DOCUMENT RESUME

ED 105 062 UD 015 095

AUTHOR Zoloth, Barbara S.
TITLE Relative Test Performances Over Time of Black, Spanish, and Anglo Students: A Case Study. Discussion Papers.
INSTITUTION Wisconsin Univ., Madison. Inst. for Research on Poverty.
SPONS AGENCY Office of Economic Opportunity, Washington, D.C.
REPORT NO IRP-249-75
PUB DATE Jan 75
NOTE 34p.

EDRS PRICE MF-$0.76 HC-$1.95 PLUS POSTAGE.
DESCRIPTORS *Academic Achievement; Caucasian Students; *Longitudinal Studies; Mexican Americans; Minority Group Children; Multiple Regression Analysis; Negro Students; *Racial Differences; Reading Achievement; *Social Differences; Test Results; *Urban Youth; Verbal Ability

ABSTRACT

The major issue investigated in this paper is whether or not any change appears over a five-year peiod in the differences in performances between minority and non-minority students in that district. Since the relative performance advantage of non-minority students is frequently ascribed to their better backgrounds, socio-economic factors are held constant. The data used consist of test scores obtained for each student in the third, fifth, and seventh grades, plus a measure of the socio-economic status of that student's family. Multiple regression analysis is used. The study concludes that the test scores of minority students relative to those of non-minority students do not appear to change much over time. Although Anglo students score higher than Black or Spanish students, socio-economic factors, while accounting for a significant portion of test-score differences, do not account for all racial/ethnic differences. The persistence of significant test-performance differences between Anglos and minorities over time leads one to conclude that the school system described in this study succeeded in maintaining the relative performance position of the three major racial/ethnic groups but did not substantially succeed in eliminating the performance deficiency exhibited by minority students. (Author/JM)

249-75

INSTITUTE FOR RESEARCH ON POVERTY DISCUSSION PAPERS

RELATIVE TEST PERFORMANCES OVER TIME OF BLACK, SPANISH, AND ANGLO STUDENTS: A CASE STUDY

Barbara S. Zoloth

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January 1975

The research reported here was supported in part by funds granted to the Institute for Research on Poverty at the University of Wisconsin-Madison by the Office of Economic Opportunity pursuant to the Economic Opportunity Act of 1964. The views expressed here are solely those of the author.

ABSTRACT

This paper examines the relative test performances over time of Black, Spanish, and Anglo students in a particular school district. The major issue investigated is whether or not any change appears over a five-year period in the differences in performance between minority and non-minority students in that district. Since the relative performance advantage of non-minority students is frequently ascribed to their better backgrounds, socioeconomic factors are held constant. The data used consist of test scores obtained for each student in the third, fifth, and seventh grades, plus a measure of the socioeconomic status of that student's family. Unfortunatly, the test scores are available only as stanines, which obscures a large amount of their variation. Multiple regression analysis is applied to these data to determine whether or not grade level and/or socioeconomic status affect racial/ethnic differences in test performance.

The study concludes that the test scores of minority students relative to those of non-minority students do not appear to change much over time. Although Anglo students score higher than Black or Spanish students, socioeconomic factors, while accounting for a significant portion of test-score differences, do not account for all racial/ethnic differences. The persistence of significant test-performance differences between Anglos and minorities over time leads one to conclude that the school system described in this study succeeded in maintaining the relative performance position of the three major racial/ethnic groups but did not substantially succeed in eliminating the performance deficiency exhibited by minority students.

INTRODUCTION

The education of children who are members of racial or ethnic minority groups in this country has been discussed on many different levels during the last decade. One focus of these concerns has been the extent to which the educational system has succeeded in eliminating the relative deficiency generally exhibited by minority students when they first enter school. An important and unresolved policy issue is whether the elimination of this deficiency is, indeed, the responsibility of our schools. Resolution of this question requires what is, in part, a value judgement: the choice of an operational definition for equal educational opportunity. Three alternatives come to mind, listed below in increasing order of the degree of responsibility that each imputes to the schooling process:

(1) The level of educational inputs provided must be essentially the same for students in all racial/ethnic groups.

