Educational Evaluation and Policy Analysis
Winter 1992, Vol. 14, No. 4, pp. 377-396

The Impact of Racial and Ethnic Segregation on the Achievement Gap in California High Schools

Russell W. Rumberger
University of California-Santa Barbara

J. Douglas Willms
University of British Columbia and University of Edinburgh

This study examines the extent and impact of racial and ethnic segregation in California high schools during the 1988-1989 school year. We find that racial and ethnic segregation is widespread in California and that the extent of segregation varies widely among ethnic groups and among the six largest school districts. We also find significant differences in achievement levels across school districts and across schools within school districts, even after adjusting for differences in the background characteristics of students. The analysis suggests that segregation can, but does not always, lead to achievement differences across schools and among ethnic groups.

One of the major problems facing the educational system in the United States is the widespread inequality in educational achievement among racial and ethnic groups. On a variety of measures-high school completion rates, college participation rates, and standardized achievement tests-minorities have much lower levels of educational achievement than Whites (U.S. National Center for Educational Statistics, 1991, Tables 9, 98, 102–115). Although the achievement gap between minorities and Whites has improved over the last decade, a sizable gap still remains.

One reason for widespread concern over minority underachievement is that it involves substantial social and economic costs. Low educational achievement is associated with higher unemployment, lower earnings, higher crime, and a greater dependency on welfare and other social services (Rumberger, 1987). The social costs of these outcomes can be staggering. A recent study estimated that a cohort of dropouts from Los Angeles city schools-where minorities represent more than 50% of the students-costs state and local governments $3.2 billion in lost earnings and more than $400 million in social services (Catterall. 1987, Tables 3 and 4).

Another reason for the widespread concern over minority underachievement is that the minority population is growing faster than the White population. In 1982 minorities constituted about one quarter of the school-age population in the United States, but by the year 2020 they will constitute almost half (Pallas, Natriello, & McDill, 1989, Figure 2). In the state of California, racial and ethnic "minorities" already constitute the majority of students enrolled in the schools (Rumberger, 1989, Table 1). Thus the problem of educational underachievement is becoming less of a "minority" issue and more of a central educational issue, a fact recognized by a number of government and business leaders who have become the most outspoken advocates of improving the educational opportunities of minorities (e.g., Committee for Economic Development, 1987).

One of the factors that historically contributed to the inequality among racial and ethnic groups is segregation. Throughout much of our nation's history, minorities were educated in separate schools with far fewer educational resources than White students (Levin, 1979, Tables 3 and 4). But in 1954 the U.S. Supreme Court ruled in ***Brown v. Board of Education*** that segregated schools were inherently unequal no matter what level of educational resources were provided. Following the Brown decision, the courts actively attempted to reduce racial and ethnic segregation in many of the nation's schools through mandatory busing. But despite the court's efforts, Black segregation has declined only slightly since the 1960s, while Hispanic segregation has actually increased. By 1984, about two thirds of all Black and Hispanic students attended schools that were predominantly minority and almost one third attended schools that were more than 90% minority (Orfield & Monfort, 1988, Table 9). Now the courts appear to be abandoning their efforts to force school districts to integrate (Armstrong, 1991; Walsh, 1992). As a consequence, some communities are attempting to integrate housing in order to integrate schools (e.g., Schmidt, 1992a), while others are attempting to force school districts to redistribute resources more equitably among schools, even if they will not redistribute students (Schmidt, 1991, 1992b). The latter strategy is based on the premise that physical integration is less important than improving the educational achievement of minority students (Bates, 1990; Vergon, 1990).

This study examines the extent and impact of racial and ethnic segregation in California high schools during the 1988-1989 school year. The extent of segregation is measured in the state as a whole and within the six largest districts using two widely used but different indices of segregation. We find that racial and ethnic segregation is widespread in California, and that the extent of segregation varies widely among ethnic groups and among the six largest school districts. Approximately half of all high school students would need to change schools for the racial and ethnic composition of the high schools to reflect the racial and ethnic composition of the state. The impact of segregation on student achievement is estimated using a multilevel statistical technique that is appropriate for hierarchical data (e.g., students nested within schools). We use the technique to estimate the effect of student-level factors such as race, ethnicity, and family background and the independent effects of school-level factors that describe the socioeconomic and racial composition of schools and levels of school resources. Because many school-level factors were highly correlated, we could not independently assess the impact of school composition and resources. But we did find significant differences in achievement levels across and within school districts even after adjusting for differences in the background characteristics of students. The analysis suggests that segregation can, but does not always, lead to achievement differences across schools and among ethnic groups.

Previous Research Literature

Segregation can contribute to minority underachievement in at least two ways. First, students in segregated schools may receive a poorer quality education because schools serving predominantly minorities or low socioeconomic groups may have lower funding levels, poorer teachers. and lower levels of other resources that contribute to student achievement. There is a long-standing debate in the education research community over exactly how much and in what ways school resources contribute to student learning. The early studies of school effects by Coleman et al. (1966) and Jencks et al. (1972) argued that the differential effect of schools on student achievement was very small compared with the effects of students' socioeconomic background. And the majority of studies that have examined the effects of expenditures and other resources have shown insignificant or inconclusive results (Hanushek, 1986, 1989; Walberg & Fowler, Jr., 1987).

But many scholars claim that earlier studies of school effectiveness were flawed in two respects. First, the models used to estimate school effects were specified and estimated in such a way as to understate the effects of school resources. Typically, the models were specified at a school or district level, which did not adequately reveal the effect of educational resources on individual achievement after controlling for differences in student background (Bryk & Raudenbush, 1992; Raudenbush, 1988). Recent studies, using more appropriate statistical techniques, have shown consistently that a variety of school factors affect student achievement after controlling for student background (e.g., Lee & Bryk, 1989; Willms, 1986). Second, earlier studies of school effectiveness often used limited measures of school resources, such as expenditures per pupil. Studies using more detailed and varied measures of school resources, such as teacher quality and staffing ratios, have found more powerful and consistent effects on student achievement (e.g., Lee & Bryk, 1989; Stern, 1989; Summers & Wolfe, 1977).

Segregation may have adverse effects on minority achievement not only because of differences in educational resources but also because of differences in the racial and social class composition of the school. These differences, often referred to as “contextual effects,” can affect achievement over and above the effects associated with students' individual characteristics and family background. Contextual effects may stem from several factors: peer effects, which may result from either face-to-face interactions among students or symbolic interactions, such as competition, emulation, or identification associated with students' primary reference group; the academic, social, and disciplinary climate in the school; and teachers' expectations (Erbring & Young, 1979; Willms & Raudenbush, 1989).

Although few studies have examined contextual effects in detail, several studies have found that the social composition of the school can have significant effects on student achievement, even after controlling for the effects of school resources and individual background. Two earlier studies of student achievement examined the contextual effects associated with school mean socioeconomic status and percentage minority. Winkler (1975) found that both White and Black students in one California school district had higher eighth-grade achievement when the mean socioeconomic status of the students in the school was higher. At the same time, the achievement of Blacks was adversely affected by transferring from an elementary school to a junior high school with a lower proportion of Blacks. Summers and Wolfe (1977) found that school mean ability had a positive effect on low-ability students but a negligible effect on high-ability students in Philadelphia elementary schools. They also found that pupil achievement was higher in more integrated schools than in either high-concentration White or high-concentration Black schools. A recent study of 160 high schools throughout the United States found that the average mathematics achievement of students in high-concentration minority schools (greater than 40%) was about 15% lower than in low-concentration minority schools, after controlling for differences in student background and a variety of other school factors (Lee & Bryk, 1989).

Of course, contextual differences in schools can be related to differences in educational resources. For example, better principals and teachers may be more attracted to and be more likely to remain in schools with high-social-class or nonminority students. But these differences are largely independent and can be manipulated separately through policies; for example. school districts can establish policies that attract better principals and teachers to less popular schools. They can also redistribute other teaching resources and change the catchment areas of schools to alter their social composition.

Together, existing research suggests that segregation can adversely affect racial and ethnic achievement in two ways. First, it can lead to differences in school resources, which recent research suggests have an important impact on student achievement. Second, it can lead to differences in the social composition of schools, in terms of both race and social class, which also has been shown to affect student achievement through effects on peer interactions and on the teaching and learning climate in the school.

