

The Decomposition of Racial Differences in Reading Test Scores Using Multi-level Modeling

**Charles L. Cappell
Northern Illinois University**

**Carrie Ippel
College of Lake County**

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Abstract

This paper applies multi-level modeling techniques to decompose the racial gap in reading test scores at the individual and school level using the NELS 1988 baseline survey of eighth graders. The analysis proceeded stepwise, first estimating individual level explanations then adding school level social characteristics to predict variation in individual level racial gap coefficients. Analysis was performed on the black/white 8th grade reading score gap as well as the more aggregated non-white/white gap. The final set of results using several student and parent characteristics as well as four school level variables to decompose the black/white gap reduced the initial gap by 18%, from -5.76 to -4.74. The parallel analysis on the non-white/white gap reduced the initial gap by 31%, from -4.29 to -2.98. The results for the black/white gap do not support the notion that increased black percentages in a school, after one controls for individual effects, decreases the performance of black students. None of the school level effects explained a significant amount of variation in the black/white gap across schools. However, all of the school variables had significant effects on the adjusted expectation of white students' average performance. In the decomposition of the non-white/white gap, the racial composition of the school had a negative effect on gap, widening it. None of the other school level variables had significant effects on the gap. However, their coefficients indicate that slight reductions in the non-white/white performance gap can be achieved by improving the percentage of students proficient in English and increasing the number of teachers with graduate degrees.

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Charles Cappell

Carrie Ippel

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This paper applies multi-level modeling techniques to statistically decompose the racial gap in reading test scores at the individual and school level. Our effort uses the NELS 1988 baseline survey of eighth graders; 20,163 students were initially included in the analysis from 948 schools. The most robust multi-level models we estimated used 772 schools for which there was sufficient data, the least robust only 30.

As we know, cities and metropolitan areas are racially segregated, and since the school one attends depends largely on one's place of residence, schools are segregated as well. According to Gary Orfield (2000), black students' exposure to white students declined over the 1986-2000 period. Data and analysis published at the Lewis Mumford Center also describes the degree of progress since *Brown v. Board of Education* (1954) in the context of whether school districts were under court orders to integrate (<http://www.albany.edu/mumford/>). Even in these settings, racial segregation persists.

Schools that educate large proportions of children from racial and ethnic minority groups show aggregated achievement gaps between themselves and schools whose students are mostly white. Previous research has shown that segregated schools have produced unequal achievement in terms of standardized test scores on state achievement tests, ACT and SAT tests (Bankston and Caldas 1998, 2000; Brown 2001). For example, Brown (2001) reports that school average test scores are highest in schools with small percentages of non-white students and are lower in schools with 50% or more non-white students. Research consistently shows that several characteristics affecting educational achievement are also associated with the racial composition of schools: school socio-economic status (Eisner 2001; Maher 2001; Bankston and Caldas 1998, 2000; Darnell 1999; Hedges 1999), class size (Johnson 2002; Lewis 2000), teacher salary (Hanushek, Kain and Rivkin 1999), school size (Lee and Smith 1995; Lee and Bryk 1989), peer culture (Downey and Ainsworth-Darnell 2002; Farcas, Lleras and Maczuga 2002; Davis 2001; Spencer, Noll and Stozfus 2001; Bettie 2000; Kao 2000; Spradlin, Welsh and Hinson 2000; Iadicola 1981), and mobility (Wright 1999).

It is also important to assess the multi-level interactions between schools' ethnic composition and individual's achievement score. Some research shows that African American students score lower in schools with large proportions of African American students than their counterparts do when attending mostly white schools. However, white students attending majority black schools score lower as well (Bankston and Caldas 1998, 2000). This suggests that a school effect operates such that predominantly non-white schools produce lower achievement regardless of the race of their students, but also generate an achievement gap between white students attending predominantly non-white schools and those attending predominantly white schools.

A more diffuse, ethnographic account of the racial gap in achievement in an affluent, suburban school district focuses on different levels of the student's academic engagement. Influences on academic engagement levels are traced to the black community's perception of real and hypothetical discriminatory treatment in the wider society (Ogbu 2003). A pervasive sentiment of mistrust of white institutions undermines the willingness to adopt the needed cultural tools for academic success among black students (Ogbu 2003, pp. 44-55).

At the individual level, many characteristics have been examined to understand how they are related to both race and achievement in ways that explain the racial gap in scores: e.g. parental income (Fan 2001, Roscigno and Ainsworth-Darnell 1999), parental education, parental marital status (Bankston and Caldas 1998, 2000; Roscigno and Ainsworth-Darnell 1999), parental involvement and parental expectations (Fan 2001), single-parent status (Bankston and Caldas 1998, 2000), parental involvement and educational expectations (Sui-Chi and Wilms 1996, Desimore 1999, and Fan 2001). Controlling for a student's access to cultural capital and household educational resources closes the racial gap slightly (13% for grades, 6% for test

scores). Still, it seems black students garner smaller boosts to their grade point averages and test scores than do white students from cultural trips and educational resources (Roscigno and Ainsworth-Darnell 1999).

Other explanations for the racial test-gap score include the bias of tests, study habits, the “summer fall-back”, and the slower rate of learning over the school career for those who enter less prepared (Farkas 2002; Phillips, Crouse, and Ralph 1998). More complicated is the process of “stereotype threat”, a sort of self-fulfilling prophecy whereby black students in conditions that invoke the non-academic component of black stereotype induce anxiety-like symptoms that reduce performance (Steele and Aronson 1998).

