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The Whiter the Better? Racial Composition and Access to School Resources for Black Students

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Abstract Rigorous courses are an important resource, distributed within schools, that merit attention as a central determinant of student achievement and future outcomes (Cook and Evans, J Labor Econ. 18(4):729–754, 2000; Rose and Betts, Rev Econ Stat. 86(2):497–513, 2004). Yet, black students are less likely to be enrolled in advanced courses in general (ex. Darity et al. 2001; Klopfenstein, Contemp Econ Pol. 23(3):416–28, 2005) and specifically Algebra 1 in middle school (Riley 1997). Debate exists around the potential benefits or drawbacks for black students attending highly integrated schools relative to highly segregated schools. This study examines which school characteristics are associated with large disparities in black student enrollment in Algebra 1 relative to white student enrollment in Algebra 1 in the same middle schools in North Carolina. Of particular interest is the relationship between access and the percentage of white students in a school. The study finds that: (1) black students are underrepresented in Algebra 1 in essentially all schools in North Carolina; (2) the largest disparities occur in schools that are highly integrated while the disparities are reduced in schools that are either large majority white or large majority non-white; (3) schools with a larger share of white teachers are related to larger disparities between black and white students; (4) the marginal effects of racial composition on the relative disparity in enrollment are significantly larger for black females than black males.

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Introduction

Rigorous courses are an important resource, distributed within schools, that merit attention as a central determinant of student achievement and future outcomes (Cook and Evans 2000; Rose and Betts 2004). Yet, black students are less likely to be enrolled in advanced courses (ex. Darity et al. 2001; Klopfenstein 2005) and specifically Algebra 1 (Riley 1997). Some researchers and policymakers have put the primary focus for improving opportunities and outcomes for black students on increased access to white students (ex. Orfield and Lee 2005). This view is supported by research that suggests that black students are negatively affected by attending schools with higher concentrations of black students (ex. Hanushek et al. 2009; Grogger 1996). Other research questions whether increases in exposure to white students improve outcomes for black students (ex. Darity 2001; Diette et al. 2011; Kelly 2009).

This study examines the relationship between the disparity in access to Algebra 1 in middle school and school characteristics in North Carolina. Of particular concern is investigating the relationship between access and the percentage of white students in a school. Following previous work, the study investigates potential nonlinear effects of racial composition.

The results of this study suggest that: (1) black students are underrepresented in Algebra 1 in essentially all middle schools; (2) the largest disparities in enrollment occur in schools that are highly integrated while the disparities are reduced in schools with either large majority white or large majority non-white populations; (3) schools with a larger share of white teachers have larger disparities in enrollment between black students and white students; (4) the disparity in enrollment between black female students and white females students appears to be more responsive to changes in racial composition than the disparity for males. The paper proceeds as follows. Section 2 provides a brief survey of related literature. Section 3 discusses the data and the descriptive statistics. Section 4 explains the empirical strategy and Section 5 reports the results of the study. Section 6 concludes.

Literature review

The black-white achievement gap is well documented and has been intensively studied (ex. Jencks and Philips 1998; Fryer and Levitt 2004). The importance of the gap is highlighted by the connection between higher test scores and earnings (ex. Murnane et al. 1995). While the role of financial resources, peers, class size, teacher quality, and other such resources have been explored within the education production function (ex. Hanushek 1986, 2003; Krueger 2003), curriculum is one critical input that has just recently begun to receive attention from economists.

A report by Darity et al. (2001) proposes that the achievement gap is fostered by the disparity of African-Americans in rigorous courses relative to white students in North Carolina public schools. Prior research documents that poor, black and Latino

students are significantly underrepresented in advanced groups and courses in public schools (Darity et al. 2001; Ford 1998; Hawley and Ready 2003; Kifer 1993; Riley 1997). Seventh and eighth grade is pivotal in school careers because this is the stage when students get into strongly differentiated curriculum in math and formal sorting in the United States begins (Kifer 1993; McKnight et al. 1987; Stevenson et al. 1994; Useem 1992a, b). Enrollment in advanced courses in high school require advanced planning in the form of taking appropriate courses such as Algebra 1 in middle school (Atanda 1999). Algebra 1 is the keystone to all secondary mathematics, as only the students who take Algebra 1 in eighth grade can take calculus in high school (Robitaille 1993; Usiskin 1987). In addition, eighth grade math placement is a strong predictor of high school math courses (Catsambis 1994; Stevenson et al. 1994). Finally, advanced math courses directly influence future earnings (Rose and Betts 2004).[1]