Research Design

This study examines segregation in California high schools for three reasons. First, California has a large concentration of minority students who are becoming increasingly segregated. Whereas about one half of all minority students were attending racially isolated schools in 1967, about 70% were attending racially isolated schools in 1984 (Haycock & Navarro, 1988, p. 9). Second. earlier school performance data revealed dramatic differences between schools with high concentrations of minorities and schools with low concentrations of minorities. In the 1986-1987 school year, 12th-grade reading and math scores on the California Assessment Program were 20% lower in high-concentration Latino and Black schools than in low-concentration Latino and Black schools (Haycock & Navarro, 1988, appendix). This meant that students graduating from high-concentration minority schools in the cities had about the same achievement level as those entering many of the suburban schools (Haycock & Navarro, 1988, p. 13). Moreover, some critics argue that the gap between the best-performing schools and the worst-performing schools may be widening, producing even greater disparities in educational outcomes (Woo, 1987). Third, California collects extensive data on individual students and schools that are necessary to carry out the complex statistical analysis used in this study.

Data and Samples

Two types of data were used in this study: data on schools and school districts and data on students. The data on schools came from the California Basic Educational Data System (CBEDS), which are collected by the California State Department of Education each year during the month of October from every teacher, school, and school district in the state. We used the 1988-1989 CBEDS data to analyze segregation and its impact on achievement in all regular high schools in the state (784) and in all high schools in the six largest districts in the state: Los Angeles Unified School District (54), San Diego City Unified School District (17), San Francisco Unified School District (12), East Side Union Unified School District (10), Kern Union High School District (10), and Grossmont Union High School District (9).

The data on students came from the California Assessment' Program (CAP). Each year the California State Department of Education administers achievement tests to all students in grades 3, 6, 8, and 12. The Grade 12 examinations are administered in December, while those for other grades are administered in the spring. In addition, a variety of demographic and educational information is collected from the students who take the tests. Most of the information is reported by students in their test booklets, but some information is reported by students' teachers. We used the CAP data for the 1988-1989 school year. Usable data were available for 198,127 12th-grade students. or 82% of all 12th-grade students that were identified in the October CBEDS data.'

Variables

Segregation was measured using CBEDS data on ethnic enrollment by school and school district. The state identifies the ethnic background of students by seven categories: (a) American Indian or Alaskan Native, (b) Asian, (c) Pacific Islander, (d) Filipino, (e) Hispanic, (f) Black, not of Hispanic origin, and (g) White. not of Hispanic origin. We concentrated our analysis on four ethnic groups-Asians. Blacks, Hispanics. and Whites-since they compose more than 96% of the student population. We did identify Filipinos separately from the other remaining ethnic groups in order to provide a clearer indication of ethnic achievement differences in the multivariate analysis (see below). But in the next section we only report results for the four largest ethnic groups.

To assess the impact of segregation on student achievement, several types of variables were constructed. First, we constructed dependent measures of student achievement. Then we constructed two types of independent variables: student-level variables that measure the effects of individual student characteristics on achievement and school-level variables that measure the effects of school characteristics on achievement.

Student achievemenr

Two measures of student achievement were used in this study: CAP scores on reading and CAP scores on mathematics. The CAP tests are administered through a matrix sampling technique whereby each student is assessed on only 10 reading and 10 mathematics questions out of a total of 240 possible questions in each area. This technique allows a broader range of questions to be assessed in a shorter amount of time and diminishes opportunities for cheating. Because each student answers only a few questions, CAP data do not provide reliable estimates of individual achievement. But they do provide reliable estimates of group achievement. The CSDE computes mean CAP scores for entire schools and for each ethnic group within each school. In a similar fashion, we used individual CAP scores to compute mean achievement levels for ethnic groups, schools, and school districts. To facilitate comparisons among groups and schools, we standardized the reading and mathematics scores at the individual level using the state means and standard deviations, and then calculated the means and standard deviations for each group. The means for each group are therefore expressed as "effect sizes," that is, as fractions of a standard deviation. This common metric allows for comparisons across racial and ethnic groups and across subject areas.

Student-level variables

We constructed a number of student-level variables that prior research has shown to influence student achievement. First, we constructed a series of dummy variables from the CAP data indicating whether students identified themselves as Asian, Black, Filipino, or Hispanic; female; or limited English proficient. We also constructed a dummy variable labeling a student as a "transient" if he or she entered high school after the 10th grade, since research suggests that tenure in a school could foster engagement and improve performance (Finn, 1989). Finally, we constructed an ordinal measure of parental education based on students' reports of their parents' education level as (a) not a high school graduate, (b) high school graduate, (c) some college, (d) college graduate, or(e) advanced degree.

School-level variables

We constructed a series of school-level variables to identify key features of schools that prior research suggests could influence student achievement apart from individual student characteristics. Two types of variables were of particular interest. The first were contextual variables that describe the socioeconomic composition and the racial and ethnic mix of the school. We constructed two contextual variables: mean parental education and the percentage of White students in the school. These variables were constructed by aggregating data from the student-level (CAP) file to the school level. The second type of variable pertains to resource levels at the schools. We constructed two variables to describe the teaching staff: mean education of teachers and mean years of teaching experience. These variables were constructed by aggregating the (CBEDS) teacher-level data to the school level. Level of education had six categories: (a) less than a bachelor's degree. (b) bachelor's degree. (c) bachelor's degree plus 30 or more semester hours, (d) master's degree. (e) master's degree plus 30 or more semester hours. and (f) doctorate. This variable was treated as a continuous variable. We also constructed a measure of the student-teacher ratio in the school, based on total school enrollments and the total number of teachers in the school.

Measures of Segregation

Segregation refers to the extent that students from different racial and ethnic groups are physically separated from each other. Segregation can occur ***among*** schools and ***within*** schools. Although there is an extensive literature on within-school segregation of students (e.g., Oakes, 1985), in this article we examine only between-school segregation of racial and ethnic groups.

We constructed two indices to measure two different aspects of segregation. These and other measures of segregation have been used extensively to examine residential segregation in cities and suburbs (e.g., Massey & Denton,1988a), but they have not been used as widely to examine segregation in schools. The mathematical formulae for the two indices are shown in the appendix.

The first measure of segregation is the dissimilarity index, which has a range of 0 to 1 and indicates the proportion of students that would have to change schools to achieve an even distribution of students across all schools in the state or in a given school district (Zoloth, 1976). We chose this index over competing indices (see Massey & Denton, 1988a) because of its wide use in the literature on school and residential segregation and for its straightforward interpretation for educational policy.

The second measure of segregation is the isolation index, which also has a range of 0 to 1 and may be interpreted as the probability that students are exposed to members of their own ethnic group rather than to members of other ethnic groups (Massey & Denton, 1988a, p. 289). The isolation index differs from the dissimilarity index in that it depends on the relative size of the minority group. For example, American Indians or Alaskan Natives may be unevenly distributed across schools in a district, but because they represent a small proportion of the total population in California school districts, they may not be isolated from students of other racial and ethnic backgrounds. The reverse is true for Hispanics in some districts, where they are the largest minority group.

We estimated segregation using both indices at two geographic levels. First. we estimated the degree of segregation in the entire state of California for all seven ethnic groups identified by the California State Department of Education. Then we estimated segregation levels in the six largest districts in the state for four ethnic groups: Asian, Hispanic, Black, and White. The other three ethnic groups, which compose less than 4% of California's total enrollment, were not included in district-level analyses because their sample sizes were too small to achieve reliable estimates.

In calculating segregation indices, we used total school enrollments, Grades 9 through 12. We also examined the extent of segregation for 9th-grade students only because we thought the estimates might differ from those based on total enrollment due to differences across schools in dropout rates for minority and nonminority students. However, the differences were negligible, so we have reported only those based on total enrollments.