Table 1 summarizes a few major research reports on how race and racial composition of schools affect individual-level school performance. Most studies regularly use regression models to ‘decompose’ the racial gap into the portion that can be explained by other related socio-economic and environmental factors. Such approaches show individual level characteristics can account for somewhere between a quarter to a half of the disparity between white and non-white student achievement.

No clear consensus exists about the complex way individual, family, and school effects explain the racial gaps in school achievement. Phillips, Crouse, and Ralph (1998) conclude in their meta-analysis of the effects of schools on the racial gap that schools effects are ‘modest’ and exacerbate rather than ameliorate the very influential initial gap in school readiness. After a review of the evidence for the influences of six major hypothetical school level characteristics on the racial gap (school readiness, ability grouping, support for youth at risk, teacher-student racial matching, class size, and teacher quality), Ferguson concludes that “When all is said and done, the main concern is quality of teaching.” (Ferguson 1998, p. 366). Yang’s (2000) investigation that focused on the effects of the degree of “communal” school structure found a limited effect, only for achievement growth in science over the first two years of high school, but he also speculated that communal characteristics of schools might affect the achievement gap more than actual performance levels. The inconclusive findings explaining the racial achievement gap led Wilson (1998) to call attention to the structural sources of inequality as well as those operating at the individual level. From the list of articles we reviewed, only a few have combined multi-level modeling and large scale, nationally representative samples, and a strategy to decompose the racial gap effects into mediating factors. This lack of attention inspired our attempt to investigate the individual and school level effects on the racial gap in student achievement.

ANALYSIS STRATEGY AND MODELS EXAMINED

We explore possible explanations for the racial gap in 8th grader’s reading scores using the NELS 1988 baseline survey, a survey permitting multi-level decomposition of the gap. We employed the following strategy: first, we estimated an equation at the individual level to generate an unadjusted, unconditional estimate of racial gaps in tested reading. Then we added a set of individual level socio-economic variables to the individual level equation in order to examine changes in the coefficients for the racial gap indicators. These were:

- an indicator for being female (NELS Variable: SEX),
- level of parental education (NELS Variable: BYPARED),
- family income (NELS Variable: BYFAMINC),
- an indicator whether the student had a male guardian at home (NELS Variable: BYS8B),
- frequency of parents checking homework (NELS Variable: BYS38A),
- and indicators of the level of schooling parents expect the student to complete (NELS Variable: BYS4B).

In the next step, we first added a single compositional school level variable, the percent black, to determine the effect racial composition has on the individual level racial gap coefficient; and subsequently, three additional school level variables:

- percent black attending the school (NELS Variable: BYSC13D),
- percent of students receiving free or reduced price lunches (NELS Variable: G8LUNCH),
- percent of students enrolled with limited English proficiency (NELS Variable: BYSC15),
- and number of teachers with graduate degrees (NELS Variable: BYSC21).

In the multilevel model containing school effects, we only included school effects on the overall intercept and the individual racial gap coefficient measuring the gap between white and black students. This individual level racial gap coefficient is treated as a random coefficient that varies across schools. We can then assess to what degree, if any, school level properties affect the size of the racial gap between students in schools.

We followed this strategy first by analyzing models with detailed racial categories: white, black, Hispanic, Pacific Islander and asian, and Native American. These results are reported in Models 1-5 (Tables 2 and 3). In these models, we only modeled the black v. white racial gap coefficient as a function of the school level variables. However, because of the high degree of racial segregation across schools in this survey, too few students in the smaller racial categories drastically limit the number of schools that can be used to estimate some inferential test statistics in these models. The modeling strategy was replicated for a dichotomized racial category, non-white v. white; these results appear in Models 6-10 (Tables 4 and 5).

Individual-level Equation:

At the individual level, an 8th grade student's reading test score (normed to a mean of 50 and standard deviation of 10) is hypothesized to be a function of the student's race, sex, family income, parental education, absence of a male guardian, parental involvement, level of homework support by parents, and parental educational expectations. Incidence variables were created for the racial/ethnic categories of black, Hispanic, Asian and Pacific Islander (API), and Native American (NATAM). The category of white was left out as the reference category, so the coefficients for the racial/ethnic variables represent the racial gap in 8th grade reading scores between the specified category and whites. The following equation specifies the full set of effects estimated in stage one of our analysis (Model 3 in Table 2):

$$Y_{ij} \text{ (student's 8}^{\text{th}} \text{ grade reading test score)} = \beta_{0j} \text{ (average test score for school } j) + \beta_{1j}x_{1j} \text{ (student's race=black)} + \beta_{2j}x_{2j} \text{ (student's ethnicity=Hispanic)} + \beta_{3j}x_{3j} \text{ (student's race=API)} + \beta_{4j}x_{4j} \text{ (student's race=NATAM)} + \beta_{5j}x_{5j} \text{ (student's sex=female)} + \beta_{6j}x_{6j} \text{ (family income, midpoints in \$1,000)} + \beta_{7j}x_{7j} \text{ (parental education, a six level ordinal scale)} + \beta_{8j}x_{8j} \text{ (no male guardian present)} + \beta_{9j}x_{9j} \text{ (parental homework involvement)} + \beta_{10j}x_{10j} \text{ (parental expectations)} + r_{ij} \quad \text{Eq. 1}$$

The coefficient estimated for the racial indicator, black (β_{1j}) is of primary substantive importance in this analysis. Because this variable is dichotomously coded 0 = white and 1 = black, the coefficient estimates the racial gap (the expected score for black students minus the expected score for white students) on 8th grade student reading scores. We will compare the magnitude of this coefficient estimated from 4 models in order to determine how much of the racial gap the various models are able to decompose, or explain as being primarily due to other sources.