A large body of research has consistently documented that factors beyond ability significantly influence the placement process.[2] Placement is a function of standardized tests, school recommendations, prior group placement, parent education levels, school size, and student and parent choice (Gamoran 1989; Oakes 1985; Useem 1992a, b). However, the selection criteria are often inconsistent within schools and may differ from stated policy (Rosenbaum 1976; 1980). In some cases, assignments even appear somewhat arbitrary (Rosenbaum 1976). Therefore, students with similar characteristics will find themselves in different tracks depending on the school they attend (Kelly 2004; Jones et al. 1995; Garet and Delany 1988; Hallinan 1991; McKnight et al. 1987). The work of Campbell et al. (2011) and Francis et al. (2011) in this volume individually identify that black female students are less likely to be recommended for advanced courses by their teachers. Another study found black geometry students with black teachers are more likely to enroll in additional rigorous math courses (Klopfenstein 2005).

Parents who have higher education levels and higher incomes are expected to have a greater awareness of the importance of Algebra 1 in middle school. Therefore, they would be more likely to lobby the school to enroll their students and create a more competitive atmosphere for admission to the course (Kelly 2004; Lucas 2001; Oakes 1995; Useem 1991, 1992a, b). The lack of transparency in the tracking decisions results in many parents failing to identify decision nodes and being unaware of their power to influence these decisions (Lee and Ekstrom 1987; Lucas 1999; Oakes 1995).

In addition to the socioeconomic characteristics, schools face various resource constraints based on their size. A school with more students has greater flexibility to provide a wider range of opportunities for students. A small school may need to offer the same curriculum to all students and therefore, if it offers Algebra 1, include

[1] Early work on the returns to curriculum found mixed results (Altonji 1995; Levine and Zimmerman 1995). Altonji measures curriculum as a quantity of math courses in high school and still finds a small positive return to additional math courses from the NLS72. Levine and Zimmerman report a positive effect on earnings for females who take additional courses using the NLSY and HS&B. Both Altonji and Levine and Zimmerman are limited to measuring the number of math courses with no control for the actual content. Rose and Betts (2004) are able to measure specific math courses based on the High School and Beyond Survey.

[2] Examples include: Haller 1985; Lee and Bryk 1988; Jones et al. 1995; Rehberg and Rosenthal 1978; Heyns 1974; Alexander and Cook 1982.

more students. School ability level is inversely related to the probability that a student is enrolled in upper level courses (Alwin and Otto 1977; Heyns 1974). This finding supports the view of the assignment process as a vacancy competition, where track sizes are predetermined and do not depend on current class characteristics (Hallinan and Sorensen 1986).

Evidence suggests that an increase in the percentage of classmates who are black or eligible for free lunches increases the chances a student will be in an upper track (Hallinan 1991; Kelly 2004; Stevenson et al. 1994). Kelly (2009) uses the National Education Longitudinal Study of 1988 to examine the effect of school racial composition on high school mathematics placement. Kelly (2009) focuses on within school analysis and finds that highly integrated high schools increase the chances that black students will be in low-track math. This study extends this research in two important ways. First, the current study takes advantage of more recent data and second it examines advanced course placement at an earlier stage in the trajectory by examining middle school placement.

Data and descriptive statistics

This study uses data from the North Carolina Department of Public Instruction (NCDPI) provided through the North Carolina Educational Research Data Center (NCERDC) for the 1997–1998 school year through the 2002–2003 school year. The data are from the North Carolina End of Grade (EOG) and End of Course (EOC) examinations administered to North Carolina public school students. The Algebra 1 EOC is used to identify students who take Algebra 1 prior to high school. Schools are the unit of observation in the study.

