group-centered student-level variables were imposed only on the intercept of the student-level model. The department factors (size, collective responsibility for learning, and variability in CRL) combined to account for 3.8% of the school-level variation in 12th-grade mathematics achievement, and the school factors (principal influence, principal perceptions of school safety, and school segregation) combined to account for 13.8% of the school-level variation in 12th grade mathematics achievement.

When I imposed the school level variables on the intercept, the three predictors (school mean-level 10th grade mathematics achievement, school mean level SES, and school mean-level teacher's highest degree) were statistically significant; that is, these predictors explained between-school variability in the mean 12th grade mathematics achievement for Black male students.

Black male students with higher mean 10th-grade mathematics achievement have better mean 12th-grade mathematics achievement than Black male students with lower mean 10th-grade mathematics achievement ($\gamma = 0.87$). The effect size of the school mean 10th grade mathematics achievement was 0.91, which is considered very large. Black male students in high-SES schools had better mean 12th grade mathematics achievement than Black male students in lower-SES schools ($\gamma = 1.23$). The effect size of the school's mean SES was 0.12, which is considered medium. Finally, Black male students at schools whose mathematics teachers are better educated have better mean 12th grade mathematics achievement than Black males at schools where teachers are not as well educated ($\gamma = 0.51$). The effect size of the school mean teacher's highest degree was 0.00, which is considered to be a negligible effect.

Model D: School Level (Intercept and Slopes as Outcomes) Model

The results at the school level (Model D) for 12^{th} grade mathematics achievement indicate three additional statistically-significant findings over the other models. The interactions between (1) 10^{th} grade mathematics achievement and segregation, (2) teaching practice and collective sense of safety, and (3) collective sense of safety, gender, and 10^{th} grade mathematics achievement explain between-school variability in the student-level predictors.

Figure 3 shows graphically that the benefit of prior achievement varies based on whether a Black student attends a more or less segregated school. That is, low achieving Black students in a segregated high-school do slightly better than in a less segregated high-school. In contrast, high-achieving Black students do marginally better in less segregated high-schools than in segregated schools. In both cases, the benefits are so slight as to be virtually unimportant from an educational point of view ($\gamma = -0.00$). That is, the effect size of the interaction between 10^{th} grade mathematics achievement and segregation was 0.00, which is considered to be negligible.

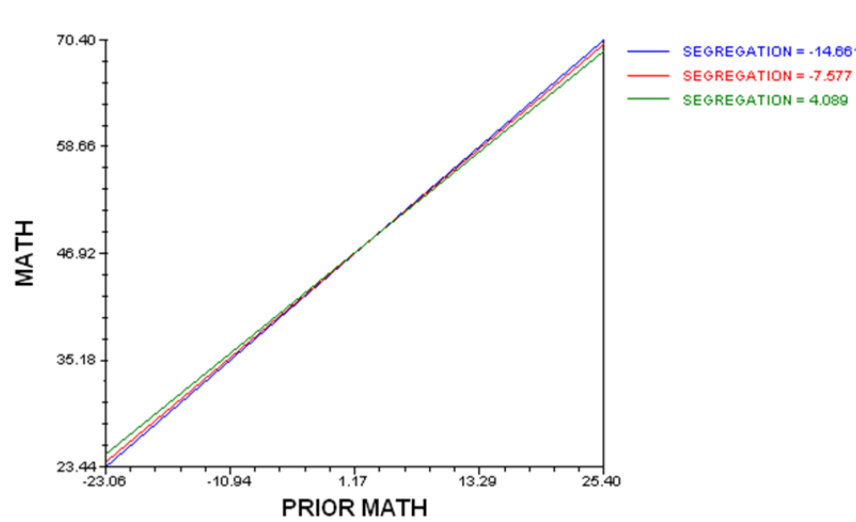


Figure 3. Prior Math on Math depending on Segregation

Figure 4 illustrates a complex and somewhat surprising results on the interaction between students' collective sense of safety and their experiencing teaching practices that promote active mathematics learning. In schools where students report a higher collective sense of school safety, the benefits of teaching practices are straightforward: the better the teaching practices, the greater the 12th grade achievement. However, in schools where collective sense of safety is somewhat mixed or where it is low (i.e., students report collectively feeling not safe) the relationship is negative; the better the teaching practices, the worse the students' 12th grade achievement ($\gamma = 0.68$). The effect size of the interaction between teaching practices and collective sense of safety was 0.03, which is considered small. Most surprising is that the highest achievement was found in schools with the lowest collective sense-of-safety and reports of the worst teaching practices.

Figure 4. Practices on Math depending on School S-safety

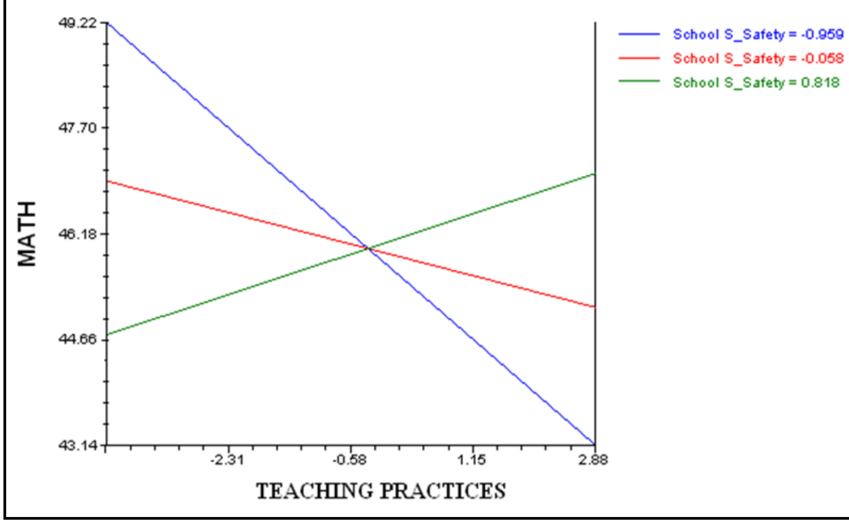


Table 7 shows the benefit of prior achievement varies based on gender and collective sense of school safety (γ = 0.18). That is, for low and mixed collective sense of school safety, the gender by 10^{th}-grade mathematics achievement interaction reveals that Black males who performed low on 10^{th} grade mathematics achievement tests did better than Black females who also performed low in 10^{th}-grade on their respective twelfth-grade tests; and that initially higher-achieving Black female students perform similar to initially higher-achieving Black male students on twelfth-grade mathematics achievement. For schools reporting a high collective sense of school safety, the gender by 10^{th-}grade mathematics achievement interaction reveals that Black females who performed poorly on 10^{th}-grade mathematics achievement tests did better than Black males who also performed low in 10^{th}-grade on twelfth-grade mathematics achievement, and higher-achieving Black male students do better than higher-achieving Black female students on twelfth-grade mathematics achievement. The effect size of the interaction among gender, 10^{th}-grade mathematics achievement, and collective sense of safety was 0.04, which is considered small.

TABLE 7.

Three-Way Interaction between S-Safety, Gender, and Prior Math

Outcome: 12th Grade Mathematics Achievement	
For Low and Mixed Collective Sense of School Safety	
Blacks with low prior math	Males > Females
Blacks with high prior math	Males = Females
For High Collective Sense of School Safety	
Blacks with low prior math	Females > Males
Blacks with high prior math	Males > Females

Summary

In this section, I summarized the findings of my research for each of the three research questions stated at the beginning of chapter III. Recall, the first research question asked, how do mathematics achievement in 12th grade for Black high school students vary, both across and within schools? In sum, 27.6% of variance in Black students' mathematics achievement was due to between-school differences.

The second research question asked how student factors (i.e., 10th-grade mathematics achievement, gender, SES, and students' perceptions of school safety); teacher factors (i.e., teaching practice/active mathematics learning, teaching experience, teacher's highest degree); and the student level interaction factors (Gender and SES, Gender and Prior Math, SES and Practices) impact Black students' 12th-grade mathematics achievement in high school. The student-level model showed three significant predictors of Black students' 12th-grade mathematics achievement: 10th-grade mathematics achievement, SES, and the interaction between SES and gender.

The third research question asked how department factors (i.e., department size and collective responsibility for learning); school factors (i.e., principal's influence, principals' perceptions of school safety, and school segregation); and the cross-level interactions impact Black students' 12th-grade mathematics achievement in high school. The school-level (intercept only) model showed three significant predictors of Black students' variability between schools for 12th-grade mathematics achievement: 10th-grade mathematics achievement, school mean SES, and school mean level of teachers' highest degree. However, school-mean level of teachers' highest degree had a negligible effect and will not be discussed further. Finally, the school-level (slopes) model revealed three significant predictors of Black students' 12th-grade mathematics achievement: the interaction of 10th-grade mathematics achievement and school-level segregation; the interaction of school-level students' perceptions of school safety and teaching practice, and the 3-way interaction of school-level safety, gender and 10th grade mathematics achievement. However, the interaction of 10th grade mathematics achievement and school level segregation had a negligible effect and will not be discuss further. I discuss the implications of these finding in the next chapter.

CHAPTER V

DISCUSSION

The purpose of this study was to investigate the predictors of mathematics achievement on a standardized test for Black high school students using a multilevel analysis of the 2002-2004 ELS data. In this chapter, I interpret the findings of the present study as they relate to previous studies.

The first analysis examined how 12th-grade mathematics achievement for Black high school students varied within and between schools. It was found that 27.6% of variability in Black students' 12th-grade mathematics achievement was due to between school differences. The average 12th-grade mathematics achievement across high schools for Black students was 44.71, around half a standard deviation below the average for the national population of 12th graders. Even though I found a higher variability in 12th-grade mathematics achievement between schools than was reported in previous research (Coleman et al., 1966; Marzano, 2003), Black 12th-grade students on average performed below the national average for all students in mathematics.

Black Students' Mathematics Achievement

Both 10th-grade mathematics achievement and socioeconomic status (SES) were significant positive predictors of 12th-grade mathematics achievement at both the student and school level. Previous researchers have found a positive relationship between prior mathematics achievement and later academic outcomes (Adam & Singh, 1998; Mickelson & Greene, 2006; Strayhorn, 2010; Tate, 1997). This research supports previous findings and indicates that prior mathematics achievement was positively related to 12th-grade mathematics achievement. This finding seems reasonable since prior success in mathematics begets future success in mathematics. Prior research also indicates that students from low-SES backgrounds have lower grades and test scores than students from higher SES backgrounds (Adam & Singh, 1998; Coleman et al., 1966; Lee & Smith, 2001; Strayhorn, 2010). Similarly, the present study substantiates that family SES has a relationship to Black students' mathematics achievement.

Moving from students' individual characteristics to look at schools, we can see that, on average, Black male students have higher 12^{th}-grade mathematics achievement when the schools have more Black students with higher 10^{th}-grade mathematics achievement and higher SES backgrounds. Previous research has argued that school differences do not matter in student achievement, and that students' background is the most important factor in predicting achievement (Coleman et al., 1966). The present study found that student background factors like SES and gender matter on 12^{th}-grade mathematics achievement, but school factors make a difference in students' achievement as well, similarly to findings of previous research (Marzano, 2003; Purkey & Smith, 1983; Zigarelli, 1996).