School-level Equations:

The models we examined in stage 2 of the analysis hypothesize that the average test score in school j is a function of the grand mean test score across all schools, school j 's student racial composition, particularly in this analysis, the percent black, the low-income status of school j measured by the percent of students on the school lunch program, school j 's percent of limited English proficiency status, and percent of teachers with graduate degrees. In equation form:

$$\beta_{0j} \text{ (intercept of student reference group reading score for school } j) = \gamma_{00} \text{ (grand mean test score across schools)} + \gamma_{01}w_{1j} \text{ (school } j\text{'s percent non-white)} + \gamma_{02}w_{2j} \text{ (low-income status at school } j) + \gamma_{03}w_{3j} \text{ (school } j\text{'s limited English proficiency status)} + \gamma_{04}w_{4j} \text{ (school } j\text{'s percent teachers with graduate degrees)} + u_{0j} \quad \text{Eq. 2}$$

A similar equation can be written for the coefficient representing the black/white racial gap, the only other 2nd order equation included in the models we analyzed:

$$\beta_{ij} \text{ (black/white test gap for school } j) = \gamma_{00} \text{ (grand mean test score across schools)} + \gamma_{11}W_{1j} \text{ (school } j\text{'s percent non-white)} + \gamma_{12}W_{2j} \text{ (low-income status at school } j) + \gamma_{13}W_{3j} \text{ (school } j\text{'s limited English proficiency status)} + \gamma_{14}W_{4j} \text{ (school } j\text{'s percent teachers with graduate degrees)} + u_{ij} . \quad \text{Eq. 3}$$

Stage 2 of the analysis treats the individual black/white gap coefficient as a random coefficient. Its value across schools depends on the school's racial composition, a measure of the composite poverty level (percent on school lunch program), the composite language ability of the student's classmates, and the degree of training of their teachers. We examine whether these school level variables have any ability to further decompose the racial gap after the individual level variables are included.

School characteristics are estimated to affect the racial gap at the individual level through two interaction effects. The first hypothesized effect is on the intercept representing the score of the white student reference group. The second hypothesized impact is on the racial gap coefficient. If a school characteristic has an ameliorative effect, reducing the gap, the estimate for this characteristic's effect will be positive because the individual gap coefficient is set up to show the black-white scores. Where white student scores are generally expected to exceed black student scores, the individual level racial gap coefficient will be negative. As higher levels of a school characteristic act to narrow the gap, a positive coefficient for that school characteristic will be estimated. If the school characteristic exacerbates the gap, the coefficient estimated will be negative.

Competing hypotheses predict different signs for the racial compositional effects at the school level. If black (or non-white) academic culture reinforces a non-achievement orientation, a negative school effect (coefficient) on the individual racial gap coefficient is predicted, indicating that the racial gap will be increased by higher proportions of black students. If racial marginalization alienates black (or non-white) students, a positive school level coefficient is predicted, since as black students become less numerically marginalized, the gap between their performance and those of white students should be reduced. A school level effect is also predicted for the intercept of the individual level equation, the expected performance of the reference group of white students. If the proportion of black students in a school acts to dilute the academic norms through lowered expectations of faculty and students, a negative coefficient would be estimated.

RESULTS

We first discuss the racial distribution across the schools in the NELS 88 baseline survey. The baseline individual level file contains 1052 schools, however, information on the racial composition or other variables was missing for 104 schools. In our analysis, the initial screening of valid cases included 948 schools. Of these schools:¹

- 146 (13.88%) were all white;
- 13 (1.24%) were all black;
- 57 (5.42%) had 0 whites;
- 514 (48.86%) had 0 blacks;
- 442 (42.02%) had 0 Hispanics;
- 510 (48.8%) had 0 Asians or Pacific Islanders; and
- 850 (80.80%) had 0 Native American students.

Table 2 summarizes the findings from the individual level models. All of the coefficients were specified as random and were not modeled by school level variables (unconditional random models). Model 1 establishes a baseline model and indicates that there is significant, but not large, variation in reading test scores across schools (intra-class correlation coefficient = .14). Model 2 establishes a benchmark for the unadjusted racial gap coefficients for all of the racial groups specified. We see that the racial gap between black and white students (-5.76) is the largest of any racial/ethnic category. Given the overall standard deviation of the test was normed to have a standard deviation of 10, the gap represents .576 of a standard deviation. This effect was specified as a random coefficient, and a standard deviation of 3.10 was estimated for this coefficient, which seems a substantial amount of expected deviation around the average gap of –

5.76 points (coefficient of variation = 53.8). the chi-square test of the hypothesis that this variation is equal to zero was only based on 30 cases and indicated the variation was not significant.