Across North Carolina during the sample period, of the 89% of public middle schools offering Algebra 1, schools included an average of 24% of their students in the course.[3] This study focuses on the relationship of school characteristics and the odds of enrollment of black students compared to white students within schools. Therefore the dependent variable of interest needs to be independent of the decision of what overall share of the student body is enrolled in Algebra 1. The odds ratio or relative odds of enrollment is constructed for each school in each year using Eqs. 1 and 2. Equation 1 calculates the odds or probability (O) that students in i group in school s in district d in year y are enrolled in Algebra 1. Equation 2 calculates the relative odds or odds ratio (RO) by dividing the odds of group i by the odds of group j within the same school in the same district in the same year.

$$O^{i}_{sdy} = \frac{\#\text{ of Group } i \text{ in Algebra 1}}{\#\text{ of Group } i \text{ in the School}} \tag{1}$$

$$RO^{ij}_{sdy} = \frac{O^{i}_{sdy}}{O^{j}_{sdy}} \tag{2}$$

[3] The sample is based on schools with student population of at least 35 8th graders, at least 5% black students, and at least 5% white students.

The remainder of the paper uses three odds ratios: all black students compared to all white students; all black male students compared to all white male students; and all black female students compared to all white female students. A value of one indicates equal chances for black and white students being enrolled in Algebra 1 while in middle school. A value of 0.75 would indicate that a black student is 25% less likely to be enrolled in Algebra 1 in the same school as a white student, while a value of 1.50 would indicate that black students are 50% more likely to be enrolled in Algebra 1 than white students within the same school.

Table 1 and Fig. 1a, b, and c show the relative odds of enrollment for all black students, black males, and black females respectively. The figures highlight that only a small percentage of schools are close to or exceed parity. The average relative odds across schools are: 0.33 for all black students (67% less likely to enroll than white students), 0.29 for black males (71% less likely to enroll than white males), and 0.38 for black females (62% less likely to enroll than white females). For all black students, only 6% of the observations have an odds ratio larger than 0.75 and only 2% are above parity.

Based on the previous literature on advanced course placement, characteristics of the school influence the competitiveness of getting into Algebra 1. The primary characteristic of interest is the percentage of white students in the grade. The additional school characteristics included in the study include the size of the grade, the racial composition of the teachers, the percent of students in the grade eligible for free or reduced price lunch, the percent of students whose parents have completed a bachelor's degree, and the average test score for the students in the grade who complete the EOG exams. Table 1 reports the mean and standard deviation for each of these variables at the school level. On average, 79% of the teachers in the schools are white. The schools average over 190 students in the 8th grade. Free and reduced price lunch eligibility is a common proxy for income. The schools have an average of 31% of their students eligible for free and reduced price lunch and 29% of the students come from families whose parents have a four year college degree.

Table 1 Descriptive statistics

Variable	All	Males	Females
Odds of algebra 1 enrollment: black relative to white	0.328 (0.29)	0.289 (0.328)	0.376 (0.414)
Percent white	58.618 (20.866)	58.766 (20.672)	58.939 (20.590)
Percent of white teachers	79.201 (17.079)	79.317 (16.840)	79.427 (16.891)
Percent free or reduced price lunch	31.329 (21.807)	31.201 (21.673)	30.990 (21.545)
Percent parents w/4+ years of college	28.842 (17.816)	28.956 (17.829)	29.027 (17.803)
Normalized school math score	0.243 (0.644)	0.248 (0.640)	0.250 (0.641)
Size of the grade (natural log)	5.250 (0.551)	5.259 (0.543)	5.260 (0.543)
Percent in algebra 1	23.765 (13.562)	23.859 (13.562)	23.901 (13.524)
Observations	2056	2037	2030

Standard Deviations in parentheses. The school level observations are unweighted. The sample includes all North Carolina public schools that: offer Algebra 1 in 7th or 8th grade; at least 5% of the population in 8th grade is black; at least 5% of the population is white; and the grade includes at least 35 students