In a recent study, Strayhorn (2010) used hierarchical regression to examine the impact of individual, family, and school factors on mathematics achievement. Strayhorn found that gender (male) was significantly related to Black high-school students' mathematics achievement. The current study found no direct relationship between gender and 12^{th}-grade mathematics achievement; however, there was an interaction between gender and SES wherein Black male students with lower SES do better than Black female students with lower SES on 12^{th} grade mathematics achievement, and Black males with higher SES do similar to Black females with higher SES on 12th grade mathematics achievement.

Unlike previous research (Lubienski, 2006), the present study found no direct effect of teaching practices and no interaction between SES and teaching practices. In her research, Lubienski (2006) found a positive relationship between achievement and the NCTM-based practices, and that high SES students' achievement positively correlated with NCTM-based practices more so than low SES students. This could be because even though Lubienski uses a large dataset (i.e., NAEP) similar to this study; her study analyzed all students, while this study focuses only on Black students who, on average, have lower SES backgrounds than did Lubienski's.

In contrast to research by Gutierrez (2000) that described how innovative instructional practices improve student achievement, the present study did not find any direct effect of teaching practices in terms of active math learning on mathematics achievement across 1607 Black students nested in 432 schools. The difference in findings might be because Gutierrez was looking specifically at a highly effective school for Black students, while my study took into account all schools included in the ELS dataset that enroll Black students. Gutierrez had qualitative data to support that her students were receiving very good practices for Black students, whereas instructional efficacy at the schools sampled for ELS study varied a great deal between schools. However, this research did find an interaction between teaching practices and collective sense of school safety. That is, in schools where students reported a higher collective sense of school safety and better quality of teaching practices, the greater the 12th grade achievement; Lubienski's school was likely to be a safe school, hence her findings would be consistent with my findings for safe schools and they might not generalize to the larger universe of schools in which Black students are educated.

On the other hand, in schools where the collective sense of safety is somewhat mixed or where it is low, and students report better quality of teaching practices, the lower the students' 12th grade achievement. This finding may be because students are likely to be able to concentrate, engage in instruction and do well in mathematics when they feel safe; and when students feel unsafe, their mathematics achievement suffers because they are worried about surviving the day than about engaging in active math learning or in doing well on a test (Bowen & Bowen, 1999).

However a surprising result within this interaction was that the highest achievement was seen in schools with the lowest collective sense-of-safety and the lowest reports on quality of teaching practices. This surprising result needs more investigation to be understood. I would suggest qualitative analysis of high-achieving schools where students' report a collective sense of feeling unsafe.

Initial Outlines of an Ideal School for Black Students

Even though I found significant predictors of Black students 12th grade mathematics achievement at both the student and school level, I will only discuss those malleable predictors at the school-level that contribute to the ideal school for Black students' mathematics achievement.

The findings suggest a number of important conclusions. Some add new insights to the existing literature while also confirming the known results. The present study shows that school's SES, high quality teaching practices in terms of active mathematics learning and students' collective sense of school safety are important and can improve the scores of Black students on 12th grade mathematics achievement. Therefore, the ideal school should have a high percentage of Black students of higher social-class backgrounds (i.e., more resources). Teachers should have teaching practices that provide the students with active mathematics learning, and Black students should collectively feel safe at the school.

Social class. The present study suggests that higher SES schools have higher 12th-grade mathematics achievement than lower SES schools. I would suggest that schools with a high percentage of disadvantaged Black students should receive additional funding for resources that they will need. This suggestion supports the mission of NCLB Title One which aims to improve the academic achievement of disadvantaged students and shown to have mixed results. However, according to Henry, Fortner, and Thompson (2010) supplemental funding for disadvantage students helps all students' academic achievement.

Teaching practices. The present study suggests that there is an interaction between teaching practices and collective sense of safety, that is, higher 12th-grade mathematics achievement is associated with greater levels of teaching practices that result in active mathematics learning in schools where students feel safe. My policy recommendation is to increase professional development for mathematics teachers on active mathematics learning. Even though teachers receive a lot of professional development during the course of their career (which may or may not be beneficial to their classroom teaching or student learning), I would suggest that mathematics teachers need to be given professional development (maybe once a month) on strategies and lessons for specific mathematics topics that improves teachers' active mathematics practices. According to Wallace (2009) the effects of professional development on student's achievement is mediated by teaching practices. Hence, effective professional development may increase teaching practices for active mathematics learning and hence Black students' 12th-grade mathematics achievement.

Collective sense of safety. The present study also suggests that with high quality practices, Black students do better in high schools they perceive as safe. I would suggest that the state/district should invest in schools to increase students' perceptions of safety whether it's from bullies, weapons, or racial hatred. This could be accomplished by providing both structure and support to the students. That is, structure is consistent enforcement of school discipline to all students where the students perceived the rules as fair. Support is availability of caring adults in the school (e.g., positive student-teacher relationships). According to Gregory at al. (2010), student perceptions that school rules were fair and strictly enforced, and that adults were supportive and willing to help students, were associated with less student victimization and bullying. Therefore with high-quality teaching practices, students may do better on 12th-grade mathematics achievement when schools provide both structure and support.

Obstacles to the Ideal School for Black Students

An obstacle to the ideal school is that Black students have long been disproportionately represented in this nation's lower socioeconomic classes (SES). Poverty (a defining factor of SES placement) surely contributes to Black students achievement patterns in school, particularly through the material limitations that are associated with lower SES such as low-quality schools, lack of school resources, stress, and pressure to leave school (Steele, 1997).

Another obstacle to the ideal school is teachers may not be able to use practices in the classroom to support active mathematics learning (e.g., problem-solving, explains work orally to class, or discuss problems) because of class size and/or class time. For students to discuss problems with each other and still get individual attention from teachers requires smaller class size. For teachers to have students really take the time to explain their work to the class orally then teachers need more time with each class.

Another obstacle to the ideal school is that students may collectively feel unsafe at their school because schools, districts, and the State do not provide the financial and personnel resources to implement programs that focus on student's safety in unsafe schools where resources are limited.

Conclusions

Although NCLB (2001) requires that schools educate every student regardless of their intellectual ability, social status, gender, or race/ethnicity, to high academic standards, and that all students should be proficient in mathematics, Black students still perform below White students in mathematics. Therefore this study examined the teacher and student factors nested within the department and school factors to provide the conceptual structure through which these factors influence the 12th grade mathematics achievement of Black students. This study found significant predictors at both levels and that Black students average 12th grade mathematics achievement across schools was a half standard deviation below the national average for all students. However, this study reports on those malleable predictors at the school level that contribute to the ideal high school for Black students (SES, teaching practices, and collective sense of school safety).

The racial composition of public schools is determined primarily by the composition of the neighborhoods in which schools are located. Blacks have a high poverty rate, and most Black students live in areas where they are the majority. Segregated housing patterns that lead to a segregated educational system can cause disparities in educational opportunities and an institutionalized reproduction of racial inequality (Oakes & Lipton, 2007). Differences in property values of the school present themselves in the curriculum, that is, “better” schools (i.e., high SES schools) provide more challenging and advanced courses (e.g., geometry, trigonometry, and calculus). Furthermore, “better” schools have better science and computer labs, the latest technologies, more appropriately-certified teachers and better-prepared teachers (Ladson-Billings & Tate, 1995). Hence the lack of availability of advanced courses in many highly segregated inner city schools causes a lack of opportunity to learn the gate keeping courses needed to enter college and major in STEM fields. Hence, society needs more ideal high schools for Black students that are high SES, the students feel safe, and have well-prepared teachers who practice active mathematics learning.

Limitations

The primary limitation of this study is the use of an extant dataset. All items were previously created, all levels of data collection were previously decided, data coding was previously decided, and the publicly available dataset was used instead of the restricted dataset. As an example of a limitation inherent to extant datasets, if you want to measure reform oriented practices as reported by students and teachers, the items that are available do not measure reform oriented instructed and are not reported by teachers but only by students. Hence in the present study, I had to adjust and focus on teaching practice for active mathematics learning. If you want to examine a three level model where student nested within classrooms nested within mathematics department or schools, because of the data collection design, only students nested within school data are available. Also, if the data managers decide to make a continuous variable into a categorical variable, information is lost during this process and is only available in the restricted data. Despite these limitations, which are inherent to all research conducted using extant data, the richness of information and the sample sizes that are obtainable through the ELS dataset make the findings in this study an important contribution to the literature.

Directions for Future Research

Since we know that student, teacher, department, and school factors are significant predictors of 12^{th}-grade mathematics, future research should consider a study that incorporates a three or four level model to examine where the variability is occurring and what predictors explain the variability for Black students. Future studies should also replicate my surprising findings vis-à-vis school safety and teaching practices/active mathematics learning; if these are, in fact, robust findings, then interview-research methods might help us to better understand why Black students in unsafe schools with lower-quality teaching practices outperform students in safe schools and with higher-quality teaching practices. Given that Black students are underrepresented in the science, technology, engineering, and mathematics (STEM) fields, future research should examine the predictors of high school students' science achievement. Also future research could take a longitudinal look at the predictors of mathematics and science achievement by simultaneously examining the three other secondary school datasets (NLS-72, HS&B, NELS:88) to see if the results (across time) are the same as the ELS:2002 data. Finally, all these analyses should be repeated for various racial/ethnic groups. The present study analyzed data on Black students' only, whereas research can analyze data on White students only and Hispanic/Latino students only to compare and contrast the results across racial/ethnic groups to see if the same factors that predict the ideal school for Black students also predict the ideal school for White and Hispanic/Latino students.

APPENDIX A

VARIABLES

Data used for this study were taken from the Education Longitudinal Study (ELS) of 2002 from the National Center for Education Statistics (NCES) in its base year (2001-2002) and the first follow up year (2003-2004). The data were originally collected from students, mathematics teachers, principals, and administrators. In the multilevel analysis, students are nested within schools, hence two levels of data analysis. However, there are two sets of predictors at each level. The student-level consists of the student and teacher factors, and the school-level consists of the department and school factors.

Multilevel Modeling

Student Outcome:

- F1TXMSTD: 2004 Math test standardized score: Composite

Student Factors:

- BYTXMSTD: 2002 Math test standardized score: Composite
- BYSEX: Sex-composite
- BYSES2: Socio-economic status composite, v.2
- Student's perceptions of School Safety
    - BYS20J: Does not feel safe at this school
    - BYS20M: There are gangs in school
    - BYS20N: Racial/ethnic groups often fight

Teacher-Factors:

(a) Teaching practice: The frequency of various instructional activities in mathematics

These items were collected from the students' reported questionnaire.

- BYS29A: How often reviews work in math class
- BYS29C: How often copies math teacher's notes from board
- BYS29E: How often does problem-solving in math class
- BYS29I: How often explains work to math class orally
- BYS29J: How often participates in student math discussions

(b) Teaching Experience

- BYTM26C: Total years teaching /K-12 (math): Teacher Questionnaire (Math)

(c) Teacher's Degree (Categorical) was computed using the following items that were coded 0 = No/1 = Yes.