Model 3 includes the full set of individual level predictors. We are primarily interested in assessing the adjustment to the racial gap coefficients made when these 9 individual level variables are introduced. We learn that the black/white gap is reduced only a little, from -5.76 to -5.25 or 9%. The Hispanic/white gap is reduced the most, 21.7%, from -4.29 to -3.36. The Asian/white gap is actually increased, from -0.66 to -1.47 when the individual level socio-economic variables are included. The gap for Native Americans changes are comparable to those for the black/white gap.

Note the significant effects of the individual level characteristics on 8th grade reading scores coming from the set of parental expectations; that females perform better than males, that parental education and family income have the usual effects of increasing performance. Counter to our hypothetical reasoning, the status of whether a male guardian is present has no effect; and parental involvement in homework has the opposite effect expected – more parental involvement is associated with lower reading scores.

The next set of results, Models 4-5 in Table 3, include the same set of individual level predictors and add school level variables to explain some of the variation in the intercept and the black/white racial gap coefficient. Model 4 introduces one school level predictor, the percentage of blacks in each school. The expected individual level black/white test score gap across schools is now estimated to be -4.57. The percent black in the school has a significant effect on the intercept, the expected score of a student adjusted for zero levels on the individual level variables (a white, male student, from a family with average family income and education, whose parents expect them to graduate from high school only). However, the percent black in the school has no statistically significant effect on the racial gap, $\gamma_{11}=.01$. We do note that this positive effect is consistent with the marginalization hypothesis: as the percent of black students increases, controlling for all the individual level effects specified, the racial gap between blacks and whites decreases (this interpretation arises from noting that the expected racial gap coefficient is negative, and a positive term in the equation will decrease it).

To decompose, or explain, the magnitude of the black/white gap further, three additional school level variables were added in Model 5, Table 3: percent participation in school lunch programs, percent students with limited English proficiency, and the percent of teachers with graduate degrees. We note that none of these school level variables explained a significant amount of variation in the distribution of the racial gap coefficient across schools. The effects of two of these variables are consistent with their hypothesized effects: as the percent of school lunch participants increases, so too does the racial gap ($\gamma_{12}=-.02$); as the percent of teachers with graduate degrees increases, the racial gap decreases ($\gamma_{14}=.01$). However, as the percent of students with limited English proficiency increases, the racial gap decreases ($\gamma_{13}=.03$). But none of these coefficients reach statistical significance. We can estimate that taking into account both individual and school level variables reduced the initial black/white gap coefficient, -5.76, to a value 18 percent lower, -4.74.

One further means of interpreting these effects, even though statistically insignificant, is to imagine a 'virtual' pair of black and white students who show a reading test gap of -4.74, and then, through the artifice of statistical modeling, move from a school with 0 percent teachers with graduate degrees to one with 100%, and from a school with 100 percent students on a lunch program to one with 0%. The gap estimated in this model, -4.74, would be decreased by a combined 3 points to -1.74, a substantively appreciable amount. Compared to the initial baseline gap of -5.76, taking into account the individual level characteristics, school effects, and algebraically manipulating the characteristics of the schools attended by this virtual pair of students, the gap is reduced by roughly 70%.

Ideally the detailed racial categories provide more information in these types of analysis, but because of the sparse frequencies of the smaller racial categories, the number of schools used in for the variance components test statistics was drastically reduced, even though all the schools were used to estimate the coefficients. It is prudent, therefore, to repeat the analysis using a Non-white/White racial gap coefficient, even though meaningful details are lost. The results that parallel those just discussed appear in Models 6-10, (Tables 4 and 5). These models were able to utilize 296 of the schools surveyed in the variance component statistical tests, far

more robust results should be obtained. Results from Model 6, the baseline unconditional model, indicate that the random non-white/white gap coefficient has a significant variation across schools, a standard deviation of 3.67 points. The variance component estimates attributed 29% of the test score variation across schools.

Model 7 provides an initial estimate of the non-white/white reading test score gap, -4.29. This gap drops to -3.81 when all the individual level characteristics are added (Model 8), a change of 11%, relatively comparable to the 9% reduction estimated for the decomposition of the black/white test score gap attributable to individual level characteristics. We note briefly that the pattern of effects for the individual level characteristics parallels the first analysis: females do better, family education and income have positive effects on performance, parental expectations have significant effects, and again, the presence or absence of a male guardian has no significant effect. Consistent with the analysis of the detailed racial categories, the effect of involvement on homework counters our hypothetical reasoning, more involvement leads to lower scores.

In model 9 (Table 5), we add the percent black students attending the school as a predictor of the overall intercept and the non-white/white test score gap, controlling for the full set of individual level indicators. We see a significant effect on the non-white/white racial gap coefficient from the percent of black students attending the school, $\gamma_{11} = -.02$; and this coefficient, unlike the one estimated for the black/white gap coefficient, is negative, indicating that as the percent of black students increases, the test score gap between non-white and whites will increase. This ambiguous result accentuates the need for surveys and assessments that can support an analysis of detailed racial/ethnic gap patterns. It may be likely that the percent black in a school has a negative effect on the performance of other racial and ethnic groups, other than the black group itself, or that, more likely we think, as a variable, the percent black captures a great deal of information about the administrative capabilities of the school to deliver equal education, an effect which offsets the gains to non-white students from decreased marginalization.