(2) The rate at which students' performances improve over time must be essentially the same for all racial/ethnic groups.

(3) The outcomes of the educational process must be essentially the same for students in all racial/ethnic groups.

We will not concern ourselves here with the philosophical choice of definitions. Clearly the choice of appropriate policy measures depends closely on which of the three goals is accepted. Although no clear formal statement of goals is available from the powers that be, there is evidence that definition (1) has been given a substantial amount of attention via educational spending programs,[1] while interest in (2) and (3) has been implicitly expressed through the use of measures of educational outcomes as indicators of program success.[2] Our

interest here is in the outcome of the educational process, which we shall examine in a very limited sense for a particular school district. We are primarily interested in the second and third definitions of equal educational opportunity. If data indicate that the gap between minority and non-minority student performance increases over time, then the schools have failed to achieve either (2) or (3). On the other hand, if the gap remains reasonably constant over time, then one may conclude that (2) has been achieved. Only if there is evidence that the gap is closing may one argue that equality of educational outcomes is being approached.

This paper presents a small-scale examination of the relative performances over time of minority students in a particular school district. The purpose is not to determine whether or not that district has succeeded in attempts to equalize educational opportunity,[3] but rather to simply examine and describe student performance. The major question to be addressed is whether or not any change appears over time in the differences in performance between minority and non-minority students in that distric. Since the relative performance advantage of non-minority students is frequently ascribed to their better backgrounds,[4] this question is also examined after controlling socioeconomic factors.

I. PROBLEMS IN ANALYZING TEST SCORES

Despite the absence of a universally accepted measure of educational outcome, and amidst a substantial amount of controversy, standardized achievement and ability test scores are the most frequently used indicators of the educational effects of our schools.[5] In spite of the acknowledged (and admitted by most test publishers) "cultural bias" inherent in most testing instruments,[6] these test scores are used in studies comparing the academic

performance of minority with non-minority students. This study also uses student test scores as the means of comparison, although the shortcomings of this approach are recognized. Perhaps the best justification for focusing on test scores is the continued use of them by both schools and parents as measures of the effectiveness of education.

The test scores used in this study are scaled in the form of stanines. A stanine is a 9-point scale, ranging from 1 to 9, with a mean of 5 and a standard deviation of 2. Raw scores are converted to stanine scores by the test publisher on the basis of a national norming sample. The major disadvantage of stanines is the resulting obfuscation of differential performance within any one stanine point. In addition, a small difference in raw scores can result in the relatively large difference of a full stanine point. Unfortunately, the test scores used here are available only in this form.

An important controversy over the use of scaled scores, such as the stanine, vs. the use of grade-equivalent types of scores has received some attention in the literature. The consensus seems to be that grade-equivalent scores do not lend themselves well to statistical analysis.[7] In particular, the computational definition of grade-equivalent scores implies that if a student's scaled score remains, say, one standard deviation below the mean over time, then the corresponding grade-equivalent score will show that student falling farther behind the "norm" over that same time period.[8] Thus, the use of grade-equivalent scores would bias the expected results of a study such as this toward establishing the existence of an "increasing gap" between minority and non-minority test performance.

The test analyzed here is the verbal portion of the Lorge-Thorndike ability test. Although we are actually interested in changes in achievement over time, there is no a priori reason to assume that ability tests measure qualities that cannot be changed by the schools. In fact, evidence demonstrates that ability test scores change over time in much the same way as achievement scores do.[9] Thus, we interpret the test scores used in this analysis as measures of both ability and learned achievement. To the extent, then, that "innate ability" does not change over time (although measures of it certainly may), any changes in ability test scores can cautiously be attributed to changes in "achievement."