  - BYTM30A: Mathematics teacher - No academic degree held
  - BYTM30B: Mathematics teacher - Associate degree held
  - BYTM30C: Mathematics teacher - Bachelor's degree held
  - BYTM30D: Mathematics teacher - Education specialist degree held/professional diploma
  - BYTM30E: Mathematics teacher - Master's degree held
  - BYTM30F: Mathematics teacher - Doctorate degree held
  - BYTM30G: Mathematics teacher - First professional degree held

Departmental-Variables:

(a) Department Size

- BYA23A: # of full-time math teachers: Administrator Questionnaire

(b) Collective Responsibility for Learning: Teachers' internalized responsibility for students' learning.

These items were collected from the mathematics teachers' reported questionnaire, and will be aggregated to the department after deleting similar response patterns within schools.

- BYTM44A: Importance of home background to student success (math)
- BYTM44B: Importance of intellectual ability to student success (math)
- BYTM44C: Importance of students' enthusiasm to student success (math) ®
- BYTM44D: Importance of teacher's attention to student success (math) ®
- BYTM44E: Importance of teaching method to student success (math) ®
- BYTM44F: Importance of teacher's enthusiasm to student success (math) ®
- BYTM45A: People can learn to be good at math (math) ®
- BYTM45B: People must be born with math ability (math)

Note: ® defines reverse coded items.

(c) Variability in Collective Responsibility for Learning: The degree to which teachers in the same department shared these attitudes

- *Standard deviation of the factor described above, computed within each department.*

School-Variables:

(a) Principal's Influence: Principal's influence over different aspects of running a high school

These items were collected from the administrators' reported questionnaire, and these items were only answered by principals

- BYA46A: Principal's influence on hiring/firing teachers
- BYA46B: Principal's influence on grouping students
- BYA46C: Principal's influence on course offerings
- BYA46D: Principal's influence on instructional materials
- BYA46E: Principal's influence on curricular guidelines
- BYA46F: Principal's influence on grading and evaluation
- BYA46G: Principal's influence on discipline policies
- BYA46H: Principal's influence on school funds

(b) Principal's Perceptions of School Safety:

- BYA49D: How often physical conflict a problem at school
- BYA49E: How often robbery/theft a problem at school
- BYA49F: How often vandalism a problem at school
- BYA49K: How often possession of weapons a problem at school
- BYA49L: How often physical abuse of teachers a problem at school
- BYA49M: How often racial tension among students a problem at school
- BYA49N: How often student bullying a problem at school
- BYA49O: How often verbal abuse of teachers a problem at school
- BYA49R: How often gang activity a problem at school

(c) School Level Segregation

- A computation of the percentage of Black students in the sample at the school level

Non-Data Analysis Sample Descriptive Variables

Student:

- BYSEX: Sex-composite

Teacher:

- BYMRACE: Math teacher's race/ethnicity-composite
- BYTM22: Teacher's sex (math): Teacher Questionnaire (Math)

School:

- BYSCTRL: School control (Public, Catholic, Other Private): Composite
- BYURBAN: School urbanicity (Urban, Suburban, Rural): Composite
- BYREGION: Geographic region of school (Northeast, Midwest, South, West): Composite
- BY10FLP: Grade 10 percent free lunch-categorical: Composite

APPENDIX B

RATING SCALE MODEL

In this study, item level data is available for five of the factors, so I used Item Response Theory (IRT) techniques to analyze the data and construct variables for these factors using all students within the full ELS dataset sample. Item Response Theory is based on developing a separate model for each item. This type of analysis expresses the probability of observing each response option as a function of the respondent's latent trait level (Embretson & Reise, 2000). The IRT technique that was utilized is the rating scale model (RSM) with polytomous items (having three or more score levels).

Rating Scale Model

The RSM is a Rasch model for polytomous items. The RSM was used because it assumes all items to be equally discriminating, and only needs the raw scale score for estimating participants' trait levels. The RSM also assumes that a fixed set of response categories are used for the entire item set, and each item is described by a single scale location parameter, λ_i, on the latent scale which reflects the relative difficulty of the particular item. The δ_{ij} intersection parameters can be considered as step difficulties associated with the transition from one category to the next, and there are m_i step difficulties (intersections) for an item with $m_i + 1$ response categories (scored $x = 0,\ldots, m_i$). The step difficulties are decomposed into two components, λ_i and δ_j, where $\delta_{ij} = \lambda_i + \delta_j$. The δ_j are the category intersection parameters that are considered equal across items, and an item's location is described by only a single λ_i parameter.

$$P_x(\theta) = \frac{exp\{\sum_{j=0}^{x}[\theta - (\lambda_i + \delta_j)]\}}{\sum_{x=0}^{M} exp\{\sum_{j=0}^{x}[\theta - (\lambda_i + \delta_j)]\}}$$

where $\sum_{j=0}^{0}\left[\theta - \left(\lambda_i + \delta_j\right)\right] = 0$ and θ corresponds to the ability of the respondent (Embretson & Reise, 2000). The five factors that the polytomous IRT model will be used to construct are authentic practices, collective responsibility for learning, principal influence, principals' perceptions of school safety, and students' perceptions of school safety.

Results

According to Lubienski (2006), when designing a survey and developing item clusters, Cronbach's alphas need to be between .7 and .9. In this study, lower values of Cronbach's alpha were considered acceptable because the goal of this study was not to design a new survey, but to create composites of existing survey items that capture various aspects of our construct. Hence the Cronbach's alphas that were considered acceptable for the constructed composite variables in this study are: Teaching practice (.60), Collective Responsibility for Learning (.66), Principal Influence (.80), Principals' Perceptions of School Safety (.83), and Students' Perceptions of School Safety (.77).

Table B1

Rasch Rating Scale Model Results for the Complete Sample

	M	SD	Min	Max
Teaching practice				
Raw Score[a]	16.10	4.20	1.00	25.00
Measure[a]	4.90	0.30	1.00	5.00
Infit: Mean Square[b]	1.01	0.15	0.85	1.26
Outfit: Mean Square[b]	1.07	0.16	0.88	1.34
Collective Responsibility for Learning				

Raw Score[a]	23.30	2.50	2.0	31.0
Measure[a]	1.54	1.06	-2.61	7.80
Infit: Mean Square[b]	1.00	0.16	0.77	1.29
Outfit: Mean Square[b]	1.02	0.17	0.76	1.35
Principal Influence				
Raw Score[a]	20.60	2.60	12.00	24.00
Measure[a]	3.46	2.14	-2.78	6.87
Infit: Mean Square[b]	0.99	0.15	0.86	1.36
Outfit: Mean Square[b]	1.10	0.37	0.83	1.77
Principals' Perceptions of School Safety				
Raw Score[a]	9.1	2.1	1.00	12.00
Measure[a]	1.68	2.17	-4.54	5.17
Infit: Mean Square[b]	0.99	0.11	0.90	1.14
Outfit: Mean Square[b]	1.00	0.12	0.90	1.17
Students' Perceptions of School Safety				
Raw Score[a]	36.50	3.80	17.00	45.00
Measure[a]	3.13	1.79	-2.56	9.66
Infit: Mean Square[b]	1.05	0.24	0.73	1.53
Outfit: Mean Square[b]	1.00	0.30	0.64	1.60

[a]Extreme and Non-Extreme (Persons)
[b]Non-Extreme (Items)

The person raw score correlates with the measure computed by the Rasch rating scale is as follows: Teaching practice (.93); Collective Responsibility for Learning (.83);

Principal Influence (.97); Principals' perceptions of School Safety (.91); and Students' Perceptions of School Safety (.94). When the infit and outfit mean square is approximately 1.0, then the items demonstrate a good fit (Linacre, 2008). The infit and outfit mean square is the chi-square statistic divided by its degree of freedom. Values higher than one indicate a poor fit, while values less than one indicate that the model predicts the data too well and may cause summary statistics to report inflated statistics. Table 1 shows that that fit statistics for all five variables are within acceptable ranges.

APPENDIX C

COMPLETE MULTILEVEL MODEL TABLE

Table C1

Complete Results of Mathematics Achievement Multilevel Model

Fixed Effects	Parameter	Model A	Model B	Model C	Model D
Intercept, β_{0j}					
Intercept	γ_{00}	44.71^{***}	45.21^{***}	45.67^{***}	45.57^{***}
		0.504	0.575	0.550	0.594
Size	γ_{01}			0.06	0.07
				0.038	0.041
CRL	γ_{02}			-0.11	-0.02
				0.356	0.396
Variability	γ_{03}			-0.30	-0.32
				0.451	0.503
Principal	γ_{04}			0.13	0.13
				0.090	0.087
P-safety	γ_{05}			-0.11	-0.10
				0.113	0.121
Segregation	γ_{06}			0.01	0.01
				0.008	0.007
School Prior Math	γ_{07}			0.87^{***}	0.88^{***}
				0.045	0.045

School SES	γ_{08}		1.23^{**}	1.21^{**}
			0.417	0.414
School S-safety	γ_{09}		0.22	0.25
			0.224	0.235
School Practices	γ_{010}		-0.08	-0.14
			0.321	0.323
School Experience	γ_{011}		0.03	0.03
			0.021	0.021
School Degree	γ_{012}		0.51	0.51^{*}
			0.231	0.230
Prior Math, β_{1j}				
Intercept	γ_{10}	0.87^{***}	0.85^{***}	0.89^{***}
		0.028	0.030	0.088
Size	γ_{11}			0.01
				0.005
CRL	γ_{12}			-0.08
				0.047
Variability	γ_{13}			-0.04
				0.058
Principal	γ_{14}			-0.01
				0.012
P-safety	γ_{15}			0.01
				0.016

Segregation	γ_{16}			-0.00**
				0.001
School S-safety	γ_{17}			-0.00
				0.020
Gender, β_{2j}				
Intercept	γ_{20}	-0.27	-0.10	-0.11
		0.300	0.277	0.274
SES, β_{3j}				
Intercept	γ_{30}	0.68*	0.76*	0.91**
		0.313	0.322	0.286
S-safety, β_{4j}				
Intercept	γ_{40}	0.01	0.00	0.00
		0.102	0.095	0.093
Practices, β_{5j}				
Intercept	γ_{50}	0.15	0.03	-0.89
		0.313	0.318	0.966
Size	γ_{51}			0.11
				0.056
CRL	γ_{52}			0.78
				0.733
Variability	γ_{53}			-0.42
				0.588
Principal	γ_{54}			0.02

				0.164
P-safety	γ_{55}			-0.07 0.198
Segregation	γ_{56}			0.02 0.013
School S-safety	γ_{57}			0.68^{*} 0.306
Experience, β_{6j}				
Intercept	γ_{60}	0.02 0.017	0.03 0.017	0.02 0.018
Degree, β_{7j}				
Intercept	γ_{70}	-0.24 0.203	-0.17 0.182	-0.21 0.184
Gender x Prior Math, β_{8j}				
Intercept	γ_{80}	0.04 0.060	0.09 0.062	0.07 0.158
Size	γ_{81}			-0.00 0.013
CRL	γ_{82}			-0.03 0.143
Variability	γ_{83}			-0.03 0.123

Principal	γ_{84}				-0.02
					0.033
P-safety	γ_{85}				-0.01
					0.041
Segregation	γ_{86}				0.00
					0.003
School S-safety	γ_{87}				0.18**
					0.057
SES x Practices, β_{9j}					
Intercept	γ_{90}		-0.08	-0.24	-0.28
			0.305	0.322	0.333
Gender x SES, β_{10j}					
Intercept	γ_{100}		1.41*	0.86	0.73
			0.540	0.479	0.504
Variance Components					
Level – 1	σ^2	46.7140***	10.3080***	10.0108***	9.9147***
		2.639	0.718	0.649	0.628
Level – 2	τ_{00}	17.8111***	38.5304***	1.9965***	1.8948***
		3.161	3.681	0.491	0.471
Level – 2	τ_{11}		0.0129***	0.0079***	0.0026***
			0.007	0.006	0.005
Level – 2	τ_{55}		2.4776***	3.3402***	2.5604***
			0.826	0.945	0.787

Level – 2	τ_{88}		0.0191**	0.0461**	0.0246***
			0.027	0.031	0.025
Level - 2	τ_{01}		0.5656	0.0461	0.0364
			0.144	0.042	0.037
Level - 2	τ_{05}		2.2153	2.2153	1.7982
			1.543	0.523	0.475
Level - 2	τ_{15}		-0.0214	-0.0214	-0.0012
			0.056	0.058	0.047
Level - 2	τ_{08}		0.2711	0.2711	-0.1539
			0.322	0.093	0.083
Level - 2	τ_{18}		-0.0046	-0.0046	-0.0075
			0.010	0.010	0.007
Level - 2	τ_{58}		0.1436	0.1436	-0.0501
			0.120	0.132	0.109
Model Fit					
Deviance		6068.815	5270.135	4735.864	4690.856
# parameters		3	22	34	55
AIC		6074.815	5314.135	4803.864	4800.856
BIC		6085.709	5287.029	4752.758	4707.750

$^{***}p < .001$, $^{**}p < .01$, $^{*}p < .05$.