The final set of results (Model 10) show that none of the other school level variables have significant effects on the non-white/white test score gap. The negative effect of the percent black in the school remains unchanged ($\gamma_{11} = -.02$). Two of the remaining three variables, percent participating in lunch programs ($\gamma_{02} = -.03$) and percent of teachers with graduate degrees ($\gamma_{04} = -.02$), have statistically significant impacts on the adjusted expectation of white student reference group performance. We don't know and can't estimate what causal process could generate the counter-hypothetical result of the negative effect ($\gamma_{11} = -.02$) of the percent of teachers with a graduate degree producing a decline in the predicted test score of a white male coming from an household with an average level of income and education where the parents expect only a high school education. Perhaps more highly educated teachers are unable to motivate or instruct students with low educational expectations inherited from their parents. The negative effect of the percent of students participating in school lunch programs on white performance is consistent with our hypothetical reasoning ($\gamma_{02} = -.03$).

The combined individual and school level variables reduce the estimated non-white/white test score performance gap from an initial value of -4.29 to -2.98, a 31% reduction in the estimated racial/ethnic gap in 8th grade performance. Given the causally distal nature of these school and individual level variables, the fact that we can explain over 30% of the test score gap between non-white and white students is encouraging for those pursuing the theoretical and research objectives of isolating those social, economic, and cultural factors that generate the performance gaps between whites and non-whites.

DISCUSSION

Our analysis has attributed 30% of the racial gap between non-white and white eighth-grade students' reading test scores to individual and school level effects. One equation was also used to demonstrate how, through algebraic assignment of a virtual pair of students, roughly 70% of the gap could be eliminated. In further analysis, several additional school level variables, amenable to policy manipulation, can be introduced in the model. For now, we have quantified some initial estimates of the effect of individual level and school characteristics such as poverty, lack of English proficiency, and school racial composition on decomposing the racial gap in eighth grade reading scores. The strategy of decomposing the racial gap in school performance by

taking into account individual and school effects can be extended to other racial/ethnic groups when there is sufficient data, not an easy condition given the degree of racial segregation across schools.

There is some slight evidence in the analysis presented in this paper that the gap between Hispanics and whites may be more 'decomposable' by introducing individual and school level variables than we found for the black/white gap. Focusing more on identifying and obtaining valid and reliable measures of the relevant school level characteristics that are amenable to policy intervention should be one of the major goals of researchers concerned about the disparate level of performance of students from different racial and ethnic statuses. Even with these distal indicators, substantial portions of the racial gaps between the major racial groups and white students can be decomposed into individual and school effects. As more state level assessment data becomes available, generated by the mandates of the No Child Left Behind Act, it may be possible to first model the factors that generate the racial gaps, and then, based on these robust results, design informed policies that eradicate it. We would like to see the day where it is only in the literature of ancient Greek tragedies that the shortcomings and foibles of one's parents, one's schools, or one's society are visited upon children.

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Table 1. Recent Research on the Racial Gap in Test Scores

Year	Author(s)/ Data Source	Theoretical Perspective	Racial Gap	Hierarchical Modeling																														
2001	Eisner/ Stanford Achievement Tests	N/A	<table border="0"> <tr> <td></td> <td>Reading</td> <td>Math</td> </tr> <tr> <td>Fourth grade</td> <td></td> <td></td> </tr> <tr> <td>White/Black</td> <td>18.0</td> <td>17.4</td> </tr> <tr> <td>White/Hispanic</td> <td>23.1</td> <td>21.0</td> </tr> <tr> <td>Eighth grade</td> <td></td> <td></td> </tr> <tr> <td>White/Black</td> <td>19.1</td> <td>18.8</td> </tr> <tr> <td>White/Hispanic</td> <td>25.8</td> <td>21.2</td> </tr> <tr> <td>Tenth grade</td> <td></td> <td></td> </tr> <tr> <td>White/Black</td> <td>16.3</td> <td>18.4</td> </tr> <tr> <td>White/Hispanic</td> <td>21.2</td> <td>19.1</td> </tr> </table> (measured as mean difference in points on Stanford Achievement Test)		Reading	Math	Fourth grade			White/Black	18.0	17.4	White/Hispanic	23.1	21.0	Eighth grade			White/Black	19.1	18.8	White/Hispanic	25.8	21.2	Tenth grade			White/Black	16.3	18.4	White/Hispanic	21.2	19.1	No
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2000	Roscigno/ NLSY	Human Capital	<table border="0"> <tr> <td></td> <td>Reading</td> <td>Math</td> </tr> <tr> <td>White/Black</td> <td>5.0%</td> <td>8.4%</td> </tr> <tr> <td>White/Hispanic</td> <td>6.2%</td> <td>4.8%</td> </tr> </table>		Reading	Math	White/Black	5.0%	8.4%	White/Hispanic	6.2%	4.8%	Yes																					
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2000	Bankston and Caldas/ LGEE	Human Capital	<table border="0"> <tr> <td>White/Black individual</td> <td>12%</td> </tr> <tr> <td>White/Black school</td> <td>9%</td> </tr> </table>	White/Black individual	12%	White/Black school	9%	Yes																										
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1999	Blair, Blair, and Madamba/ NELS	Human Capital	<table border="0"> <tr> <td></td> <td>Reading</td> <td>Math</td> </tr> <tr> <td>White/Black</td> <td>10.4%</td> <td>11.7%</td> </tr> <tr> <td>White/Hispanic</td> <td>12.2%</td> <td>14.7%</td> </tr> </table>		Reading	Math	White/Black	10.4%	11.7%	White/Hispanic	12.2%	14.7%	Yes, time series																					
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White/Black	14.9%																																	
1999	Hedges/ NELS	Human Capital	<table border="0"> <tr> <td>Eighth grade</td> <td>Reading</td> <td>Math</td> </tr> <tr> <td>White/Black</td> <td>.71</td> <td>.70</td> </tr> <tr> <td>Twelfth grade</td> <td>Reading</td> <td>Math</td> </tr> <tr> <td>White/Black</td> <td>.80</td> <td>.82</td> </tr> </table> (measured in standard deviation units)	Eighth grade	Reading	Math	White/Black	.71	.70	Twelfth grade	Reading	Math	White/Black	.80	.82	No																		
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1998	Bankston and Caldas/ LGEE	Human Capital	<table border="0"> <tr> <td>White</td> <td>34% scored below the mean</td> </tr> <tr> <td>Black</td> <td>71% scored below the mean</td> </tr> </table>	White	34% scored below the mean	Black	71% scored below the mean	Yes																										
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1998	Roscigno/ NELS, CCD	Human Capital	<table border="0"> <tr> <td></td> <td>Reading</td> <td>Math</td> </tr> <tr> <td>White/Black</td> <td>15.1%</td> <td>12.5%</td> </tr> </table>		Reading	Math	White/Black	15.1%	12.5%	Yes																								
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1994	Rivkin/ HSB, 1980 Census Data, 1980 FBI Crime Statistics	Time Allocation	<table border="0"> <tr> <td></td> <td>Reading</td> <td>Math</td> </tr> <tr> <td>White/Black males</td> <td>3.5%</td> <td>3.0%</td> </tr> <tr> <td>White/Black females</td> <td>3.1%</td> <td>3.0%</td> </tr> </table>		Reading	Math	White/Black males	3.5%	3.0%	White/Black females	3.1%	3.0%	Yes, time series																					
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White/Black males	3.5%	3.0%																																
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Note: CCD is the Common Core of Data
 HSB is the High School and Beyond survey
 LGEE is the Louisiana Graduation Exit Examination
 NELS is the National Educational Longitudinal Study
 NLSY is the National Longitudinal Study of Youth