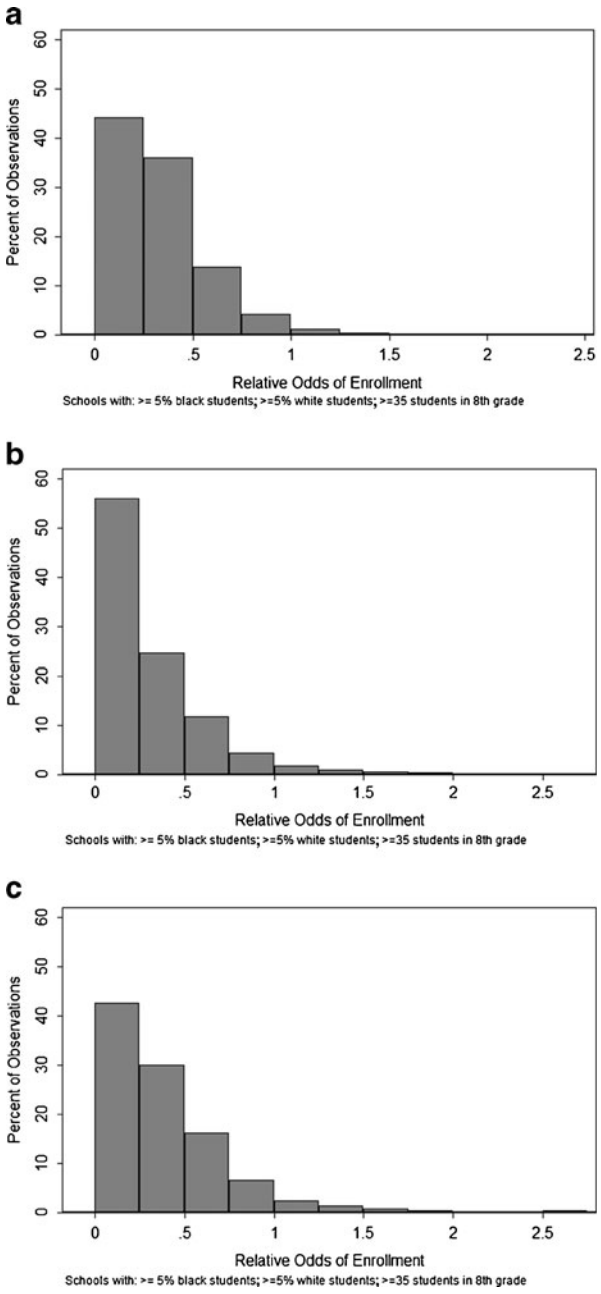

Fig. 1 Distribution of relative odds of enrollment in algebra in middle school. **a** Black students relative to white students. **b** Black males relative to white males. **c** Black females relative to white females

Table 2 displays the characteristics of schools by range of relative odds of enrollment in Algebra 1 for black students relative to white students. The percentage of white students in the school is highest in schools where no black students are enrolled in Algebra 1, a relative odds of zero. The relationship between the odds ratio and the percent of the 8th grade in the school that is white is demonstrated in

Table 2 Descriptive statistics: by odds of algebra 1 enrollment: black students relative to white students

Variables	0	>0–0.25	>0.25–0.50	>0.50–0.75	>0.75–1	>1
Percent white	76.091 (14.595)	57.189 (17.195)	56.085 (20.804)	54.906 (22.751)	54.242 (25.264)	53.375 (31.202)
Percent of white teachers	90.532 (10.634)	80.413 (13.733)	76.758 (17.995)	74.897 (18.282)	73.870 (21.991)	74.025 (26.264)
Percent free or reduced price lunch	26.956 (19.215)	30.259 (19.988)	31.627 (22.346)	33.230 (23.152)	37.646 (25.875)	44.001 (27.738)
Percent parents w/4+ years of college	25.289 (16.225)	33.447 (18.063)	27.974 (17.092)	27.225 (18.431)	23.233 (16.867)	15.391 (14.669)
Normalized school math score	0.491 (0.554)	0.337 (0.590)	0.168 (0.650)	0.097 (0.694)	0.072 (0.707)	−0.061 (0.719)
Size of the grade (natural log)	4.920 (0.660)	5.383 (0.489)	5.316 (0.489)	5.237 (0.505)	4.940 (0.594)	4.691 (0.633)
Percent in algebra 1	16.183 (8.623)	22.732 (10.498)	24.289 (12.333)	28.999 (18.101)	31.263 (21.066)	26.547 (20.900)
Observations	254	658	736	283	83	42

Standard Deviations in parentheses. The school level observations are unweighted. The sample includes all North Carolina public schools that: offer Algebra 1 in 7th or 8th grade; at least 5% of the population in 8th grade is black; at least 5% of the population is white; and the grade includes at least 35 students

Fig. 2. The unconditional relationship suggests that the relative odds of a black student being in Algebra 1 decrease as the percentage of white students increase. The figure also suggests that the odds improve for the average black female student at the schools that have the largest percent of white students relative to highly integrated schools. The relative odds do not improve for black males in the schools composed mostly of whites.