APPENDIX D

GRADE POINT AVERAGE STUDY

The purpose of this study was to investigate the characteristics of high-school mathematics programs and how those characteristics are related to high school grade point average (GPA). I examined how student, teacher, department and school factors facilitate high GPAs for Black students. The student factors that I used as predictors of high school grade point average were: (a) 10th grade mathematics achievement, (b) gender, (c) socioeconomic status, and (d) students' perceptions of school safety. Teacher factors were: (a) teaching practice, (b) number of years of teaching mathematics (i.e., experience), and (c) teacher's highest degree level. The department characteristics were: (a) department size, and (b) teachers' collective responsibility for learning. The school factors were: (a) principal influence, (b) principal perceptions of school safety, and (c) school segregation.

This study aims to describe the characteristics of high schools that are related to high-school GPA for Black students because high school GPA opens the door to postsecondary education and improved future options. In particular, high-school GPA was found to be a stronger predictor than SAT scores of first-year-college GPAs for Black students (Zwick & Sklar, 2005). According to the National Center for Education Statistics (NCES, 2009), the overall GPA for American high-school graduates increased from 2.68 in 1990 to 3.00 in 2009; however the overall GPA did not increase from 2005 to 2009. NCES states that female graduates continued to earn higher GPAs than male graduates. For example in 2009, females had a GPA of 3.10 while males had a GPA of

2.90. In addition, Black female students have higher GPAs than Black male students in high school (Mickelson & Greene, 2006; Williams, Davis, Cribbs, Saunders, & Williams, 2002). According to the NCES (2009) results, although the average GPA has increased for all racial/ethnic groups from 1990 to 2009, Black and Hispanic graduates had no change in GPA from 2005 to 2009, while Asian/Pacific Islander and White graduates GPA increased from 2005 to 2009. There is a need to improve high school GPAs for Black graduates because high school GPA is a predictor of college admission and completion.

Williams et al. (2002) examined the relationship between a number of contextual factors for 9th grade African American students and academic performance in an urban setting. They found that boys and girls differ greatly in their GPA; girls generally have higher GPA scores than boys (Mickelson & Greene, 2006). Mickelson and Greene also found that female test scores (hence GPA) are more likely to be influenced by family socioeconomic status than male students.

Methodology

Research Questions

1. How does grade point average in 12th grade for Black high school students vary, both across and within schools?
2. How do student factors, teacher factors, and student-level interaction terms impact Black students' overall grade point average in high school?
3. How do department factors, school factors, and cross-level interaction terms impact Black students' overall grade point average in high school?

Dependent Variable

The dependent variable, grade point average, measures Black students' GPA for all courses taken in the 9th - 12th grades. This variable was coded by ELS as 0 = 0.00-1.00; 1 = 1.01-1.50; 2 = 1.51-2.00; 3 = 2.01-2.50; 4 = 2.51-3.00; 5 = 3.01-3.50; and 6 = 3.51-4.00. The mean GPA for students in the sample was 3.33 (SD = 1.37), and the range of the scores was 0 to 6.

Data Analysis

The multilevel analysis for grade point average was performed where students were nested within schools. The student level consists of the student and teacher factors while the school level consists of the department and school factors. Three models were imposed: the unconditional means model, the student level (within-school) model, and the school level (intercepts as outcomes) model. The equation below provides an uncombined equation representing the final full model for GPA.

Student level model:

$$\begin{aligned} GPA_{ij} = \beta_{0j} &+ \beta_{1j}\left(Prior\ Math_{ij} - \overline{Prior\ Math_{.j}}\right) + \beta_{2j}\left(Gender_{ij}\right) \\ &+ \beta_{3j}\left(SES_{ij} - \overline{SES_{.j}}\right) + \beta_{4j}\left(S - safety_{ij} - \overline{S - safety_{.j}}\right) \\ &+ \beta_{5j}\left(Practices_{ij} - \overline{Practices_{.j}}\right) \\ &+ \beta_{6j}\left(Experience_{ij} - \overline{Experience_{.j}}\right) + \beta_{7j}\left(Degree_{ij} - \overline{Degree_{.j}}\right) \\ &+ \beta_{8j}\left(Gender\ x\ Prior\ Math_{ij}\right) + \beta_{9j}\left(SES\ x\ Instruction_{ij}\right) \\ &+ \beta_{10j}\left(Gender\ x\ SES_{ij}\right) + r_{ij} \end{aligned}$$

School level model:

$$\beta_{0j} = \gamma_{00} + \gamma_{01}(Size_j) + \gamma_{02}(CRL_j - \overline{CRL_{..}}) + \gamma_{03}(Variability_j)$$

$$+ \gamma_{04}(Principal_j - \overline{Pincipal_{..}}) + \gamma_{05}(P\_Safety_j - \overline{P\_Safety_{..}})$$

$$+ \gamma_{06}(Segregation_j - \overline{Segregation_{..}}) + \gamma_{07}(School\ Prior\ Math_{ij}$$

$$- \overline{School\ Prior\ Math_{..}}) + \gamma_{08}(School\ SES_{ij} - \overline{School\ SES_{..}})$$

$$+ \gamma_{09}(School\ S\_Safety_j - \overline{School\ S\_Safety_{..}})$$

$$+ \gamma_{010}(School\ Instruction_{ij} - \overline{School\ Practices_{..}})$$

$$+ \gamma_{011}(School\ Experience_{ij} - \overline{School\ Experience_{..}})$$

$$+ \gamma_{012}(School\ Degree_{ij} - \overline{School\ Degree_{..}}) + u_{0j}$$

$$\beta_{1j} = \gamma_{10}$$

$$\beta_{2j} = \gamma_{20}$$

$$\beta_{3j} = \gamma_{30}$$

$$\beta_{4j} = \gamma_{40}$$

$$\beta_{5j} = \gamma_{50}$$

$$\beta_{6j} = \gamma_{60}$$

$$\beta_{7j} = \gamma_{70}$$

$$\beta_{8j} = \gamma_{80}$$

$$\beta_{9j} = \gamma_{90}$$

$$\beta_{10j} = \gamma_{100}$$

The assumptions of the multilevel model (homogeneity of level 1 variance, and normality at level 2) were tested. The homogeneity of the level 1 variance was tested in the HLM software and was not significant, high school GPA: $\chi^2(149) = 80.39$, $p > .500$, hence we assume homogeneity. The normality at level 2 was tested by doing a scatter plot of CHIPCT against MDIST (variables in the residual file), and the line was examined to be at a 45 degree angle, hence normality.

Results

Model A: Unconditional Means Model

Results from the unconditional model (Model A) are displayed in table D1. The level 1 variance (σ^2) for the unconditional model was 1.50, and the level 2 variance (τ_{00}) was 0.24. The intraclass correlation coefficient (ICC) was computed as .138, that is, 13.8% of variance in Black students' high school GPA was due to between-school differences, whereas 86.2% of the variance in Black students' high school GPA was due to within-school differences. The variance of the intercept (u_{0j}) was statistically significant ($\chi^2[278] = 419.38$, $p < .001$), that is a significant amount of variance in Black students' high school GPA is between schools. The grand mean for Black students' high school GPA across schools and students, β_{00}, was equal to 3.45 and was statistically significant, which means that the mean Black students' high-school GPA across schools and students was different from zero.

TABLE D1

Results of Grade Point Average Multilevel Model

Fixed Effects	Parameter	Model A	Model B	Model C
Intercept, β_{0j}				
Intercept	γ_{00}	3.45^{***} 0.078	3.08^{***} 0.093	3.59^{***} 0.270

Size	γ_{01}	-0.04*
		0.018
CRL	γ_{02}	0.02
		0.192
Variability	γ_{03}	-0.11
		0.145
Principal	γ_{04}	-0.01
		0.032
P-safety	γ_{05}	0.05
		0.052
Segregation	γ_{06}	0.00
		0.002
School Prior Math	γ_{07}	0.04**
		0.014
School SES	γ_{08}	0.53**
		0.168
School S-safety	γ_{09}	-0.03
		0.088
School Practices	γ_{010}	-0.03
		0.143
School Experience	γ_{011}	0.00
		0.008
School Degree	γ_{012}	-0.01

			0.074
Prior Math, β_{1j}			
Intercept	γ_{10}	0.08^{***}	0.08^{***}
		0.008	0.008
Gender, β_{2j}			
Intercept	γ_{20}	0.68^{***}	0.69^{***}
		0.099	0.093
SES, β_{3j}			
Intercept	γ_{30}	0.27^{**}	0.27^{**}
		0.102	0.102
S-safety, β_{4j}			
Intercept	γ_{40}	0.00	0.00
		0.036	0.036
Practices, β_{5j}			
Intercept	γ_{50}	0.10	0.10
		0.062	0.061
Experience, β_{6j}			
Intercept	γ_{60}	0.01	0.01
		0.007	0.008
Degree, β_{7j}			
Intercept	γ_{70}	-0.03	-0.04
		0.060	0.060
Gender x Prior Math, β_{8j}			

Intercept	γ_{80}		0.04* 0.015	0.03 0.015
SES x Practices, β_{9j}				
Intercept	γ_{90}		0.01 0.121	0.00 0.113
Gender x SES, β_{10j}				
Intercept	γ_{100}		0.25 0.230	0.23 0.223
Variance Components				
Level – 1 (student-level)	σ^2	1.5005*** 0.0860	1.0635*** 0.062	1.0414*** 0.060
Level – 2 (intercept)	τ_{00}	0.2444*** 0.069	0.3965*** 0.074	0.2319*** 0.055
Model Fit				
Deviance		2754.257	2554.902	2481.900
# parameters		3	13	25
AIC		2760.257	2580.902	2531.900
BIC		2771.298	2571.943	2498.941

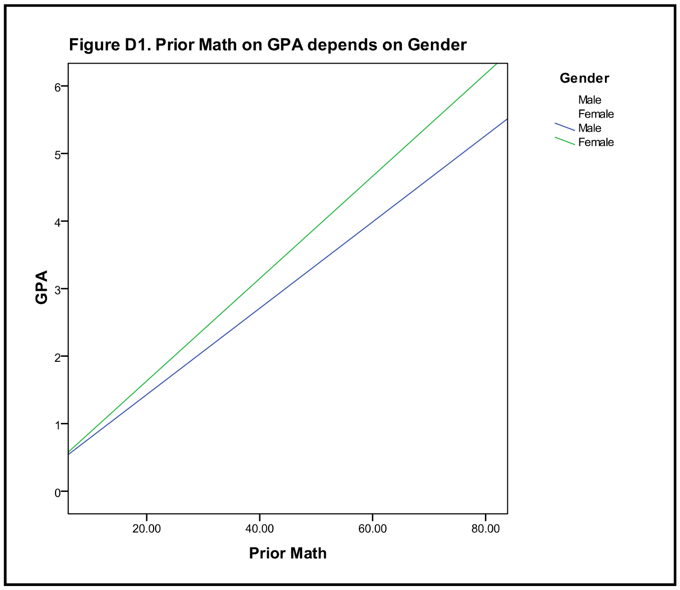
*** $p < .001$, ** $p < .01$, * $p < .05$.