Estimating the Impact of Segregation

We estimated the impact of segregation in several steps using a number of procedures. In the first step we simply computed the mean achievement levels in reading and mathematics for each ethnic and racial group in the entire state. This provides a base reference point to see the achievement gap that currently exists between various racial and ethnic groups. Our premise is that some of the observed gap can be attributed to differences in the background characteristics of students. and some to the characteristics of the schools that they attend. We also computed the mean achievement level within each of the six largest districts in the state. Again some of the observed differences in mean achievement levels across districts can be attributed to differences in the characteristics of the students in the districts, and some to differences in the schools within the districts.

In subsequent steps of the analysis we used a new statistical technique, known as hierarchical linear modeling (HLM). HLM is a powerful technique specifically designed to estimate models at two levels of interest: student-level models that operate *within* institutional units (similar to ordinary least squares regression) and school-level models that examine whether the student-level models vary systematically ***between*** institutional units (Bryk & Raudenbush. 1992). In effect. the school-level models use the estimated coefficients for the individual-level model from each institutional unit (school) and attempt to explain variation in those coefficients with school-level explanatory variables. Since the computer applications to generate HLM procedures have been available for only a few years and the data requirements are extensive, relatively few studies of school effects have employed HLM procedures. But research generated to date substantiates the notion that both individual-level and school-level factors contribute to student achievement (Lee & Bryk, 1989; Raudenbush & Willms, 1991).

Using HLM, we estimated a series of models for each of the six districts of interest. In our analyses we were interested mainly in two indicators of schooling outcomes: the average achievement level and the achievement gap between ethnic groups. We used HLM to establish whether these indicators vary significantly among schools in each district, before and after controlling for students' background. In districts where they did vary significantly, we attempted to discern whether the variation was related to differences in school context or school resources. The mathematical formulas for each of the models is shown in the appendix. Willms (1992) provides a discussion of the basic models and their applications for monitoring school performance. Here we simply describe the estimates that each model provides.

The first model was a "null" model with no independent variables, at either the individual or the school level. It was used to partition the variance in the outcome measure (reading or mathematics) into within- and between-school components. Typically. most of the variation in student achievement can be attributed to student characteristics, but a substantial proportion (usually between 10% and 20%) can be attributed to school characteristics.

In the next model, we estimated a within-school model using dichotomous variables for four ethnic groups: Asian, Filipino, Hispanic, and Black. The estimated coefficients provide a measure of the gap in achievement between each ethnic group and the reference category composed of the remaining three ethnic groups identified in the data: Native Americans and Alaskan Natives, Pacific Islanders, and Whites. Since the first two groups represent less than 1% in most districts, the reference category is predominantly White.

In these regressions we adjusted the values of the dichotomous variables by subtracting the state mean from each one. This process is known as "centering." Although it does not affect the estimated values of the achievement gap (regression slopes), it does transform the value of the intercept. With this transformation, the intercept provides an estimate of the mean achievement within each district assuming that the ethnic composition in the district was the same as the ethnic composition in the entire state. With these estimates it is possible to compare how effective school districts would be if they had similar ethnic populations.

The HLM analysis is also able to determine whether there are statistically significant differences in the estimated coefficients among schools in the district. If there were significant differences, then we attempted to model those differences with school-level variables. Finally, the HLM analysis provides estimates of the proportion of variance in the coefficients that is explained by the model. This information is useful in determining how "robust" the model is in explaining variance among schools, similar co the R^2 statistic in regression analysis.

In the third model we added to model 2 four variables pertaining to students' characteristics and family background: female. parental education. transient, and limited English proficiency. We estimated this model to determine the adjusted district means and the magnitude of the minority achievement gaps after controlling for the effects of background characteristics. Because we were not interested in modeling variation between schools in the effects of these background characteristics. we "fixed" their slopes to be the same (parallel) across schools.[2] In this model we again centered each variable on its state mean so that the intercepts represent the estimated mean achievement levels for students in the district with mean characteristics like those for the state as a whole.

In the fourth model we tested for the effects of school-level variables on between-school differences in adjusted mean achievement and the minority achievement gap. In particular, we were interested in estimating the effects of student characteristics in the school as a whole. referred to as school context, and the effects of school resources.

Unfortunately, we encountered two problems. First, these variables are highly correlated with each other. In the Los Angeles school district, for example, the sample estimates of the percentage of White students was highly correlated with mean parental education ($r = .768$), years of teaching experience ($r = .647$), and student-teacher ratio ($r = .439$). Therefore, it was impossible with these data to differentiate between the effects of the contextual variables and the effects of the resource variables on average student achievement in the district and the size of the minority achievement gap. Second, the numbers of schools within districts, with the exception of Los Angeles, were too small to accurately estimate models that included two or three school-level variables.

In order to address these problems, we decided to select a single school-level variable-mean parental education--to "explain" between-school differences in mean achievement and the minority achievement gap within each of the six districts. We selected this variable based on an analysis of Los Angeles in which we estimated separate models with school-context measures (percentage of White students and mean parental education) alone, school resource measures (mean teacher education, mean teacher experience, and student-teacher ratio) alone. and context and resource measures together. The analysis revealed that mean parental education had the largest independent effect on district mean achievement and the minority achievement gap. We suspect that this is the case because it serves as a good measure of school context and also serves as at least a partial proxy for school resources. whereas the resource variables are unable to serve as a proxy for school context.

Results

The Extent of Racial and Ethnic Segregation

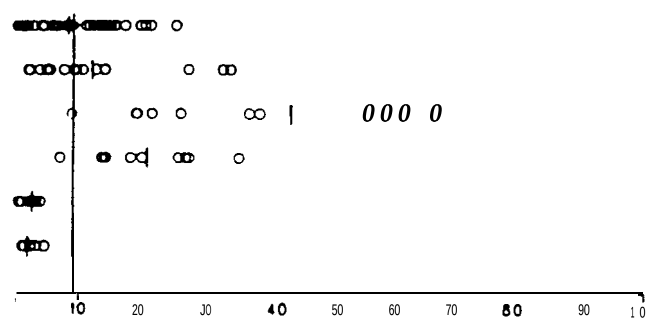
Results. for measures of segregation in California high schools are shown in Figure 1 for the four major ethnic groups: Asians, Blacks, Hispanics, and Whites. Results are shown for the six largest districts and for the state as a whole. Column 1 shows the mean proportion of each ethnic group in the district and in the state; column 2 shows the extent of dissimilarity, and column 3 shows the extent of isolation. In addition to the numerical measures, we generated dot plots that show the distribution of each ethnic group among the high schools within the district. The percentage of minority students in each school is represented by a small circle. The long vertical line drawn on each graph for each racial and ethnic group indicates the percentage of minorities in the state; the small vertical line drawn for each district indicates the percentage of minority students in each district. If there were no segregation within districts, the circles for each school would be centered on the small vertical line.

Statewide, Whites composed just over one half of the secondary school students in 1988-1989, Hispanics about one quarter. and Asians and Blacks 9% and 8%. respectively. American Indians, Alaskan Natives. Pacific Islanders, and Filipinos together made up only about 4% of the population. Among the four largest ethnic groups. the dissimilarity index (D) ranges from .446to .541, with the highest value for Blacks and the lowest value for Asians. These figures indicate that approximately one half of all students in California would have had to change schools to achieve an even balance of racial and ethnic groups across all high schools in the state. The isolation index (I) ranged from .205 for Asians to .668 for Whites. The large value for Whites indicates that in California high schools Whites tended to be exposed only to other Whites. Hispanics were the next most isolated. with an index of .470. followed by Blacks at .287 and Asians at .205.

The district figures show that the concentration of high school students varied widely across the six largest districts. Grossmont had the highest concentration of White students (.818); San Francisco and Los Angeles had the lowest concentrations (.140 and .195. respectively). Los Angeles had a much higher concentration of Hispanics (.527) than any of the other districts, about twice the state average, while San Francisco had a much higher concentration of Asians (.437), almost five times the state average. Blacks were more evenly distributed; Los Angeles. San Diego, and San Francisco had similar proportions that were about twice the state average (.166,.157, and .151, respectively).