Model

The relative odds (RO) of a black student enrolling in Algebra 1 in middle school relative to a white student in school s in district d in year y are a function of school characteristics, district characteristics, and year. The analysis is based on a reduced form OLS regression equation with district and year fixed effects represented by Equation 3.

$$RO_{sdy} = \alpha + \beta_1 White_{sdy} + \beta_2 White^2_{sdy} + \theta X_{sdy} + \delta_d L_d + \pi_y T_y + \eta_s + u_{sdy} \qquad (3)$$

White is the percentage of the students in the grade within the school who are white. A squared term is included to allow flexibility of the effect of white students on the relative odds of enrollment. X is a vector of additional school characteristics including the percent of white teachers, the percent of students with parents who have a bachelors degree or beyond, the percent of students in the school eligible for free or reduced price lunch, the mean test score of the school, and a control for the number of students in the 8th grade in the school. L is a vector of time-invariant district fixed effects and T is a vector of year fixed effects. The district fixed effects attempt to control for differential enrollment policies which are commonly established at the district level. The error term includes a school specific error component.

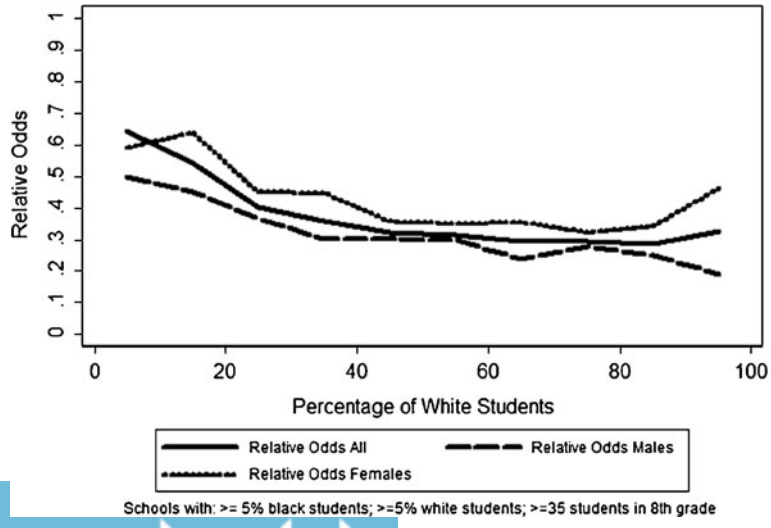

Fig. 2 Unconditional relative odds of enrollment in algebra by percent white

Results

Three specifications are estimated with the relative odds of enrollment in Algebra 1 of all black students relative to all white students as the dependent variable. The first specification, column (1) in Table 3, reports a base model that only includes the percent white and percent white squared, other student race/ethnicity controls, district fixed effects and year fixed effects. The second specification adds the additional school characteristics, excluding the racial composition of teachers. Finally, column (3) reports the full specification. While the inclusion of additional controls reduces the magnitude of the effect, the percent white and percent white squared are statistically significant in each model.

We stratify by gender to examine if the average marginal effects vary by gender. Columns (4) and (5) in Table 3 report the results for the fully specified model for males and females respectively. The odds of enrollment for black females relative to white females has a similar relationship as the relative odds for all students with the percent of the grade that is white, in both magnitude and statistical significance. The estimates for the odds of black males relative to white males are the same sign, but are not statistically significant. The largest negative marginal effect of white students on the relative odds of black enrollment occurs at a white enrollment of 51%. For both males and females, the largest negative marginal effect occurs when the student body is 46% white. Figure 3 displays the margin effect for overall odds and relative odds by gender. All else equal, a black female student is 58% less likely to enroll in Algebra 1 than a white female student in a school that is 5% white. The relative odds fall to 69% less likely to enroll than a white female student if the school is 50% white, and improve to 53% less likely to enroll in a school that is 95% white.[4]

The findings of the potential negative effects of highly integrated schools support proposed theory (Darity 2001) and empirical findings (for example: Diette 2011; Diette et al. 2011; Kelly 2009). The findings are potentially suggestive that the competition for resources may be most intense in highly racially integrated environments. As black students become a smaller percent of the overall student population then the relative odds of enrollment rise to similar levels of schools where black students are the majority of the school population. The chances of enrollments for black males are harmed by a larger percentage of white teachers. These results support the research by Francis et al. (2011) in this volume on the important role of teachers in advanced course recommendations.