Table 2: Individual Level Effects on Racial Gap Reading Scores – Detailed Racial/Ethnic Categories

Racial Gap Coefficient (Random Coefficients)	Model 1	Model 2	Model 3
β_{00} Reading test score (Intercept) Expected scores for Whites across schools (Model 1 All)	50.61*** (0.17)	51.83*** (0.15)	49.43*** (0.22)
β_{10} Black - White Test Score Gap (β_{10})	--	-5.76*** (0.31)	-5.25*** (0.30)
β_{20} Hispanic – White Test Score Gap (β_{20})	--	-4.29*** (0.36)	-3.36*** (0.32)
β_{30} API – White Test Score Gap (β_{30})	--	-0.66 (0.53)	-1.47*** (0.45)
β_{40} NATAM – White Test Score Gap (β_{40})	--	-5.70*** (.87)	-5.27*** (.83)
Individual-level Variables (Random Coefficients)			
Female(Male=0, Female=1)	--	--	2.18*** (0.17)
Parental education	--	--	1.65*** (0.09)
Family income	--	--	0.21*** (0.03)
Student does not live with father or male guardian (Male present = 0, No Male = 1)	--	--	0.06 (0.24)
How often parent checks homework (1=often, 4=never)	--	--	0.22** (0.08)
Parents expect student to attend a vocational/trade school†	--	--	-1.01** (.39)
Parents expect student to finish some college†	--	--	0.52 (.29)
Parents expect student to graduate college†	--	--	2.72*** (.20)
Parents expect student to attend graduate school†	--	--	5.32*** (.30)
Deviance of Model (degrees of freedom)	141098 (2)	140461 (16)	136365 (106)

† indicates an incidence variable created from response regarding expected level of attainment, graduate high school as reference category.

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

Table 3: Effects and (Standard Errors) for Multi-level Models Decomposing Racial Gap Coefficients – Detailed Racial/Ethnic Categories