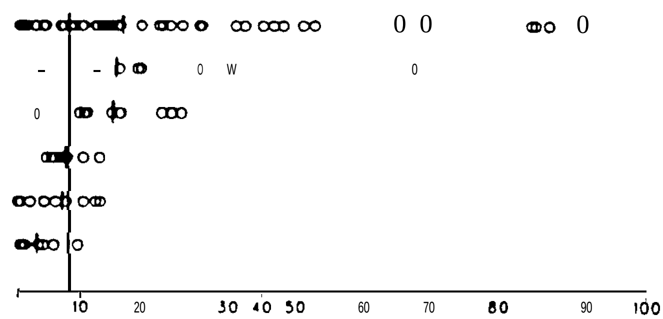
Asians

	P	D	I
Los Angeles	.081	.393	.137
San Diego	.120	.362	.202
San Francisco	.437	.361	.523
East Side Union	.208	.196	.235
Kern Union	---	.325	.027
Grossmont	.024	.193	.029
Statewide	.090	.446	.205



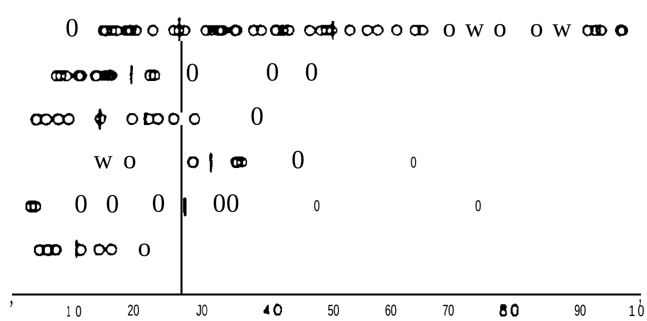
Blacks

	P	D	I
Los Angeles	.166	.530	.423
San Diego	.157	.345	.263
San Francisco	.151	.235	.186
East Side Union	.075	.122	.082
Kern Union	.071	.326	.103
Grossmont	.030	.419	.060
Statewide	.080	.541	.287



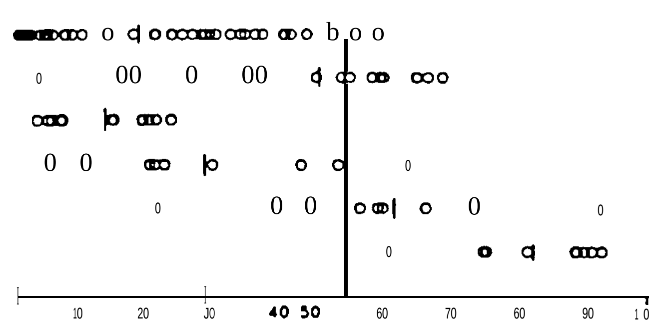
Hispanics

	P	D	I
Los Angeles	.527	.460	.662
San Diego	.191	.297	.257
San Francisco	.159	.420	.252
East Side Union	.3 18	.253	.380
Kern Union	.288	.415	.433
Grossmont	.104	.259	.134
Statewide	.271	.463	.470



Whites

	P	D	I
Los Angeles	.195	.542	.375
San Diego	.450	.334	.528
San Francisco	.140	.288	.180
East Side Union	.297	.344	.395
Kern Union	.597	.295	.656
Grossmont	.818	.3 10	.833
Statewide	.520	.475	.668



P=proportion of students D=dissimilarity index I=isolation index

FIGURE 1. ***Racial and Ethnic Segregation in California High Schools by Major District and Statewide, 1988***

Asians were more segregated in the three largest districts (Los Angeles, D = .393, I = .137; San Diego, D = .362, I = .202; and San Francisco, D = .361, I = .523) than in the other three districts. The figures show the importance of using the two measures of segregation; in each of these districts the proportion of students that would have to change schools to achieve an even balance is about the same (D ranges from .361 to .393), but in San Francisco, Asians were more isolated (I = .523, compared with .137 and .202). In Kern and Grossmont. the isolation index was low, indicating that Asians had considerable exposure to non-Asians in those districts.

Blacks also experienced a high degree of segregation in Los Angeles (D = .530, I = .423) and San Diego (D = .345, I = .263). In Grossmont, the dissimilarity index was high (D = .419), but the isolation index was low (I = .060) because only about 3% of the district population was Black.

Hispanics were segregated to a large extent in Los Angeles (D = .460, I = .662), San Francisco (D = .420, I = .252), and Kern (D = .415, I = .433). The isolation index for Los Angeles is particularly large. It is also high in East Side and Kern.

With the exception of Los Angeles, the dissimilarity indices for whites are not particularly high, but the isolation indices are high for Los Angeles (I = .375), San Diego (1 = .520), East Side (I = .395), Kern (I = .656), and Grossmont (I = .833). This means that districts tend to isolate Whites from non-Whites across schools.

Overall, the figures indicate a high degree of segregation in California high schools. These findings are consistent with recent national and state figures showing that minority students are still highly segregated in the nation's schools despite more than 20 years of desegregation efforts (Haycock & Navarro, 1988; Orfield & Monfort, 1988). On a more positive note, comparisons of these results with an earlier study of segregation in 23 California school districts by Zoloth (1976) show that segregation in most districts decreased substantially over the last 2 decades even though the number of ethnic and racial minorities in the state increased dramatically. Despite these trends, however, school segregation remains high. To a large extent, between-school segregation reflects the high level of residential segregation found in many cities (Denton & Massey, 1988; Massey & Denton, 1988b). But districts can create more equitable distributions of students among schools through a number of policy initiatives (see Bates, 1990; Vergon, 1990). Although some districts have been required by the courts to implement desegregation programs, others have voluntarily introduced measures such as redefining school catchment boundaries and creating magnet schools to attract certain types of students to particular schools.

School and Ethnic Differences in Achievement

The preceding analysis revealed that high school students are highly segregated among schools according to their ethnic and racial background. But does segregation lead to differences in educational achievement among schools? To address that question we first examine differences in mean achievement levels among high schools in each of the largest districts. and then achievement differences among racial groups within these districts. In the discussion we will refer to the results in both Tables 1 and 2.

School differences in mean achievement

The results reveal that mean achievement levels vary widely among the six largest school districts in the state (Table 1). Due to standardization, the mean achievement levels in the state have a value of 0 and a standard deviation of 1. As a result, the unadjusted mean values for the districts represent "effect sizes" relative to the state mean. In Los Angeles, for example, high school seniors had a mean reading achievement score of −.256 in 1988, which represents one quarter of a standard deviation below the state mean (subsequently referred to as −.256 SD). Mathematics achievement in Los Angeles was even worse-more than a third of a standard deviation below the state mean. Achievement test scores were also significantly below the state average in San Francisco, East Side, and the Kern school districts. In San Diego, student achievement

TABLE 1

Actual and Adjusted Values for Mean Achievement and the Racial and Ethnic Achievement Gap in California High Schools, Statewide and in the Six Largest School Districts, 1988