Larger schools also appear to significantly reduce the relative odds that a black student will be enrolled in Algebra 1. To further investigate differences by school size, the data are stratified by quartile of grade size. The results are reported in Table 4 with separate panels for all black students (Panel A), male black students (Panel B), and female black students (Panel C).

In the smallest schools, those with fewer than 146 students in 8th grade, the relative odds of being enrolled are not related to any of the explanatory variables.

[4] The results are robust to alternative specifications that include either: the mean scores of black students and the mean scores of white students within a school; or the ratio of black student test scores to white student test scores. The relative test scores are not included in the models presented as it is likely that test scores are endogenous with other right-hand side variables.

Table 3 Determinants of the odds ratio for algebra 1 enrollment: all black students vs. all white students; black male students vs. white male students; and black female students vs. white female students

Variables	(1) All	(2) All	(3) All	(4) Males	(5) Females
Percent white	−0.0092*** (0.0025)	−0.0076*** (0.0025)	−0.0056** (0.0024)	−0.0028 (0.0023)	−0.0057** (0.0028)
Percent white-squared	0.0001*** (0.0000)	0.0001*** (0.0000)	0.0001*** (0.0000)	0.0000 (0.0000)	0.0001*** (0.0000)
Percent of white teachers			−0.0021** (0.0009)	−0.0024*** (0.0009)	−0.0016 (0.0010)
Percent Free or reduced price lunch		−0.0011* (0.0007)	−0.0011* (0.0007)	−0.0006 (0.0008)	−0.0016* (0.0008)
Percent parents w/4+ years of college		−0.0034*** (0.0006)	−0.0034*** (0.0006)	−0.0027*** (0.0008)	−0.0042*** (0.0009)
Normalized school math score		−0.0049 (0.0177)	−0.0004 (0.0179)	0.0228 (0.0204)	−0.0337 (0.0237)
Size of the grade (natural log)		−0.0747*** (0.0226)	−0.0755*** (0.0225)	−0.0697*** (0.0248)	−0.1206*** (0.0311)
Constant	0.5514*** (0.1027)	1.0100*** (0.1601)	1.1033*** (0.1681)	0.9502*** (0.1819)	1.4398*** (0.2267)
Observations	2,094	2,094	2,094	2,037	2,030
R-squared	0.2438	0.2736	0.2771	0.1853	0.2073

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Each specification includes district and year fixed effects. Robust standard errors clustered by school are in parentheses. The sample includes all North Carolina public schools that: offer Algebra 1 in 7th or 8th grade; at least 5% of the population in 8th grade is black; at least 5% of the population is white; and the grade includes at least 35 students. Observations are weighted by the school's share of the 8th grade population. Additional controls included in all regressions are the percentage of the students in the grade who are: Latino, Native American, and Asian

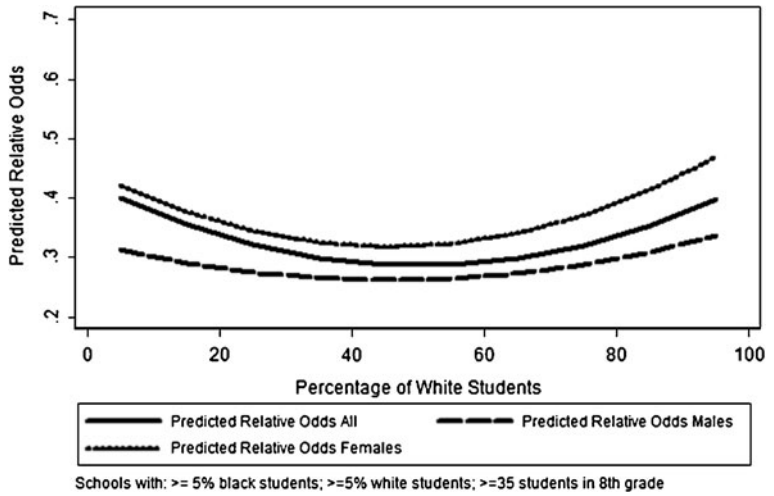

Fig. 3 Marginal effect of percentage of white students, predicted relative odds of enrollment in algebra

The finding of the negative effect of highly integrated schools is primarily in the largest schools, those schools with more than 280 students in the 8th grade.