Racial Gap Coefficients (Random Coefficients)	Model 4	Model 5
γ_{00} Reading test score (Intercept) Expected conditional scores for Whites across schools	49.73*** (0.21)	50.72*** (0.28)
γ_{10} Expected Black - White Test Score Gap (β_{10})	-4.57*** (0.57)	-4.74*** (0.71)
γ_{20} Expected Hispanic – White Test Score Gap (β_{20})	-3.28*** (0.31)	-2.92*** (0.32)
γ_{30} Expected API – White Test Score Gap (β_{30})	-1.32** (0.44)	-1.16* (0.44)
γ_{40} Expected NATAM – White Test Score Gap (β_{40})	-5.10*** (0.78)	-4.58** (0.74)
School Level Fixed Effects on Racial Gap Coefficient		
γ_{01} Effect of percent black on Reading test score Expected conditional scores for whites across schools (β_{0j})	-0.04*** (0.01)	-0.03** (.01)
γ_{02} Effect of percent students receiving reduced price lunch on expected conditional scores for whites across schools (β_{0j})	--	-0.03*** (.001)
γ_{03} Effect of percent students with limited English proficiency on expected conditional scores for whites across schools (β_{0j})	--	-0.03* (.02)
γ_{04} Effect of # teachers with graduate degree on expected conditional scores for whites across schools (β_{0j})	--	-0.02* (.01)
γ_{11} Effect of percent black students on black-white Racial Gap (β_{1j})	0.01 (0.01)	0.02 (0.01)
γ_{12} Effect of percent students receiving reduced price lunch on black-white score gap (β_{1j})	--	-0.02 (0.01)
γ_{13} Effect of percent students with limited English proficiency on black-white test score gap (β_{1j})	--	0.03 (0.02)
γ_{14} Effect of # teachers with graduate degree on black-white test score gap (β_{1j})	--	0.01 (0.02)
Individual-level Variables (Random, Unconditioned Coefficients)		
Female(Male=0, Female=1)	2.17*** (0.17)	2.17*** (0.17)
Parental education	1.65*** (0.09)	1.61*** (0.09)
Family income	0.20*** (0.03)	0.18*** (0.03)
Student does not live with father or male guardian (Male present = 0, No Male = 1)	0.09 (0.24)	0.10 (0.24)
How often parent checks homework (1=often, 4=never)	0.21* (.08)	0.21* (0.08)
Parents expect student to attend a vocational/trade school†	-1.00** (.39)	-0.98** (0.39)
Parents expect student to finish some college†	0.50 (.29)	0.52 (0.29)
Parents expect student to graduate college†	2.70*** (.20)	2.68*** (0.21)
Parents expect student to attend graduate school†	5.33*** (.30)	5.33*** (0.30)

† indicates an incidence variable created from response regarding expected level of attainment, graduate high school as reference category.

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

Table 4: Individual Level Effects on Racial Gap Reading Scores (Non-white/White)

Racial Gap Coefficient (Random, Unconditioned Coefficients)	Model 6	Model 7	Model 8
β_{00} Reading test score (Intercept) Expected scores for whites across schools (Model 1 All)	50.63*** (0.15)	51.78** * (0.15)	49.45*** (0.21)
β_{10} Non-white/white Test Score Gap (β_{10})	--	-4.29*** (0.26)	-3.81*** (0.23)
Individual-level Variables (Random, Unconditioned Coefficients)			
Female(Male=0, Female=1)	--	--	2.17*** (0.17)
Parental education	--	--	1.66*** (0.09)
Family income	--	--	0.23*** (0.03)
Student does not live with father or male guardian (Male present = 0, No Male = 1)	--	--	-0.06 (0.24)
How often parent checks homework (1=often, 4=never)	--	--	0.24** (.08)
Parents expect student to attend a vocational/trade school†	--	--	-1.02** (.39)
Parents expect student to finish some college†	--	--	0.49 (0.29)
Parents expect student to graduate college†	--	--	2.67*** (0.20)
Parents expect student to attend graduate school†	--	--	5.36*** (.30)
Deviance of Model (degrees of freedom)	141098 (2)	140557 (4)	136473 (67)

† indicates an incidence variable created from response regarding expected level of attainment, graduate high school as reference category.

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

Table 5: Effects and (Standard Errors) for Multi-level Models Decomposing Racial Gap (Non-white/White) Coefficients

School Level Fixed Effects on Racial Gap Coefficient	Model 9	Model 10
γ_{00} Reading test score (Intercept) Expected scores for conditional whites across schools	49.69*** (0.22)	50.71*** (0.32)
γ_{01} Effect of percent black students on expected scores for conditional whites across schools (β_{0j})	-0.03*** (0.01)	-0.01 (0.01)
γ_{02} Effect of percent students receiving reduced price lunch on expected scores for conditional whites across schools (β_{0j})	--	-0.03*** (0.01)
γ_{03} Effect of percent students with limited English proficiency on expected scores for conditional whites across schools (β_{0j})	--	-0.02 (0.03)
γ_{04} Effect of percent graduate degree teachers on expected scores for conditional whites across schools (β_{0j})	--	-0.02** (0.01)
Individual-level Variables (Random, Unconditioned Coefficients)		
Female	2.17*** (0.17)	2.17*** (0.17)
Family income	0.21*** (0.03)	0.19*** (0.03)
Parental education	1.65*** (0.09)	1.61*** (0.09)
Student does not live with father or male guardian	0.04 (0.24)	0.03 (0.24)
How often parent checks homework (1=often, 4=never)	0.21** (0.08)	0.21** (0.08)
Parents expect student to attend a vocational/trade school†	-1.03* (0.39)	-0.99* (0.39)
Parents expect student to finish some college†	0.46 (0.29)	0.49 (0.29)
Parents expect student to graduate college†	2.68*** (0.21)	2.64*** (0.21)
Parents expect student to attend graduate school†	5.36*** (0.30)	5.37*** (0.30)
Deviance of Model (degrees of freedom)	136428 (67)	136409 (67)

† indicates an incidence variable created from response regarding expected level of attainment, graduate high school as reference category.