	Statewide		Los Angeles		San Diego		San Francisco		East Side		Kern		Grossmont	
	Reading	Math	Reading	Math	Reading	Math	Reading	Math	Reading	Math	Reading	Math	Reading	Math
Mean achievement														
Unadjusted	.000	.000	−.256**	−.338**	.025	.079	−.234*	−.147	−.153	−.167*	−.158*	−.212**	.119*	.105*
Adjusted for race/ethnicity	—	—	−.156**	−.230**	.067	.114*	−.054	−.014	.074	−.123*	−.143*	−.207**	.074	.076
Adjusted for race/ethnicity, pupil background	—	—	−.125**	−.180**	.047	.098**	−.023	−.004	−.028	−.077	−.088*	−.106*	.045	.048
Adjusted for race/ethnicity, pupil background, school context	—	—	−.075*	−.125**	.039	.076**	.173	.172	−.030	−.070	−.033	−.034	.028	.016
Contextual effect (parental education)	—	—	.218**	.232**	.126	.229**	.635*	.548	−.013	.070	.204*	.234*	.110	.280*
Asian/White achievement gap														
Unadjusted	−.301**	.134**	−.227**	.155**	−.467*	−.231**	−.488**	−.144*	−.370**	.084	−.080	−.056	−.271**	.108
Adjusted for pupil background	—	—	−.097**	.211**	−.210*	.009	−.185**	−.007	−.024	.297*	.123*	.203	−.168*	.214
Adjusted for pupil background, school context	—	—	−.076**	.223**	−.238**	.004	−.171*	.007	.002	.343**	.113	.191	−.167*	.259*
Contextual effect (parental education)	—	—	—	−.042	.287*	.140	.029	.052	.269	.163	—	—	—	−.277
Black/White achievement gap														
Unadjusted	−.514**	−.661**	−.325**	−.363**	−.435**	−.534**	−.414**	−.604**	−.225**	−.282**	−.129	−.362**	−.234*	−.345**
Adjusted for pupil background	—	—	−.324**	−.387**	−.391**	−.484**	−.402**	−.584**	−.245**	−.309**	−.229**	−.338**	−.315**	−.432**
Adjusted for pupil background, school context	—	—	−.342**	−.445**	−.389**	−.476**	−.395**	−.572**	−.256**	−.316**	−.230**	−.340**	−.315**	−.423**
Contextual effect (parental education)	—	—	−.79	−.262	−.000	—	—	.060	—	—	—	—	—	—
Hispanic/White achievement gap														
Unadjusted	−.489**	−.558**	−.350**	−.343**	−.392**	−.423**	−.331**	−.425**	−.255**	−.294**	−.294**	−.306**	−.143*	−.212**
Adjusted for pupil background	—	—	−.166**	−.214**	−.190**	−.234**	−.170*	−.328**	−.054	−.152**	−.134*	−.172**	−.068	−.128*
Adjusted for pupil background, school context	—	—	−.208**	−.282**	−.197**	−.210**	−.180*	−.329**	−.066	−.152**	−.122*	−.166**	−.068**	−.125*
Contextual effect (parental education)	—	—	[illegible]	−.239	—	−.223	−.080	—	—	—	—	—	—	—
Number of students	198,127		26,380		6,702		4,057		4,593		3,060		4,334	
Number of schools	784		54		17		12		10		10		9	

Note: Pupil background variables include parental education, transient, limited English, and female.
*Significant at .05 level. **Significant at .01 level.

TABLE 2
Estimates of the Pr of Pa Variance Explained for Six California School

Variance type	Los Angeles		San Diego		San Francisco		East Side		Kern		Grossmont	
	Reading	Math	Reading	Math	Reading	Math	Reading	Math	Reading	Math	Reading	Math
Variance components (Percentages)												
Within schools	89.7	84.2	95.3	93.5	83.6	80.0	92.9	95.7	95.3	93.4	98.5	97.9
Between schools	10.3	15.8	4.7	6.5	16.4	20.0	7.1	4.3	4.7	6.6	1.5	2.1
District mean achievement												
Parameter variance	.103**	.145**	.043**	.059**	.166**	.183**	.066**	.036**	.043**	.059**	.012**	.018**
Percentage parameter variance explained												
by race/ethnicity	9.5	1.6	64.6	46.4	14.4	19.7	15.6	41.5	44.7	13.2	0.0	15.3
by race/ethnicity pupil background	37.9	27.2	82.5	81.8	38.6	25.8	0.0	59.5	74.0	73.5	0.0	37.3
by race/ethnicity, pupil background, school context	54.1	39.9	87.7	93.7	57.1	36.8	0.0	45.1	84.9	83.4	0.0	66.9
Asian/White achievement gap												
Parameter variance	.006	.016*	.073**	.033	.058**	.030**	.046*	.066**	.004	.035	.004	.064*
Proportion parameter variance explained												
by pupil background	—	44.9	85.2	81.3	86.3	55.0	60.7	25.7	—	—	—	11.7
by pupil background, school context	—	39.6	90.1	89.3	84.6	46.6	43.2	0.0	—	—	—	0.0
Black/White achievement gap												
Parameter variance	.009*	.049**	.007	.009	.010	.049*	.002	.009	.039	.001	.008	.030
Proportion parameter variance explained												
by pupil background	33.8	46.7	36.4	—	—	29.9	—	—	—	—	—	—
by pupil background, school context	63.1	82.8	58.7	—	—	27.3	—	—	—	—	—	—
Hispanic/White achievement gap												
Parameter variance	.010**	.040**	.010	.037*	.024	.025	.003	.002	.001	.003	.001	.004
Proportion parameter variance explained												
by pupil background	30.7	51.7	—	53.4	90.0	—	—	—	—	—	—	—
by pupil background, school context	72.2	82.9	—	69.5	86.3	—	—	—	—	—	—	—

Note. Pupil background variables include parental education, transient, limited English, and female.
*Significant at .05 level. **Significant at .01 level.

was on par with the state average, while in Grossmont, students scored more than .l SD above the state mean.

While these figures reveal the average level of achievement in the district, they do not reveal how much variation there is in student achievement among schools within the district. The figures in the top row of Table 2 reveal the extent of this variation, particularly the proportion of variance in the two outcome measures that exists within and between schools in the six districts. As we suggested earlier, most of the variation in achievement occurs within schools and can be attributed to differences in students. But in some districts, particularly Los Angeles and San Francisco, there is substantial variation in achievement among schools.

These differences are also revealed in the values for the estimated parameter variance for district mean achievement. The values are much higher for Los Angeles and San Francisco than for the other school districts. Yet the values in all six districts were statistically significant, which means that there were significant differences in average achievement among high schools in all six districts.

Some of these differences can be attributed to differences in the characteristics of students. We therefore estimated values of district means with statistical adjustment for race and ethnicity, student background, and school context. The adjusted values for mean student achievement shown in the top part of Table 1 are the estimated achievement levels in the six districts assuming that the composition of students in each district was the same as in the state as a whole. Any remaining differences among districts reveal the impact of school factors on student achievement since the effects of student factors have been controlled. The adjusted values therefore provide a much more appropriate basis for comparing the performance of school districts (Willms, 1992).

The first set of estimates are adjusted for differences in the race and ethnicity of the students. In most cases, these adjustments reduce some of the disparities among districts. In Los Angeles, for example, the mean reading achievement level rises from −.256 SD to −.156 *SD* after adjustment for racial and ethnic composition. In most cases the adjusted achievement levels are closer to the state average than the actual levels. This means that these school districts have relatively low levels of academic achievement, in part, because they enroll higher concentrations of minority students than other districts in the state. In other words, school-district performance results would be better in these school districts if they enrolled students like those found in the state as a whole. By the same token. in school districts with lower concentrations of minorities, like Grossmont. enrolling students like those found in the state as a whole would reduce some of their apparent superior performance.

The next set of estimates is adjusted for both racial and ethnic composition and other student characteristics-gender, transient, limited English proficiency, and parental education. These adjustments further reduce the disparities among these six districts. In fact. these estimates suggest that San Diego, San Francisco, East Side, and Grossmont would perform at about the state average if they enrolled students with characteristics similar to the state average. In mathematics achievement, San Diego would actually do significantly better than the state average. Los Angeles and Kern would continue to perform significantly below the state average.

The final set of adjustments controls for contextual differences in parental education in addition to student background characteristics. These adjustments eliminate all disparities in achievement among the six districts, with the exception of Los Angeles.

The estimated effects of mean parental education vary by district. Mean parental education has a strong and significant effect on both reading and math achievement in Los Angeles and Kern school districts, on reading achievement in San Francisco, and on math achievement in the Kern and Grossmont districts. In Los Angeles, for example, a 1 *SD* increase in mean parental education in Los Angeles schools would increase mean achievement levels by more than .2 *SD*. These results suggest that average achievement levels are higher in schools with students of higher socioeconomic status, independent of the effects of individual socioeconomic status on individual achievement. And they are consistent with virtually all school-effects studies that have found strong and powerful effects of school context, particularly using measures of average parental socioeconomic status (e.g., Lee & Bryk, 1989; Willms 1986).

Yet in some districts, such as East Side, San Diego (in reading), and Grossmont (in reading), the effects of mean parental education were small and not statistically significant. But in all cases, with the exception of reading for East Side (−.012), the effects were positive. The accuracy with which we can estimate the effects of context or other school-level variables depends on both the number of students and the number of schools in the analysis. This could account for our failure to find a statistically significant effect, particularly in the smaller districts. One possibility is that school context has a negligible influence in these districts: another possibility is that school contest has an important effect, but the analysis is not powerful enough to detect it.