Conclusion

The study documents the unconditional disparity in Algebra 1 enrollment in middle school in North Carolina for black males and black females relative to their white counterparts. Controlling for other school characteristics, the largest disparities occur in schools that are highly integrated with roughly half of the students being white. The conditional disparities are smaller in schools with either large majority white or large majority non-white populations. The penalty for black students of being in highly integrated environments provides further support for the findings on high school track placement (Kelly 2009) and on high school completion (Diette et al. 2011).

Black student enrollment appears to be harmed by having a larger share of teachers who are white. Black female students are particularly influenced by school characteristics and experience economically significant changes in their relative odds of enrollment in Algebra 1 compared to white female students. The studies in this volume by Francis and Campbell provide significant insights into potential explanations.

Highly integrated schools may benefit black students along some outcomes as reported by some previous studies; however, these schools may not be unambiguously better for black students. The results of this paper suggest that the racial composition of students is related to the relative odds of a black student being placed into advanced courses. Additional research is needed to fully understand the complex effects of school racial composition on future outcomes for black students. At a minimum, the results suggest that policymakers should not solely target racial composition without consideration of policies within schools, including placement policies for students.

Table 4 Determinants of the odds ratio for algebra 1 enrollment: by school size quartile

Panel A: All students				
Variables	(1) Smallest quartile	(2)	(3)	(4) Largest quartile
Percent white	−0.0098 (0.0066)	−0.0060 (0.0049)	−0.0083* (0.0049)	−0.0070** (0.0031)
Percent white-squared	0.0001 (0.0001)	0.0001 (0.0000)	0.0001** (0.0000)	0.0001** (0.0000)
Percent of white teachers	0.0014 (0.0029)	0.0019 (0.0018)	−0.0041** (0.0019)	−0.0028** (0.0011)
Percent free or reduced price lunch	0.0010 (0.0019)	0.0018* (0.0011)	−0.0035** (0.0016)	−0.0028*** (0.0010)
Percent parents w/4+ years of college	−0.0002 (0.0028)	−0.0035*** (0.0013)	−0.0044*** (0.0013)	−0.0040*** (0.0012)
Observations	519	517	506	514
R-squared	0.2413	0.4135	0.3483	0.4384
Panel B: Male students				
Percent white	0.0024 (0.0054)	−0.0049 (0.0064)	−0.0081** (0.0040)	−0.0049 (0.0036)
Percent white-squared	−0.0000 (0.0000)	0.0001 (0.0001)	0.0001** (0.0000)	0.0001* (0.0000)
Percent of white teachers	0.0023 (0.0031)	−0.0010 (0.0019)	−0.0026* (0.0015)	−0.0034** (0.0013)
Percent free or reduced price lunch	0.0041* (0.0024)	−0.0002 (0.0015)	−0.0001 (0.0019)	−0.0014 (0.0013)
Percent parents w/4+ years of college	0.0032 (0.0024)	−0.0018 (0.0018)	−0.0039** (0.0017)	−0.0014 (0.0014)
Observations	513	506	504	514
R-squared	0.2260	0.3114	0.2843	0.3090
Panel C: Female students				
Percent white	−0.0095 (0.0081)	−0.0075 (0.0063)	−0.0033 (0.0048)	−0.0111*** (0.0036)
Percent white-squared	0.0001 (0.0001)	0.0001 (0.0001)	0.0000 (0.0000)	0.0001*** (0.0000)
Percent of white teachers	0.0014 (0.0047)	0.0042 (0.0026)	−0.0035** (0.0016)	−0.0022 (0.0014)
Percent free or reduced price lunch	−0.0008 (0.0029)	0.0035** (0.0016)	−0.0056*** (0.0017)	−0.0042*** (0.0012)
Percent parents w/4+ years of college	−0.0021 (0.0038)	−0.0033* (0.0018)	−0.0056*** (0.0017)	−0.0061*** (0.0016)
Observations	506	505	514	505
R-squared	0.2347	0.3227	0.2590	0.3763

Robust standard errors in parentheses

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Additional research is also needed to understand specific policies and characteristics of schools that successfully enroll black students at a rate closer to parity with white students. School districts with a higher percentage of students in the most challenging courses actively reduce the role for parents (Useem 1991, 1992a, b). School policy to encourage enrollment for all qualified students assists students who do not necessarily realize that they are making irreversible decisions (Rosenbaum 1976). In addition, schools and communities must focus attention on significant enrollment disparities to ensure that all students have an equal opportunity to take rigorous courses in middle school.

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