Model B: Student Level (Within-School) Model

After examining the unconditional model, the student-level variables (i.e., student and teacher factors) were entered into the model. The random effect of the intercept was the only variance included in the model, which suggests that there is variability across school in Black male students' mean high-school GPA. The results of the final student level model are presented in table D1 (Model B). The student factors (10^{th} grade mathematics achievement, gender, SES, and students' perceptions of school safety) combined to account for 27.2% of the student-level variation in high school GPA. The teacher factors (teaching practices, teaching experience, teacher's highest degree) combined to account for 1.1% of the student-level variation in high school GPA. The interaction terms (gender x prior math, SES x practices, and gender x SES) combined to account for 1.5% of the student-level variation in high school GPA. When the student level variables were included in the model, in addition to the findings of model A, I found that 10^{th} mathematics achievement, gender, SES, and the interaction of gender and 10^{th} mathematics achievement were significant predictors of high school GPA for Black students, that is, these predictors explain statistically significant amounts of within-school variability in high-school GPA.

High-achieving Black students on 10^{th} grade mathematics have better GPAs than low-achieving Black students ($\gamma = 0.08$). The effect size of 10^{th} grade mathematics achievement is 0.18 which is considered to be large. Black females have better GPAs than Black males ($\gamma = 0.68$). The effect size of gender is 0.11 which is considered to be medium. Black students with higher social class backgrounds have better GPAs than Black students with a lower social class backgrounds ($\gamma = 0.27$). The effect size of SES is 0.03 which is considered to be small. Figure D1 illustrate that the gender by 10^{th} grade mathematics achievement interaction reveals that lower achieving Black female students perform similar to lower achieving Black male students on twelfth grade mathematics achievement, and higher achieving Black female students do better than higher achieving

Black male students on twelfth grade mathematics achievement ($\gamma = 0.04$). The effect size of the interaction between gender and 10th grade mathematics achievement is 0.01 which is considered to be small.



Model C: School Level (Intercepts as Outcomes) Model

The school level variables (department and school factors) and the aggregated mean of the group centered student level variables were imposed only on the intercept of the student level model. The department factors (size, collective responsibility for learning, and variability in collective responsibility for learning) combined to account for 3.8% of the school level variation in high-school GPA, and the school factors (principal influence, principal perceptions of school safety, and school segregation) combined to account for 13.8% of the school-level variation in high school GPA.

Model C had three significant findings over Model B: department size, school-level 10th grade mathematics achievement and school-level SES. All of these variables were statistically significant predictors of Black male students' mean GPA in a given school; that is, these variables explain statistically significant between-school variability in the intercept. Black male students in smaller departments (and hence, smaller schools) have better mean GPAs than Black male students in larger departments (γ = -0.04). The effect size of department size is 0.05 which is considered to be small. Black male students in high achieving schools have better mean GPA than Black male students in low-achieving schools (γ = 0.04). The effect size of the school's 10^{th} grade mathematics achievement is 0.11 which is considered to be medium. Black male students in high-SES schools have better mean GPA than Black male students in low SES schools (γ = 0.53). The effect size of the school's SES is 0.10 which is considered to be medium.

Conclusion

Mickelson and Greene (2006) have argued that girls generally have higher GPA scores than boys (Williams et al., 2002). This research supports the contention that females have better GPA scores than males. Also, there is no gender difference between low achieving Black students, while higher achieving female students have higher GPAs than higher achieving male students. The present study also shows that higher mathematics achieving Black students have higher GPAs than lower mathematics achieving Black students. Also, Black students with higher social class backgrounds have higher GPA than Black students with lower social class background. However, I am interested in those malleable school factors that predict high school GPA for Black students.

Initial Outlines of an Ideal High School for Black Students

The ideal high schools for Black students are schools with small departments, higher proportion of high SES Black students, and a high percent of Black students doing well in 10^{th} grade mathematics. Previous researchers have also found that students achieve higher in small schools than in large schools (Darling-Hammond, Rose, & Milliken, 2007; Stewart, 2009; Lee & Smith, 2001). The present research supports this finding, in that it found Black male students have higher GPAs in smaller departments than larger departments. The present study also found that school-level SES and school-level 10^{th} grade mathematics achievement make a difference in students' high school GPA scores. These finding are evident in the results of my study that indicate schools that have high percentage of Black male students with higher SES have higher GPA scores, and schools that have high percentage of Black male students with higher 10^{th} grade mathematics achievement have higher GPA scores.

APPENDIX E

CURRICULUM TRACK STUDY

The purpose of this study was to investigate the characteristics of high-school mathematics programs and how those characteristics are related to completion of an academic or an occupational track. I examined how school factors (10^{th} grade mathematics achievement, SES, percent female, collective sense of school safety, and segregation) facilitate completion of an academic or an occupational track for Black students as compared to non-Black students.

In the first half of the twentieth century, public high schools used to track students based on the students' past academic performance and their future occupational plans (Lee & Ready, 2009). Towards the middle of the century, students could choose their courses which varied in content and academic rigor (Lee & Ready, 2009). Regardless of the availability of these new-found choices, minority and low-income students completed college preparatory courses less often than other students (Lee & Ready, 2009). During the 1990s, significantly more students in the upper third of the income distribution completed geometry and trigonometry than low-income students; hence the public high schools were internally segregated and stratified by students' social class. According to Lee and Ready (2009), students taking these higher level classes showed higher achievement gains even after controlling for student social and academic background. Students in poverty graduate from high school in low frequency and of those who do graduate, many are lacking the basic skills needed for college and the present-day labor force (Lee & Ready, 2009); that is, these students were not offered advanced courses in high school (e.g., algebra, trigonometry and calculus) that are needed for college success and the growing technology-based labor force.

According to Gamoran, Porter, Smithson, and White (1997), students in high schools who follow a college-preparatory curriculum learn more regardless of level of prior mathematics skills when placed in these classes; that is, all students benefit from taking algebra in high school (Gamoran & Hannigan, 2000). Tracking sustains and facilitates social and educational inequality by providing students in lower tracks with a substandard education that never provides the opportunity to learn advanced math (Oakes, 2005). A high number of African American students are disproportionately placed in low tracks in high schools (Archbald, Glutting, & Qian, 2009), while their middle to upper-class White and Asian counterparts are placed in more rigorous college-bound courses (Mickelson, 2001). Black students who are placed in low tracks have limits placed on their upward social and economic mobility, whereas Black students who are placed in college preparatory tracks achieve more bachelor's degrees than students in any other track (Fletcher & Zirkle, 2009). Having a strong curricular preparation with advanced-mathematics coursework is important for students who plan on entering STEM fields (Heckel, 1996).

This study builds upon previous research on curriculum tracking that used raw scores to represent Black and non-Black students' curriculum track placement to investigate the rate of representation of Black students as compared to non-Black students in curriculum tracks in high school (Archbald, Glutting, & Qian, 2009; Mickelson, 2001). This study uses ratios instead of raw scores for track placement because I am interested in the predictors of Black students' over- or under-representation in curriculum tracks.

Ratios provide a better indicator of Black students' representation in curriculum tracks when dealing with schools that are segregated to different degrees. What is more, the level and the type of courses students take in high school form a set of predictors of success after high school.

Furthermore, tracking practices have disproportionately placed Black students into lower and/or more occupational tracks; as a result, Black students' postsecondary educational attainment and careers have been limited. However, as a result of No Child Left Behind (NCLB, 2001) legislation and similar state-level policy initiatives, high schools have been experiencing accountability measures that focus on student achievement and graduation; and hence, indirectly on student track placement. With the importance being placed on the results of standardized testing and with the need for schools to maximize students' performance, schools are being forced to reduce the stratification of course taking; in turn, this reduction in tracking is affording to Black students' increased opportunities to take high- level college preparatory courses (Kelly, 2009).

Archbald, Glutting, and Qian (2009) examined students moving from 8^{th} to 9^{th} grade in two middle schools and two high schools. They found that grades and test scores strongly predict track placement decisions. Also students from low SES backgrounds have a higher chance of being enrolled in low-level mathematics courses (Kelly, 2009). Additionally, Black students have a higher probability of being placed in upper tracks if they attend schools with higher percentage of Black students (Lucas & Gamoran, 2002). Kelly (2009) analyzed the National Education Longitudinal Study of 1988 with 8^{th}, 9^{th}, and 10^{th} grade students and found that students have a better chance of being enrolled in higher level mathematics courses if they attend predominantly Black school. However, Gamoran and Hannigan (2000) found that all high school students benefit from taking algebra and that students benefit no less from algebra when their schools have a more diverse group of students taking algebra compared to schools with a more homogeneous population. The socioeconomic diversity in a school helps explain the school-to-school differences in track placement (Kelly, 2004).

Methodology

Research Questions

1. What is the impact of school level 10th grade mathematics achievement, percentage of females, SES, collective sense of safety, and segregation have on the Black to non-Black students' academic track placement?
2. What is the impact of school level 10th grade mathematics achievement, percentage of females, SES, collective sense of safety, and segregation have on the Black to non-Black students' occupational track placement?

Variables

This study looks at the school level characteristics that predict the ratio of Blacks to non-Blacks students' representation in the academic and in the occupational tracks. The variables in this analysis were taken from student questionnaires and transcript records from the publicly available ELS database. All variables with the exception of the dependent variables were measured in the students' 10th grade year in the school year 2001-2002. Students in this study could be tied to their respective schools; hence an aggregation of the student factors to the school level was completed. The two dependent variables in the analysis were computed using all 15,362 students across 752 schools, but only the 432 schools with Blacks students were used in the data analysis. However, the independent variables were computed using only the Black students sample within the 432 schools.