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

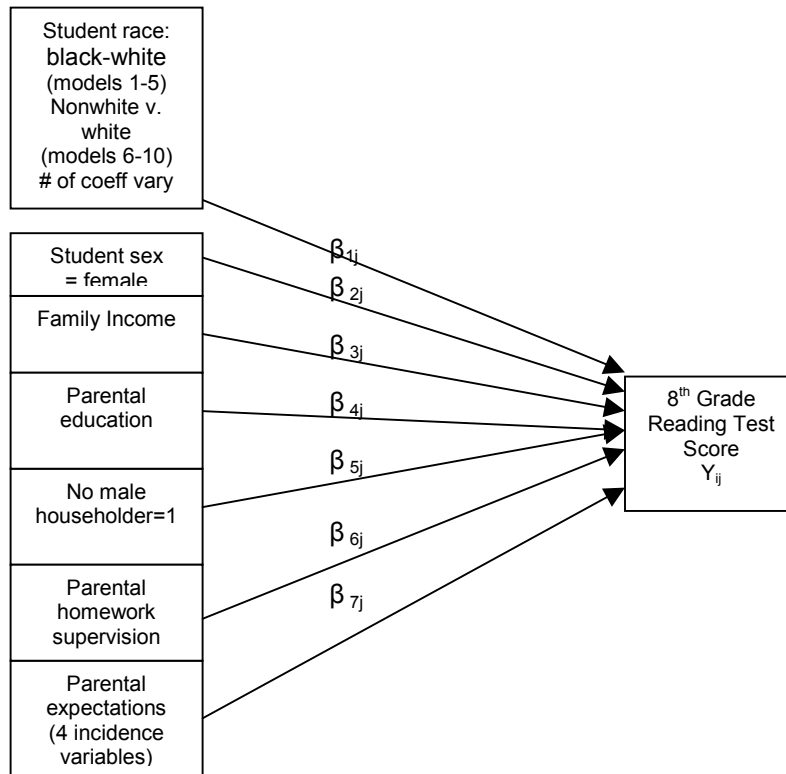


Figure 1. Individual Effects on Reading Test Score

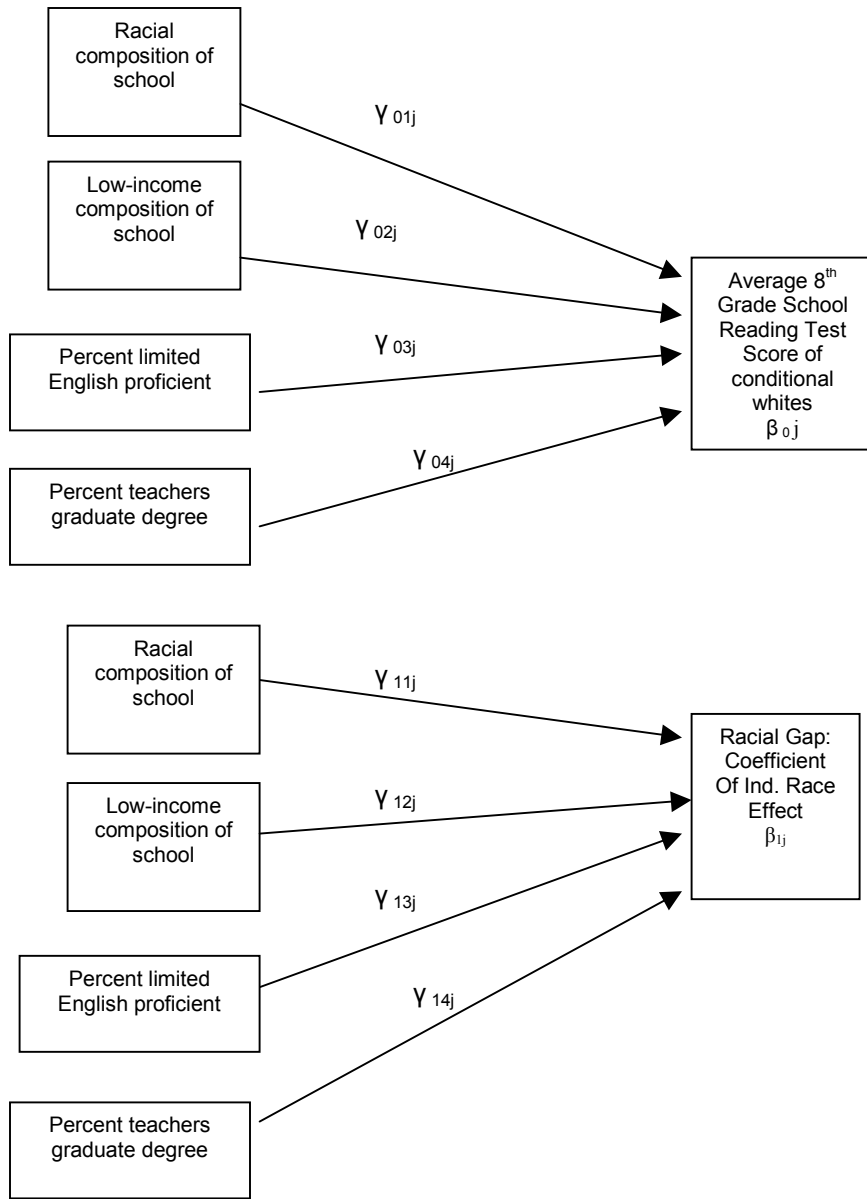


Figure 2. Interaction Effects on the Racial Gap Coefficient Modeled in the Multi-Level Equations

Footnotes

¹ The number of schools with complete racial information at the school level was reduced to 30, making the likelihood ratio tests of the random variation of these coefficients fairly unrobust.