The figures in the top part of Table 2 reveal how well these adjustments explain between-school differences in mean achievement levels. In San Diego and Kern. adjustments for individual student characteristics alone—ethnicity, gender, parental education, transience, and English proficiency-explain more than three quarters of the between-school differences in student achievement. These adjustments also explain about 60% of the between-school variation in math achievement in East Side. But in Los Angeles, San Francisco, and Grossmont, the adjustments explain only about a third of the between-school variation. The inclusion of mean parental education in most cases increased the proportion of variation in mean achievement explained by the model. But in some districts, the variation among schools in mean achievement was small to begin with, and most of the variation could be explained by pupil-level characteristics. In the two districts that had the largest variation between schools in mean school achievement, Los Angeles and San Francisco, mean parental education explained about 11% to 18% of the variation, after student-level factors had been taken into account.

Racial and ethnic differences in achievement

We now turn to racial and ethnic differences in achievement. The unadjusted values for the achievement gap shown in Table 1 reveal large disparities among racial and ethnic groups in the state as a whole and within the six largest school districts. Statewide, the achievement gap between Whites and minorities in 1988 was generally negative and very large. The achievement gap between Whites and Blacks and between Whites and Hispanics in both reading and math was about −.5 *SD.* The gap between Whites and Asians in reading was somewhat smaller. about a third of a standard deviation. And in mathematics achievement, Asians scored higher than Whites by more than a tenth of a standard deviation.

Within the six districts. the achievement gap was mostly negative and significant. meaning that minorities scored significantly lower than Whites in reading and math. But for each ethnic group, the size of the gap varied a great deal among the six districts. For Asians and Blacks it tended to be largest for San Diego and San Francisco. For Hispanics, the gap was more uniform across the six districts. In some cases the gap was either insignificant or positive. In the Kern high school district, there was no significant achievement gap between Whites and Asians and between Whites and Blacks (in reading). There was also no significant gap in math achievement between Whites and Asians in East Side. Asians had a positive achievement gap in math in Los Angeles, which means they scored higher than Whites.

In most cases, the size of the achievement gap for Asians and Hispanics is greatly reduced after controlling for differences in background characteristics. In general, the reduction is greater in reading achievement than in mathematics achievement. In fact, in the East Side district, a sizable and significant achievement gap in reading for Asians and Hispanics becomes insignificant after controlling for these characteristics. In San Diego and San Francisco, the Asian achievement gap in mathematics also becomes insignificant. And in Grossmont, the Hispanic achievement gap in reading becomes insignificant.

Overall, the results indicate that a sizable portion of the achievement gap for Asians and Hispanics is due to their family and individual circumstances: lower levels of parental education, higher rates of transience. and limited English proficiency. But these characteristics explain very little of the achievement gap for Black students, and in all six districts the Black achievement gap is generally much larger than for any other minority group (except in San Diego and San Francisco for reading achievement). In other words. Blacks would continue to perform more poorly than other ethnic groups and than Whites even if they had the same family backgrounds, rates of transience, and English proficiency. This finding is consistent with Ogbu's argument that African-Americans represent "involuntary" minorities who perform poorly in school not because of differences in socioeconomic status. but because of cultural differences of how they relate to schooling and how schooling relates to them (Ogbu, 1989).

As in the case of average school achievement. these figures only show whether there was an average achievement gap between Whites and minorities within the six districts. To determine whether there were significant differences in the achievement gaps among schools within the districts, we have to examine the parameter variance estimates in Table 2.

The estimates reveal that in most districts, there were significant differences among schools in the size of the achievement gap for Asians, but not for Blacks or Hispanics. The exception was in Los Angeles, where there were significant differences in the size of the achievement gap for all ethnic groups. And in the Kern school district, there were no significant differences in the size of the achievement gap for any minority group.

In most cases the analysis was not powerful enough to discern differences among schools in the size of the racial and ethnic achievement gaps because the variability in the estimates of the achievement gaps due to measurement and sampling error were relatively large compared with the amount of variability among schools in their achievement gaps. Los Angeles was the exception, where there was considerable variability among schools. Nonetheless, in those cases where there were significant differences among schools in the size of the achievement gap, we further adjusted the minority achievement gap for differences in school context. The results of these estimates are shown in Table 1.

In most cases, controlling for school context had little effect on the minority achievement gap. The negative achievement gap between Whites and minorities remained. And except in Los Angeles and San Diego (in reading). school context had no significant impact on the size of the achievement gap, In Los Angeles, the results suggest that increasing mean parental education by 1 ***SD*** would increase mean school achievement by .218 ***SD*** in reading and .232 ***SD*** in math. but it would also exacerbate the achievement gap between Whites and Blacks (by −.179 *SD* in reading and by −.262 ***SD*** in math) and between Whites and Hispanics (by −.185 ***SD*** in reading and by −.239 ***SD*** in math). In San Diego, the effects of mean parental education on reading achievement was stronger for Asians than it was for Whites, at least in reading (.287 ***SD***). The lack of association between school context and the minority achievement gap outside of Los Angeles and San Diego is consistent with Lee and Bryk (1989), who found no differential effect of mean SES on minority achievement for a national sample of high schools.

The estimated parameter variances in Table 2 show that, in many cases, a large proportion of the between-school variance in the minority achievement can be explained by student background characteristics and school context.

Summary and Conclusions

This study examined the extent of racial and ethnic segregation in California high schools and attempted to assess whether segregation contributes to differences in achievement between ethnic groups. A detailed assessment of these issues necessarily requires complex statistical methods because variables at one level of the schooling hierarchy can affect the relationships between variables at other levels. Our analysis employed a multilevel regression technique in an attempt to address this problem, but was only moderately successful. Nonetheless, we can draw conclusions not only for policymakers concerned with school segregation and minority achievement, but also for administrators who wish to use monitoring data to examine questions concerning why schools vary in their achievement or why some schools are more successful in reducing inequities between racial and ethnic groups.

We found that the extent of segregation was large in the state as a whole and within each of the six largest school districts. We used two measures of segregation: one that indicated dissimilarities in the racial and ethnic mix of schools (dissimilarity index). and one that indicated the amount of exposure that members of a racial or ethnic group had to members of other groups (isolation index). About one half of all students in California would have had to change high schools for the schools to represent the racial and ethnic composition of the state in 1988-1989. Across the six districts we examined, the dissimilarity index indicated that about one quarter to one half of the students would have had to relocate schools to achieve a consistent racial and ethnic mix among schools. Estimates of the isolation index showed that although some racial and ethnic groups (e.g., American Indians, Asians, Pacific Islanders, and Filipinos) were unevenly distributed among the district's schools. their numbers were relatively small so that they were exposed to members of other groups.

White students had the least exposure to members of other groups because they attended schools that were predominantly White. This may have important implications for desegregation plans. Given that White students, on average, come from more advantaged backgrounds and have higher levels of achievement, the proportion of White students in a school may be critical to determining the climate of a school and its levels of teaching and nonteaching resources. If so, desegregation policies should be aimed at attracting White students to schools that are not predominantly White. Desegregation policies that result in a redistribution of other ethnic groups might not have the same effect.

Our analysis of school achievement assumed that in districts where segregation is high, there is wide variation in the "context" or climate of the schools. One could ask therefore whether a Black pupil would fare better in a school that was predominantly White, predominantly Black, or racially integrated. Initially, we attempted to estimate the effects of several indicators of context (e.g., percentage White, percentage Black, percentage Hispanic, etc.), but found that these variables were too highly correlated with each other, and the number of variables reduced the statistical power of our analyses. A simple way to overcome this problem was to operationalize school context by the mean level of parental education in the school. This gave us an overall indication of the effects of segregation, but did not allow us to ask more particular questions like whether students of each minority group would fare better in schools with a particular racial and ethnic mix. Racial and ethnic segregation may also be reiated to the levels of teaching and nonteaching resources in a school. But here, too, we found that indicators of school resources were too highly correlated with our measure of context.