Dependent variables. The first dependent variable, representation in academic track (RIAT), is define as the percentage of Black students in an academic track divided by the percentage of non-Black students in an academic track in the 12^{th} Grade. The second dependent variable, representation in occupational track (RIOT), is defined as the percentage of Black students in an occupational track divided by the percentage of non-Black students in an occupational track in the 12^{th} Grade. A value of one (or very close to one) for RIAT/RIOT means Black students is similarly represented in the curriculum track as compare to non-Black students. When these variables have values less than one it means that Black students in the respective curriculum track are underrepresented compared to non-Blacks, and when these variables' values are greater than one it means that Black students in the respective curriculum track are overrepresented compared to non-Blacks.

Independent variables. The first independent variable, school-level 10th grade mathematics achievement is an aggregation (mean) of the student 10th grade mathematics achievement for Black students. The second independent variable, the percentage of Black females within the school is an aggregation (percent) of the variable gender. The third independent variable, school-level socio-economic status is an aggregation (mean) of the student level socio-economic status for Black students. The fourth independent variable, school-level students' perceptions of school safety is an aggregation (mean) of the students' perceptions of school safety for Black students. The final independent variable is school-level segregation which is defined as the percentage of Black students within the school.

Descriptive Statistics

The descriptive statistics and abbreviations for the variables in the study are displayed in table E1. The mean, standard deviation, and range are given for all the school level variables. The number of valid cases for each variable is also given in the table. After adjusting for missing data (list wise deletion), the sample size for the school level variables for the analysis of representation in academic track was 330 schools, and for the analysis of representation in occupational track was 250 schools. On average the ratio of representation in academic tracks for Blacks compared to non-Blacks is lower than the rate of representation in occupational tracks for Blacks compared to non-Blacks, that is, representation in academic tracks variable range from 0 to 18 with a mean of 0.65 (SD = 1.48), while representation in occupational tracks variable range from 0 to 16 with a mean of 0.77 (SD = 1.76).

TABLE E1

Descriptive Statistics (School Level)

Variable	Abbreviation	N	Range of Values	M	SD
Representation in Academic Track	RIAT	330	0 – 18	0.65	1.48
Representation in Occupational Track	RIOT	250	0 – 16	0.77	1.76
10^{th} grade Mathematics Achievement	Prior Math	432	22.3 – 69.4	46.41	7.23
Percent of Females	Female	432	0 – 100	49.79	37.77
Socio-Economic Status	SES	432	-1.7 – 1.7	-0.05	0.56
Students' Perceptions of School Safety	S-safety	432	-2.2 – 5.2	1.43	1.30
School Segregation	Segregation	432	2 - 100	23.10	23.37

Recall that the ratio is an indicator of equality of representation: values of one (or near one) mean that Blacks and non-Blacks are relatively equally represented in the academic track; values less than one imply that Blacks are underrepresented, and values greater than one imply that Blacks are overrepresented. Table E2 shows the frequency and percentage of schools that have Black students underrepresented, equally represented, or overrepresented in the academic track as compared to non-Black students. Similar to previous research (Archbald, Glutting, & Qian, 2009), Black students are underrepresented in high tracks (i.e., academic tracks). That is, 58.6% of our nationally representative sample of Black schools has Black students underrepresented in the academic track. In contrast, only 17.4% of the schools have Black students overrepresented in the academic track. However, only 0.5% of the schools have Black students equally represented in the academic compare to non-Black students. That is, most Black students attend schools in which there is an unequal placement in an academic track.

TABLE E2

Frequency of RIAT Values for High Schools

	Frequency	Percent
Blacks Underrepresented	253	58.6
Blacks Equally represented	2	0.5
Blacks Overrepresented	75	17.4
Unknown	102	23.6
Total	432	100.0

Table E3 shows the frequency and percentage of schools that have Black students underrepresented, equally represented, or overrepresented in the occupational track as compared to non-Black students. Previous research indicates that Black students are generally overrepresented in low (i.e., occupational) tracks (Archbald, Glutting, & Qian, 2009). However, this research reports that 44.4% of our nationally representative sample of Black schools indicates that Black students are underrepresented in the occupational tracks. Only 12.7% of the schools have Black students overrepresented in the occupational track. However, only 0.7% of the schools have Black students equally represented in the occupational compared to non-Black students. Also 42.1% of the high-schools did not report data recording the levels of representation in an occupational track for Blacks or non-Blacks.

TABLE E3

Frequency of RIOT Values for High Schools

	Frequency	Percent
Blacks Underrepresented	192	44.4
Blacks Equally represented	3	0.7
Blacks Overrepresented	55	12.7
Unknown	182	42.1
Total	432	100.0

Data Analysis

Data analysis occurred in two steps, first order correlations and fixed effects linear regression. Two separate Ordinary Least Squares Fixed Effects Linear Regression analyses were conducted to examine the relations of five independent variables on Black/Non-Black students' ratio of 12th grade academic and occupational track. The data is a nationally representative sample, so I used the school level weights in the regression analysis. Also all independent variables were centered because they had no meaningful zero point except for gender. Four interaction terms were included in the data analysis because according to Mickelson (2001) low social class Blacks are disproportionately placed in low tracks in high schools. I was interested in examining the relationship between social class and the other variables in my data analysis. In each analysis, the R^2 for each model was reported; the R^2 provides the amount of variance that the independent variables combined to account for in the dependent variable.

Representation in academic track. A hierarchical regression analysis was conducted on representation in academic track (RIAT). The school level predictors (prior math , percent female, SES, S-safety, and segregation) were specified as predictors of RIAT in model 1, and four two-way interactions terms (prior math x SES; percent female x SES; S-safety x SES; and Segregation x SES) were also specified as predictors of RIAT in model 2 (Research Question 1).

Representation in occupational track. Similarly, a hierarchical regression analysis was conducted on representation in occupational track (RIOT). The school level predictors (prior math , percent female, SES, S-safety, and segregation) were specified as predictors of RIOT in model 1, and four two-way interactions terms (prior math x SES; percent female x SES; S-safety x SES; and Segregation x SES) were also specified as predictors of RIOT in model 2 (Research Question 2).

The assumptions of the regression analysis (linearity, independence, homoscedasticity, and normal distribution) were tested. The residuals were plotted against each independent variable, and no departure from linearity and homoscedasticity was found. The Normal Q-Q Plot of unstandardized residual was plotted and showed normality of the residuals.

Results

First Order Correlations

The intercorrelations of the regression analysis variables are displayed in table E4.

RIAT. Schools with higher 10th grade mathematics achievement exhibit a higher ratio of Black-students-represented to non-Black-students-represented in the academic track than do schools with lower 10th grade achievement. Integrated schools exhibit a higher ratio of Black-students-represented to non-Black-students-represented in the academic track than do segregated schools.

Tenth-grade mathematics. Schools exhibiting higher 10th grade mathematics achievement also exhibit (1) higher ratios of Black-student representation to non-Black student representation in school's academic tracks, (2) higher SES schools, safer schools, and less-segregated schools also exhibited higher-levels of mathematics achievement.

School SES. Higher SES schools correlate with lower percentages of Black females, higher school safety, and less-segregated schools.

Collective sense of safety. Higher-segregated schools correlate with less safety.

TABLE E4

Intercorrelations among Variables

	1	2	3	4	5	6	7
1. RIAT	1	-.103	.304**	.116*	.166**	.036	-.051
2. RIOT		1	-.044	-.126*	-.115	.101	.002
3. Prior Math			1	-.091	.440**	.312**	-.232**
4. Female				1	-.098*	.067	.080
5. School SES					1	.251**	-.244**
6. S-safety						1	-.131**
7. Segregation							1

** $p < .01$, * $p < .05$.

Fixed Effects Linear Regression Results

Findings – representation in academic track. The school level predictors 10th grade mathematics achievement, the percentage of Black females, SES, collective sense of safety, segregation, and the four interaction terms (i.e., Prior Math x SES, Female x SES, S-safety x SES, and Segregation x SES) combined to account for 13.5% of the variance in representation in academic track. The omnibus test was statistically significant, $R^2 = .135$, $F(9, 320) = 5.53$, $p < .001$.

TABLE E5

Results of Representation in Academic Track Regression Analysis

Coefficients	Model 1	Model 2
Constant	0.36**	0.35**
	0.121	0.127
School Prior Math	0.06***	0.05***
	0.012	0.012
Female	0.01**	0.01**
	0.002	0.002
School SES	0.26	-0.24
	0.135	0.223
School S-safety	-0.13*	-0.11
	0.064	0.066
Segregation	0.00	-0.00
	0.003	0.004
Interaction Terms		

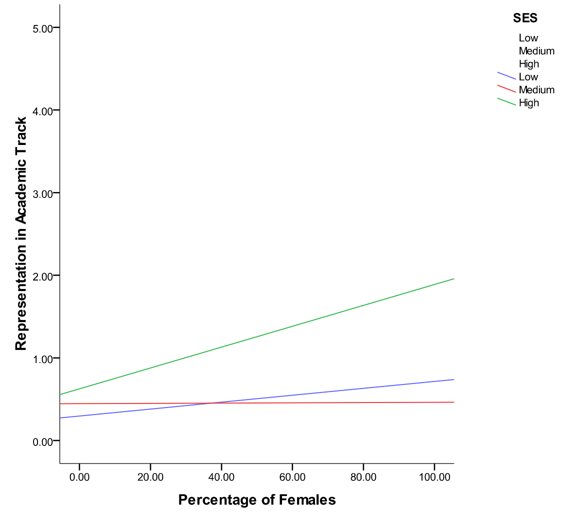
Segregation x SES	-0.01
	0.010
Prior Math x SES	0.02
	0.017
S-safety x SES	-0.09
	0.112
Female x SES	0.01^{**}
	0.003

$^{***}p < .001$, $^{**}p < .01$, $^{*}p < .05$.

The results of model 1 are that Black students in high achieving schools, or in schools where there are more Black females, or in schools where Black students report feeling collectively unsafe are schools in which Black students achieve higher levels of representation in academic tracks. The inclusion of the interaction terms removes safety as a predictor of track completion.

Model 2 results replicate the results of model 1, with the exception of safety and the inclusion of the interaction between female and SES. The interaction of female by SES indicates that higher-SES schools where also more females are in attendance do a better job of placing Black students in academic tracks. As shown in figure E1, only high-SES schools where 30% are females are equally represented of Black compared to non-Black students in the academic track.

Figure E1. Percent Female on RIAT depending on SES.



Findings – representation in occupational track. The school level predictors 10th grade mathematics achievement, the percentage of Black females, SES, collective sense of safety, and segregation combined to account for 10.1% of the variance in representation in occupational track. The omnibus test was statistically significant, R^2 = .101, $F(5, 244) = 5.46$, $p < .001$.The addition of the interaction terms results in an omnibus test that was not statistically significant, and the interaction terms were not statistically significant predictors of RIOT. Hence only model 1 was reported.

TABLE E6

Results of Representation in Occupational Track Regression Analysis

Coefficients	Model 1
Constant	1.14^{***}
	0.162
School Prior Math	-0.03
	0.016
Female	-0.01^{**}
	0.003
School SES	-0.29
	0.184
School S-safety	0.22^{*}
	0.087
Segregation	-0.00
	0.005

$^{***}p < .001$, $^{**}p < .01$, $^{*}p < .05$.

The results of model 1 are that Black students in schools where there are more Black males, or in schools where Black students report feeling collectively safe are schools in which Black students achieve higher levels of representation in occupational tracks, as shown in table E6.

Summary

The first research question examined the impact of school level 10th grade mathematics achievement, percentage of females, SES, collective sense of safety, and segregation on the Black to non-Black students' academic track placement. The school-level model for representation in academic track for the ratio of Black students to Non-Black students showed three key significant findings. Black students' collective sense of safety, Black students' 10^{th} grade mathematics achievement, and the interaction between percent of females and social class were significant predictors of Black to non-Black students' representation in academic track.

Finally, the second research question examined the impact of school level 10th grade mathematics achievement, percentage of females, SES, collective sense of safety, and segregation on the Black to non-Black students' occupational track placement. Also, the school-level model for representation in occupational track for the ratio of Black students to Non-Black students showed two significant findings. The percentage of Black male students' and Black students' collective sense of safety were significant predictors of Black to non-Black students' representation in occupational track.

Conclusion

Archbald, Glutting, and Qian (2009) found that grades and test scores strongly predict track placement decisions. Similarly, this study found that Black students' 10^{th} grade mathematics achievement is a significant predictor of Black students' representation in an academic track but not the occupational track. The present study also shows that as the percent of Black female students increases so does representation in an academic track but rate of increase depends on level of SES, however as the percent of Black male students increases so does representation in an occupational track.

Milam, Furr-Holden, and Leaf (2010) found that students' perceived sense of safety in school was related to their academic achievement. The present study finds that

Black students' collective sense of school safety has a negative effect on representation in an academic track but a positive effect on representation in an occupational track.

The results show that Black students' 10th grade mathematics achievement was a positive predictor of representation in an academic track but not representation in an occupational track. The result also shows that as the percent of Black female students increases so does representation in an academic track, however as the percent of Black male students increases so does representation in an occupational track. The results also show that Black students' collective sense of safety oppositely predicts representation in an academic track and representation in an occupational track; that is, as Black students collectively feel safer, then representation in an occupational track increases and representation in an academic track deceases.

According to previous research, schools that have a higher percentage of Black students have a higher probability of their Black students being placed in upper tracks (Kelly, 2009; Lucas & Gamoran, 2002). This study did not find any significant effect between segregation on the ratio of Black students' representation as compared to non-Black students' representation in the academic track nor the occupational track. This may have been because segregated Black schools have higher percentages of Black students, and hence a higher number of Black students in the academic track which would make it seem as a higher probability of being in an academic track if they attend segregated schools.

REFERENCES

Adam, C. R., & Singh, K. (1998). Direct and indirect effects of school learning variables on the academic achievement of Black 10th graders. *The Journal of Negro Education, 67*(1), 48-66.

Archbald, D., Glutting, J., & Qian, X. (2009). Getting into honors or not: An analysis of the relative influence of grades, test scores, and race on track placement in a comprehensive high school. *American Secondary Education, 37*(2), 65-81.

Barton, P. E., & Coley, R. J. (2010). *Policy Information Report: The Black-White achievement gap, when progress stopped.* Princeton, NJ: Educational Testing Service.

Berry, R. Q. (2008). Access to upper-level mathematics: The stories of successful African American middle school boys. *Journal for Research in Mathematics Education, 39*(5), 464-488.

Boaler, J. (2002). *Experiencing school mathematics: Traditional and reform approaches to teaching and their impact on student learning.* Mahwah, NJ: Lawrence Erlbaum Associates, Publishers.

Borg, M., Plumlee, J., & Stranahan, H. A. (2007). Plenty of Children Left Behind: High-Stakes Testing and Graduation Rates in Duval County, Florida. *Educational Policy*, 21(5), 695-716.

Borman, K. M., Elitle, T. M., Michael, D., Eitle, D. J., Lee, R., Johnson, L., Cobb-Robb, D., Dorn, S., & Shircliffe, B. (2005). Accountability in a postdesegregation era: The continuing significance of racial segregation in Florida's schools. *American Educational Research Journal, 41*, 605-631.

Bowen, N. K., & Bowen, G. L. (1999). Effects of crime and violence in neighborhoods and schools on the school behavior and performance of adolescents. *Journal of Adolescent Research, 14*, 319-342.

Boyd, D. J., Lankford, H., Loeb, S., Rockoff, J. E., & Wyckoff, J. H. (2007). *The narrowing gap in New York city teacher qualifications and its implications for student achievement in high-poverty schools. CALDER Working Paper 10.* Wahington, DC: The Urban Institute.

Braun, H. I., Wang, A., Jenkins, F., & Weinbaum, E. (2006). The Black-White achievement gap: Do state policies matter? *Education Policy Analysis Archives*, 14(8), 1-110.

Brewer, D. J. (1993). Principals and student outcomes: Evidence from U.S. high schools. *Economics of Education Review, 12*(4), 281-292.

Bronfenbrenner, U. (1977). Towards an experimental ecology of human development. *American Psychologist, 32*, 513-531.

Brown, S. (2004, August 19). *High school racial composition: Balancing excellence and equity*. Paper presented at the meeting of the American Sociological Association, Chicago, IL.

Bruce, A. M., Getch, Y. Q., Ziomek-Daigle, J. (2009). Closing the gap: A group counseling approach to improve test performance of African-American students. *Professional School Counseling, 12*(6), 450-457.

Carter, D. J. (2008). Cultivating a critical race consciousness for African American school success. *Educational Foundations*, 22(1-2), 11-28.

Cizek, G. J. (2001). More unintended consequences of high-stakes testing. *Educational Measurement: Issues and Practice,* 19-27.

Clewell, B. C., Campbell, P. B., & Perlman, L. (2007). *Good schools in poor neighborhoods: Defying demographics, achieving success.* Washington, DC: The Urban Institute Press.

Coleman, J. S., Campbell, E. Q., Hobson, C. J., McPartland, J., Mood, A. M., Weinfield, F. D., & York, R. L. (1966). *Equality of educational opportunity.* Washington, DC: U.S. Government Printing Office.

Crisp, G., Nora, A., & Taggart, A. (2009). Student characteristics, pre-college, college, and environmental factors as predictors of majoring in and earning a STEM degree: An analysis of students attending a Hispanic serving institution. *American Educational Research Journal*, 46(4), 924-942.

Croninger, R. G., Rice, J., Rathbun, A., & Nishio, M. (2007). Teacher Qualifications and Early Learning: Effects of Certification, Degree, and Experience on First-Grade Student Achievement. *Economics of Education Review*, 26(3), 312-324.

Darling-Hammond, L. (2010). *The flat world and education: How America's commitment to equity will determine our future.* New York, NY: Teachers College Press.

Darling-Hammond, L., Rose, P., & Milliken, M. (2007). High school size, organization, and content: What matters for student success? *Brookings Papers on Education Policy*, 163-203.

Darling-Hammond, L., & Youngs, P. (2002). Defining “highly qualified teachers”: What does “scientifically-bases research” actually tell us? *Educational Researcher, 31*, 13-25.

Davis, J. D., & Shih, J. C. (2007). Secondary options and post-secondary expectations: Standards-based mathematics programs and student achievement on college mathematics placement exams. *School Science and Mathematics*, 107(8), 336-346.

Edmonds, R. (1979). Effective schools for the urban poor. *Educational Leadership, 37*(10), 15–24.

Embretson, S. E., & Reise, S. P. (2000). *Item response theory for psychologists*. Mahwah, NJ: Lawrence Erlbaum Associates, Inc.

Fan, X., Chen, M., & Matsumoto, A. R. (1997). Gender differences in mathematics achievement: Findings from the National Education Longitudinal Study of 1988. *Journal of Experimental Education*, 65(3), 229-242.

Fletcher, E. C., & Zirkle, C. (2009). The relationship of high school curriculum tracks to degree attainment and occupational earnings. *Career and Technical Education Research, 34*(2), 81-102.

Florida Department of Education. (2011). *Educator certification: Certification types and requirements*. Retrieved from hhttp://www.fldoe.org/edcert/cert_types.asp

Gamoran, A., & Hannigan, E.C. (2000). Algebra for everyone? Benefits of college-preparatory mathematics for students with diverse abilities in early secondary school. *Educational Evaluation and Policy Analysis, 22*(3), 241-254.

Gamoran, A., Porter, A. C., Smithson, J., & White, P. A. (1997). Upgrading high school mathematics instruction: Improving learning opportunities for low-achieving, low-income youth. *Educational Evaluation and Policy Analysis, 19*(4), 325-338.

Griffith, A. L. (2010). Persistence of women and minorities in STEM field majors: Is it the school that matters? *Economics of Education Review, 29*, 911-922.

Gregory, A., Cornell, D., Fan, X., Sheras, P., Shih, T., & Huang, F. (2010). Authoritative school discipline: High school practices associated with lower bullying and victimization. *Journal of Educational Psychology*, 102(2), 483-496.

Gresham, J. G. (2008). *Determining the correlation between students perceived level of safety and achievement.* Dissertation: Morgan State University, US.

Gutierrez, R. (1996). Practices, beliefs and cultures of high school mathematics departments: Understanding their influence on student advancement. *Journal of Curriculum Studies, 28* (5), 495-529.

Gutierrez, R. (1998). Essay review departments as contexts for understanding and reforming secondary teachers' work: Continuing the dialogue. *Journal of Curriculum Studies, 30* (1), 95-103.

Gutierrez, R. (1999). Advancing urban Latina/o youth in mathematics: Lessons from an effective high school mathematics department. *The Urban Review, 31* (3), 263-281.

Gutierrez, R. (2000). Advancing African-American, urban youth in mathematics: Unpacking the success of one math department. *American Journal of Education, 109* (1), 63-111.

Gutstein, E. (2006). *Reading and writing the world with mathematics: Toward a pedagogy for social justice.* New York, NY: Taylor and Francis Group, LLC.

Harper, S. R. (2009). Niggers no more: A critical race counternarrative on Black male student achievement at predominantly White colleges and universities. *International Journal of Qualitative Studies in Education*, 22(6), 697-712.

Heckel, R. W. (1996). Engineering freshman enrollments: Critical and non-critical factors. *Journal of Engineering Education, 85*, 5-9.

Henry, G. T., Fortner, C., & Thompson, C. L. (2010). Targeted Funding for Educationally Disadvantaged Students: A Regression Discontinuity Estimate of the Impact on High School Student Achievement. *Educational Evaluation and Policy Analysis*, 32(2), 183-204.

Howard, T. C. (2010). *Why race and culture matter in schools: Closing the achievement gap in America's classroom.* New York, NY: Teachers College Press.

Kelly, S. (2004). Do increased levels of parental involvement account for the social class difference in track placement? *Social Science Research, 33*, 626-59.

Kelly, S. (2009). The Black-White gap in mathematics course taking. *Sociology of Education, 82*(1), 47-69.

Keppel, G., & Wickens, T. D. (2004). *Design and analysis: A researcher's handbook.* Upper Saddle River, NJ: Pearson Education, Inc.

Kitchen, R. S., Lee, O., Roy, F. C., & Secada, W. G. (2009). Comparing teachers' conceptions of mathematics education and student diversity at highly effective and typical elementary schools. *Journal of urban Mathematics Education, 2*(1), 52-80.

Konstantopoulos, S. (2006). Trends of school effects on student achievement: Evidence from NLS:72, HSB:82, and NELS:92. *Teachers College Record*, 108(12), 2550-2581.