Our inability to separate the effects of context from resources has implications for those attempting to monitor school performance. Schools and districts are likely to find it more useful to monitor changes in the racial and ethnic achievement gap from year to year than to emphasize differences among schools or districts. Researchers attempting to assess the impact of various reforms could achieve a more powerful analysis than this cross-sectional analysis by examining whether ***changes*** in school context or resources are associated with ***changes*** in school performance or changes in the ethnic achievement gaps among schools (see Willms & Raudenbush, 1989). Another shortcoming of the present analysis is that there was no control measure for the academic achievement or ability of students at the time they entered secondary school. Thus our estimates of the variation in adjusted school means represent the cumulative effects of both primary and secondary schooling, not the unbiased estimates of secondary school effects. For the same reason, our estimates of the contextual effect may be upwardly biased (see Hauser, 1970).

Despite these limitations, the analysis of student achievement yielded several important conclusions. First, there was substantial variation in achievement across school districts and across schools within each district. Many, but not all, of these differences could be explained by differences in the background characteristics of students-their ethnicity, gender, parental education, transience, and English proficiency. After controlling for student-level characteristics, there was little variation in mean achievement among school districts, although mean achievement in Los Angeles still remained significantly below the state average. Within some of the school districts. however, there remained significant variation among schools. The remaining variation in these districts was significantly related to mean parental education. This suggests that students attending schools with high levels of mean parental education are likely to fare better than if they attended schools with low parental education. In Los Angeles, this "contextual effect" was stronger for Whites than it was for Blacks or Hispanics. In other districts the effect did not differ significantly across racial and ethnic groups.

Second, there was a substantial achievement gap between racial and ethnic groups. This, too, varied among districts and among schools within districts. Controlling for family background reduced the size of the achievement gap for Asians and Hispanics, but not for Blacks. Controlling for family background also reduced the variation in the achievement gaps among school districts and among schools within districts. But in most cases the analysis was not powerful enough to discern differences among schools in the size of the racial and ethnic achievement gaps due to small sample sizes.

Third, even with these adjustments, substantial differences remain among school districts in both mean achievement levels and mean achievement differences between Whites and minorities. Controlling for differences in student characteristics revealed that mean achievement levels would be comparable to the state average in five of the six districts, but not in Los Angeles. But the biggest variation was in the size of the minority achievement gap. In some districts, minority achievement levels were actually comparable to Whites after controlling for differences in background, but only for certain groups, primarily Asians.

Our analysis confirms the widely supported tenet that differences in students' backgrounds can explain many of the differences we observe in the performance of schools and the performance of ethnic groups. But they cannot explain all of the differences. If schools enrolled students with identical characteristics, we would still see substantial variation in the performance of schools and students.

Nevertheless, our results suggest that students, in general, achieve better results when they attend a school with higher average parental background. Because minority students are less likely to attend schools with favorable school contexts. they are less able to capitalize on contextual effects. Efforts to desegregate students are therefore likely to reduce differences in achievement. What our analysis is unable to do, however, is determine whether these differences could be eliminated just as effectively through changing the distribution of resources.

What this and other research suggests is that both types of changes would probably help reduce the minority achievement gap. Educational policymakers can alter the social composition of schools by redefining catchment areas and through magnet school programs or other choice mechanisms. Or they can redistribute resources among schools to help compensate for the adverse effects of social composition.

But choosing one strategy over the other may be less effective than pursuing both strategies together because context and resources are closely linked. For example, teachers with more education and experience may be attracted to and remain longer in those schools with more "desirable" students because they probably find it easier to maintain discipline, hold high expectations, and provide an enriched curricula in such schools than in schools serving more disadvantaged students. Given these forces, reforms that both alter the social composition of schools and redistribute resources may be the most successful.

APPENDIX

Measures of Segregation

Dissimilarity index. The dissimilarity index is defined as:

$$D = \frac{\sum_{i=1}^{m} t_i \left| p_i - P \right|}{2TP(1-P)}$$

where t_i and p_i are, respectively. the total enrollment and the proportion of minority students in school i; T and P are the total enrollment of the state or district and the proportion of minority students in the state or district: and m is the number of schools.

Isolation index. The isolation index is defined as:

$$I = \sum_{i=1}^{m} \left[\frac{x_i}{X}\right] * \left[\frac{x_i}{t_i}\right]$$

where x_i and t_i are, respectively, the minority enrollment and total enrollment in school i. and X is the state or district enrollment of minority students, and m is the number of schools in the state or district.

HLM Models

Model 1. The first model is referred to as a "null" model, which specifies the following student-level model for each school:

$$(\text{Achievement})_{ij} = \beta_{0j} + \epsilon_{ij} \qquad (1a)$$

where $(\text{Achievement})_{ij}$ is the reading or mathematics score for pupil i in the school j. These scores are represented as a school mean, β_{0j}, and a student-level residual, ϵ_{ij}. Notice there is a separate β_0 for each of the j schools. In the between-school model, the school means are represented as a district mean, and as a school-level residual:

$$\beta_{0j} = \theta_{00} + \mu_{0j} \qquad (1b)$$

where θ_{00} is the district mean, expressed as an effect size relative to the state average. The school-level residuals, μ_{0j}, are the deviations of each school's mean from the state average. HLM combines equations (la) and (lb) and provides estimates of θ_{00} and the variances of the residual terms, $\text{Var}(\epsilon_{ij}) + \text{Var}(\mu_{0j})$. The ratio of the between-school variance $[\text{Var}(\mu_{0j})]$ to the total variance $[\text{Var}(\epsilon_{ij}) + \text{Var}(\mu_{0j})]$ is an indication of the extent to which schools differ in their achievement.

Model 2. In model 2, the student-level model is:

$$\begin{aligned}(\text{Achievement})_{ij} = \beta_{0j} &+ \beta_{1j}(\text{Asian})_{ij} \\ &+ \beta_{2j}(\text{Filipino})_{ij} \\ &+ \beta_{3j}(\text{Black})_{ij} \\ &+ \beta_{4j}(\text{Hispanic})_{ij} + \epsilon_{ij} \qquad (2a)\end{aligned}$$

where Asian, Filipino, Hispanic. and Black are dichotomous variables denoting membership in those groups. These coefficients can be interpreted as the achievement gap between these groups and the reference category, which consists primarily of Whites. Due to centering, the estimates of the β_{0j} are the predicted achievement scores for a hypothetical pupil who had state-average characteristics.

The school-level model for these regressions includes a separate equation. like equation lb. for each of the β_j's:

$$\beta_{pj} = \theta_{p0} + \mu_{pj}, \text{ for } p = 0, 1, 2, 3, 4 \qquad (2b)$$

$\text{Var}(\mu_{0j})$ is the variance of the school means adjusted for race and ethnicity. The variance of the remaining μ_j's indicate the extent to which the racial and ethnic achievement gap varies across schools. The HLM program includes Chi-square tests of whether these variances differ significantly from zero. If they were not statistically significant, we constrained the slopes to be parallel in subsequent regressions (i.e., fixed effects); otherwise we allowed them to vary (i.e., random effects) and attempted to model their variation on school-level variables.

Model 3. In model 3, the student-level model is:

$$\begin{aligned}(\text{Achievement})_{ij} = \beta_{0j} &+ \beta_{1j}(\text{Asian})_{ij} \\ &+ \beta_{2j}(\text{Filipino})_{ij} \\ &+ \beta_{3j}(\text{Black})_{ij} \\ &+ \beta_{4j}(\text{Hispanic})_{ij} \\ &+ \beta_{5j}(\text{Female})_{ij} \\ &+ \beta_{6j}(\text{Pared})_{ij} \\ &+ \beta_{7j}(\text{Transient})_{ij} \\ &+ \beta_{8j}(\text{LEP})_{ij} + \epsilon_{ij} \qquad (3a)\end{aligned}$$

where, in addition to the ethnicity variables for model 2. we added dummy variables indicating female, transient, and limited English proficiency

(LEP), and an ordinal variable indicating level of parent's education.

The school-level model is the same as in model 2. For each β_j in equation (3a), we specify a model:

$$\beta_{pj} = \theta_{p0} + \mu_{pj}, \text{ for p} = 0, 1, 2, 3, 4, 5, 6, 7, 8 \quad (3b)$$

Again, $Var(\mu_{0j})$ is the variance of the school means adjusted for race, ethnicity, family background, and student characteristics. The variance of the remaining μ_j's indicate the extent to which the student variables vary across schools. In this model, we fixed the effects of the family and student characteristics other than race and ethnicity to be the same (parallel) across all schools.

Mode14. In model 4, the student-level equation is the same as in model 3. In the school-level equation the β_j's for the nonethnicity coefficients are fixed. For the other β_j's the school-level equation is:

$$\beta_{pj} = \theta_{p0} + \theta_{p1} \text{ (mean parental education)} + \mu_{pj}, \text{ for p} = 0, 1, 2, 3. 4 \quad (4a)$$

In these regressions we are interested primarily in the size and statistical significance of the contextual effects, denoted by θ_{01}, and the interactions of these effects with race and ethnicity (i.e., θ_{11}, θ_{21}, etc.).

Notes

An earlier version of this article was presented at the Annual Meeting of the American Educational Research Association, Chicago, April 3-7, 1991. We would like to thank the editor arid two anonymous reviewers for their comments on an earlier version of the article.

'The discrepancy in the two numbers represents students who dropped out between October, when the CBEDS data were collected, and December, when the CAP tests were administered. It also includes enrolled 12th-grade students who did not take the CAP exam for either official or unofficial reasons.

'Estimates based on these fixed-effects models did not differ substantially from those based on a random-effects model.

References

Armstrong, L. S. (1991, January 23). High court eases rules for ending integration plans. ***Education Week,*** pp. 1, 27.

Bates, P. (1990). Desegregation: Can we get there from here? ***Phi Delta Kappan, 72,*** 8-17.

Bryk, A. S., & Raudenbush, S. W. (1992). ***Hierarchical linear models: Applications and data analysis methods.*** Newbury Park, CA: Sage.

Catterall, J. S. (1987). On the social costs of dropping out of school. ***High School Journal, 71,*** 19-30.

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

Committee for Economic Development. (1987). ***Children in need: investment strategies for the educationally disadvantaged. New*** York: Author.

Denton, N. A., & Massey, D. S. (1988). Residential segregation of Blacks, Hispanics, and Asians by socioeconomic status and generation. ***Social Science Quarterly, 69,*** 797-817.

Erbring, L., & Young, A. A. (1979). individuals and social structure: Contextual effects as endogenous feedback. ***Sociological Methods and Research. 7, 396-430.***

Finn, J. D. (19891. Withdrawing from school. ***Review of Educational Research. 59,*** 117- 142.

Hanushek, E. A. (1986). The economics of schooling: Production and efficiency in public schools. ***Journal of Economic Literature, 24,*** 1141-1177.

Hanushek. E. A. (1989). The impact of differential expenditures on school performance. ***Educational Researcher, 18***(4), ***45-62.***

Hauser, R. M. (1970). Context and consex: A cautionary tale. ***American Journal of Sociology, 75, 645-654.***

Haycock, K., & Navarro. A. S. (1988). ***Unfinished business: Fulfilling our children's promise*** (A Report from the Achievement Council). Emeryville, CA: Albany Press.

Jencks, C. S., Smith, M., Acland. H., Bane, M. J.. Cohen, D., Gintis. H., Heyns, B., & Michelson, S. (1972). ***Inequality: A reassessment of the effect of family and schooling in*** America. New York: Basic Books.

Lee, V. E.. & Bryk, A. S. (1989). A multilevel model of the social distribution of high school achievement. ***Sociology of Education, 62,*** 172-192.

Levin, H. M. (1979). Education and earnings of Blacks and the Brown Decision. In M. Namorato (Ed.), ***Race relations since*** Brown: ***Have*** we ***overcome?*** Jackson, MI: University Press of Mississippi.

Massey, D. S., & Denton, N. A. (1988a). The dimensions of residential segregation. ***Social Forces, 67,*** 281-315.

Massey, D. S., & Denton, N. A. (1988b). Suburbanization and segregation in U.S. metropolitan areas. ***American Journal of Sociology,*** 94, 592-626.

Oakes, J. (1985) ***Keeping track: How schools structure inequality.*** New Haven, CT: Yale University Press.

Ogbu, J. U. (1989). The individual in collective adaptation: A framework for focusing on academic underperformance and dropping out among involuntary minorities. In L. Weis, E. Farrar, & H. G. Petrie (Eds.), ***Dropouts from school: issues, dilemmas, and solutions.*** Albany, NY: State University of New York Press.

Orfield, G., & Monfort, F. (1988). ***Racial change and desegregation in large school districts: Trends through the 1986-1987 school year*** (A Report to the Council of Urban Boards of Education and the National School Desegregation Project of the University of Chicago). Washington, DC: National School Boards Association Council of Urban Boards of Education

Pallas, A. M., Natriello, G., & McDill, E. L. (1989). The changing nature of the disadvantaged population: Current dimensions and future trends. ***Educational Researcher, 18***(5), 16-22.

Raudenbush, S. W. (1988). Applications of hierarchical linear models in educational research: A review. ***Journal of Educational Staristics, 13.*** 85-116.

Raudenbush, S. W., & Willms, J. D. (Eds.). (1991). ***Schools, classrooms and pupils: International studies of schooling from a multilevel perspective.*** San Diego: Academic Press.

Rumberger, R. W. (1987). High school dropouts: A review of issues and evidence. ***Review of Educational Research,*** 57, 101-121.

Rumberger, R. W. (1989). The challenge and opportunity of educational diversity. ***California Public School Forums, 3,*** 1- 18.

Schmidt, P. (1991, December 11). L. A. decree would equalize resources among all schools. ***Education Week,*** pp. 1, 11.

Schmidt, P. (1992a, February 26). Courts, school boards testing strategies to integrate both neighborhoods, schools. ***Education Week,*** pp. 11-12.

Schmidt, P. (1992b, June 3). Milwaukee plans calls for new school-funding formula. ***Education Week,*** p. 13.

Stem, D. (1989). Educational cost factors and student achievement in grades 3 and 6: Some new evidence. ***Economics of Education Review,*** 8, 149-158.

Summers, A. A., & Wolfe, B. L. (1977). Do schools make a difference? ***American Economic Review, 67, 639-652.***

U.S. National Center for Education Statistics. (1991). ***Digest of Education Statistics: 1991.*** Washington, DC: U.S. Government Printing Office.

Vergon, C. B. (1990). School desegregation: Lessons from 3 decades of experience. ***Education and Urban Society, 23, 22-49.***

Walberg, H. J., & Fowler, W. J.. Jr. (1987). Expenditure and size efficiencies of public school districts. ***Educational Researcher, 16(7), 5-13.***

Walsh, M. (1992. April 8). High court eases federal guidelines for desegregation. ***Education Week,*** pp. 1, 26.

Willms, J. D. (1986). Social class segregation and its relationship to pupil's examination results in Scotland. ***American Sociological Review, 51,*** 224-24 1.

Willms. J. D. (1992). ***Monitoring school performance: A guide for educators.*** Washington, DC: Falmer.

Willms, J. D.. & Raudenbush. S. W. (1989). A longitudinal hierarchical linear model for estimating school effects and their stability. ***Journal of Educational Measurement, 26. 209-232.***

Winkler, D. R. (1975). Educational achievement and school peer group composition. ***The Journal of Human Resources, IO,*** 189-204.

Woo, E. (1987, October 25). Inner-city high schools failing despite Honig claims, study finds. ***Los Angeles Times.*** p. 3.

Zoloth, B. S. (1976). Alternative measures of school segregation. ***Land Economics, 52,*** 278-298.

Authors

RUSSELL W. RUMBERGER, Associate Professor of Education, Department of Education, University of California, Santa Barbara, CA 93106. ***Specializations:*** economics of education, school dropouts, education policy.

J. DOUGLAS WILLMS, Associate Professor, Faculty of Education, University of British Columbia, 2125 Main Mall, Vancouver, British Columbia, Canada, V6T 125. ***Specializations:*** school effectiveness, education policy.

Received August 1, 1991
Revision received August 7. 1992
Accepted August 10, 1992