Ladson-Billings, G. (1994). *The dreamkeepers: Successful teachers of African American children.* San Francisco, CA: Jossey-Boss Inc.

Ladson-Billings, G., & Tate, W. (1995). Toward a critical race theory of education. *Teachers College Record, 97*(1), 47-68.

Leak, J. A., & Farkas, G. (2011). Effects of teacher credentials, coursework, and certification on student achievement in math and reading in kindergarten: An ECLS-K study. *Society for Research on Educational Effectiveness.* Retrieved from http://www.eric.ed.gov/PDFS/ED518799.pdf.

Lee, J. (2004). Multiple facets of inequity in racial and ethnic achievement gaps. *Peabody Journal of Education*, 79(2), 51-73.

Lee, V. E., & Ready, D. D. (2009). U.S. high school curriculum: Three phases of contemporary research and reform. *The Future of Children, 19*(1), 135-156.

Lee, V. E., & Smith, J. B. (2001). *Restructuring high schools for equity and excellence: What works.* New York, NY: Teachers College Press.

Lewis, J. L.; Menzies, H.; Najera, E. I.; Page, R. N.(2009). Rethinking trends in minority participation in the sciences. *Science Education, 93*(6), 961-977.

Linacre, J. M. (2008). *A user's guide to winsteps: Program Manual 3.66.0.* Chicago, IL.

Love, A., & Kruger, A. C. (2005). Teacher beliefs and student achievement in urban schools serving African American students. *The Journal of Educational Research, 99*(2), 87-98.

Lubienski, S. T. (2002). A closer look at Black-White mathematics gaps: Intersections of race and SES in NAEP achievement and instructional practices data. *Journal of Negro Education*, 71(4), 269-287.

Lubienski, S. T. (2006). Examining practices, achievement, and equity with NAEP mathematics data. *Education Policy Analysis Archives, 14*(14), 1-33.

Lucas, S. R., & Gamoran, A. (2002). *Track assignment and the Black-White test score gap: Divergent and convergent evidence from 1980 and 1990 sophomores (pp. 171-98).* In T. Loveless (Ed). *Closing the gap: Promising strategies for reducing the achievement gap.* Washington, DC: Brookings Institution.

Lynn, M. (2006). Race, culture, and the education of African American. *Educational Theory*, 56(1), 107-119.

Martin, D. B. (2000). *Mathematics success and failure among African-American youth: The roles of sociohistorical context, community forces, school influence, and individual agency.* Mahwah, NJ: Lawrence Erlbaum Associates, Inc.

Marzano, R. J. (2003). *What works in schools: Translating research into action.* Alexandria, VA: Association for Supervision and Curriculum Development.

Massachusetts Department of Elementary and Secondary Education. (2011). *Educator Licensure: Academic (PreK – 12)*. Retrieved from http://www.doe.mass.edu/Educators/e_license.html?section=k12

Maton, K. I., & Hrabowski, F. A., (2004). Increasing the number of African American PhDs in the sciences and engineering: A strengths-based approach. *American Psychologist*, 59(6), 547-556.

Mau, W., & Lynn, R. (2000). Gender differences in homework and test scores in mathematics, reading and science at tenth and twelfth grade. *Psychology, Evolution & Gender*, 2(2), 119-125.

Mendro, R. L. (1998). Student achievement and school and teacher accountability. *Journal of Personnel Evaluation in Education, 12*(3), 257-267.

Mickelson, R. (2001). Subverting swann: First- and second-generation segregation in Charlotte-Mecklenburg schools. *American Educational Research Journal, 38*(2), 215-52.

Mickelson, R. A., & Greene, A. D. (2006). Connecting pieces of the puzzle: Gender differences in Black middle school students' achievement. *The Journal of Negro Education, 75*(1), 34-48.

Milam, A. J., Furr-Holden, C. D. M., & Leaf, P. J. (2010). Perceived school and neighborhood safety, neighborhood violence and academic achievement in urban school children. *Urban Review: Issues and Ideas in Public Education, 42*(5), 458-467.

Moses, R. P., & Cobb, C. E. (2001). *Radical equations: Math literacy and civil rights.* Boston, MA: Beacon Press.

National Center for Educational Statistics. (1997). *The condition of education.* Washington, DC: U.S. Department of Education.

National Center for Educational Statistics. (2009). *America's high school graduates: Results of the 2009 NAEP high school transcript study.* Washington, DC: U.S. Department of Education.

National Council of Teachers of Mathematics. (2000). *Principles and standards for school mathematics.* Reston, VA: The National Council of Teachers of Mathematics, Inc.

Newmann, F. M., & Associates. (1996). *Authentic achievement: Restructuring schools for intellectual quality.* San Francisco, CA: Jossey-Bass Publishers.

No Child Left Behind Act of 2001, Pub. L. No. 107–110, §1118,115 Stat. 1425 (2002).

Nye, B., Konstantopoulos, S., & Hedges, L. V. (2004). How large are teacher effects? *Educational Evaluation and Policy Analysis, 26*(3), 237-257.

Oakes, J. (2005). *Keeping track: how schools structure inequality*. New Haven, CT: Yale University Press.

Oakes, J., & Lipton, M. (2007). *Teaching to change the world.* New York, NY: McGraw-Hill.

Palardy, G. J., & Rumberger, R. W. (2008). Teacher effectiveness in first grade: The importance of background qualifications, attitudes, and instructional practices for student learning. *Educational Evaluation and Policy Analysis*, 30(2), 111-140.

Palmer, R. T., Davis, R. J., & Thompson, T. (2010). Theory meets practice: HBCU initiatives that promote academic success among African Americans in STEM. *Journal of College Student Development, 51*(4), 440-443.

Purkey, S., & Smith, M. (1983). Effective schools: A review. *The Elementary School Journal, 83*(4), 427– 452.

Raudenbush, S. W., & Bryk, A. S. (2002). *Hierarchical linear models: Applications and data analysis methods.* Thousand Oaks, CA: Sage Publications.

Ready, D. D., Lee, V. E., & Welner, K. G. (2004). Educational equity and school structures: School size, overcrowding, and schools-within-schools. *Teachers College Record, 106*(10), 1989-2014.

Rech, J. F., & Stevens, D. J. (1996). Variables related to mathematics achievement among Black students. *The Journal of Educational Research, 89*(6), 346-350.

Rice, J. K. (2010). *The impact of teacher experience: Examining the evidence and policy implications (Brief). CALDER Working Paper 11.* Washington, DC: The Urban Institute.

Roderick, M., & Engel, M. (2001). The grasshopper and the ant: Motivational responses to low achieving students to high-stakes testing. *Educational Evaluation and Policy Analysis, 23*(3), 197-227.

Rodriguez, A. J., & Kitchen, R.S. (2005). *Preparing Mathematics and Science Teachers for Diverse Classrooms: Promising Strategies for Transformative Pedagogy*. Mahwah, New Jersey: Lawrence Erlbaum Associates.

Romberg, T. A., Carpenter, T. P., & Dremock, F. (Eds.). (2005). *Understanding mathematics and science matters.* Mahwah, NJ: Lawrence Erlbaum Associates, Publishers.

Rumberger, R. W., & Palardy, G. J. (2005). Does segregation still matter? The impact of student composition on academic achievement in high school. *Teachers College Record, 107*(9), 1999-2045.

Shulman, L. S. (1987). Knowledge and teaching: Foundations of the new reform. *Harvard Educational Review, 57*(1), 1-22.

Steele, C. M. (1997). A threat in the air: How stereotypes shape intellectual identity and performance. *American Psychologist, 52***,** 613–629.

Stewart, L. (2009). Achievement differences between large and small schools in Texas. *Rural Educator, 30*(2), 20-28.

Strayhorn, T. L. (2010). The role of schools, families, and psychological variables on math achievement of Black high school students. *The High School Journal, 93*(4), 177-194.

Stronge, J. H., Ward, T. J., Tucker, P. D., & Hindman, J. L. (2007). What is the relationship between teacher quality and student achievement? An exploratory study. *Journal of Personnel Evaluation in Education, 20*, 165-184.

Suitts, S. (2003). Fueling education reform: Historically Black colleges are meeting a national science imperative. *Cell Biology Education*, 2(4), 205-206.

Tate, W. F. (1997). Race, ethnicity, SES, gender, and language proficiency trends in mathematics achievement: An update. *Journal of Research in Mathematics, 28*(6), 652-680.

Teddlie, C. (1994). *The integration of classroom and school process data in school effects research.* In D. Reynolds, B. P. M. Creemers, P. S. Nesselrodt, E. C. Shaffer, S. Stringfield, & C. Teddlie (Eds.), *Advances in school effectiveness research and practices* (pp. 111-32). Oxford: Pergamon.

Tyson, W., Lee, R., Borman, K. M., & Hanson, M. A. (2007). Science, technology, engineering, and mathematics (STEM) pathways: High school science and math coursework and postsecondary degree attainment. *Journal of Education for Students placed at risk, 12*(3), 243-270.

U.S. Census Bureau. (2010). *People and families in poverty by selected characteristics: 2008 and 2009.* Retrieved from http://www.census.gov/hhes/www/poverty/data/incpovhlth/2009/table4.pdf

U.S. Department of Education. (2008). *National Center for Education Statistics: Bachelor's degrees conferred by degree-granting institutions, by sex, race/ethnicity, and field of study: 2006-07.* Retrieved from http://nces.ed.gov/programs/digest/d09/tables/dt09_287.asp

U.S. Department of Education. (2009). *NAEP data explorer.* Retrieved from http://nces.ed.gov/nationsreportcard/naepdata/dataset.aspx

U.S. Department of Education, National Center for Education Statistics. (2010). The Condition of Education 2010 (NCES 2010-028), Indicator 20. Retrieved from http://nces.ed.gov/fastfacts/display.asp?id=16

U.S. Department of Education. (2011). *The education longitudinal study of 2002.* Retrieved from http://nces.ed.gov/surveys/els2002/index.asp

Wallace, M. R. (2009). Making Sense of the Links: Professional Development, Teacher Practices, and Student Achievement. *Teachers College Record*, 111(2), 573-596.

Wehlage, G. G., Newmann, F. M., & Secada, W. G. (1996). *Standards for authentic achievement and pedagogy (pp. 21-48)*. In F. M. Newmann & Associates. *Authentic achievement: Restructuring schools for intellectual quality.* San Francisco, CA: Jossey-Bass Inc Publishers.

Western, B. (2008). Incarceration, unemployment, and inequality. In D. B. Grusky (ED.) *Social stratification: Class, race, and gender in sociological perspective*. Boulder, CO: Westview Press.

Williams, T. R., Davis, L. E., Cribbs, J. M., Saunders, J., & Williams, J. H. (2002). Friends, family, and neighborhood: Understanding academic outcomes of African American youth. *Urban Education, 37*(3), 408-431.

Wright, S. P., Horn, S. P., & Sanders, W. L. (1997). Teacher and classroom context effects on student achievement: Implications for teacher evaluation. *Journal of Personnel Evaluation in Education, 11*, 57-67.

Zigarelli, M. A. (1996). An empirical test of conclusions from effective schools research. *Journal of Educational Research, 90*, 103-110.

Zwick, R., & Sklar, J. C. (2005). Predicting college grades and degree completion using high school grades and SAT scores: The role of student ethnicity and first language. *American Educational Research Journal, 42*(3), 439-464.