II. MODELS AND PROCEDURES

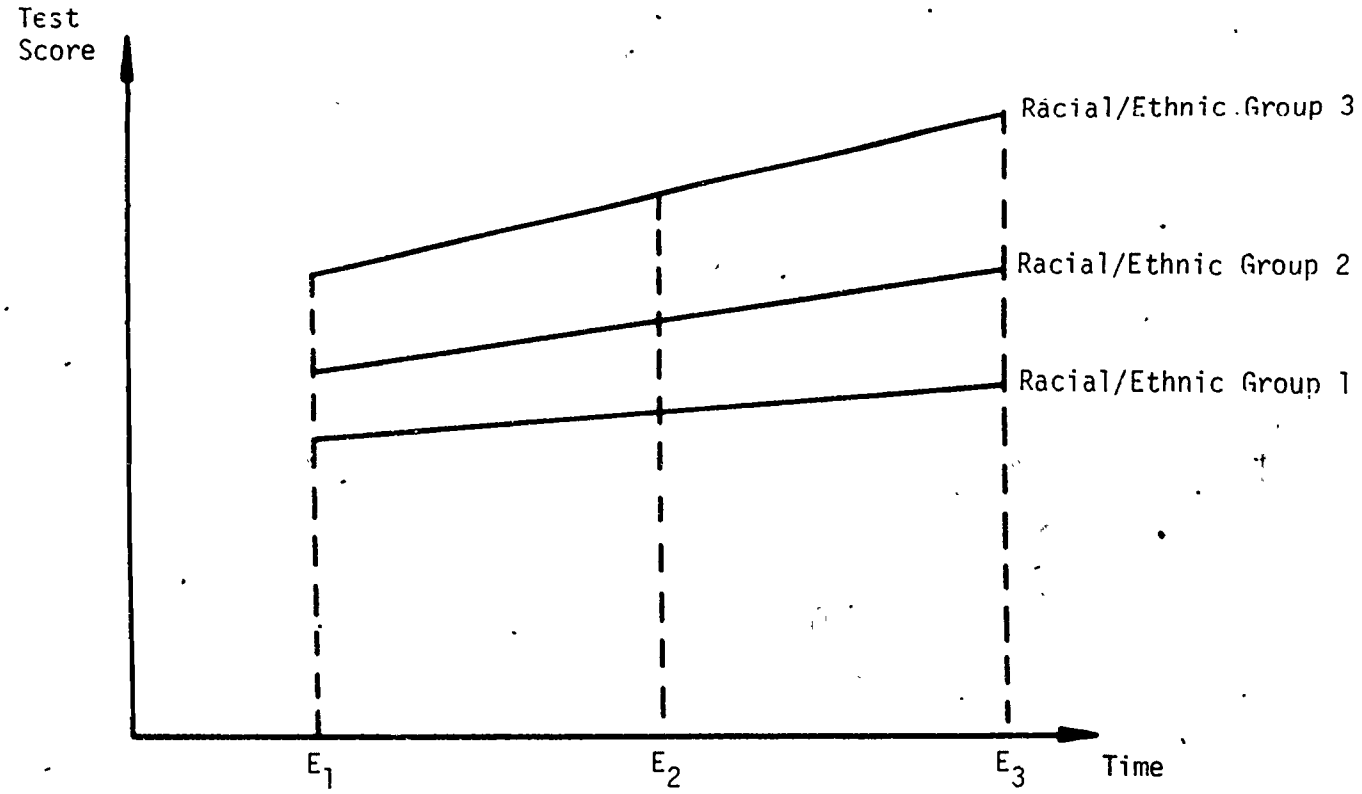
A. General Model

This section describes the linear regression model used to determine whether the rate of change in test scores over time has been different for students in different racial/ethnic groups. The major hypothesis we are interested in testing is depicted graphically in Figure 1, and reduces to asking whether the vertical distances between the lines in that figure become significantly different over time. For the case of three racial/ethnic groups and three points in time, the following regression model can be used to test that hypothesis:

$$T = \alpha_o + \alpha_1 E_1 + \alpha_2 E_2 + \beta_2 R_2 + \beta_3 R_3 + \gamma_{12}(E_1 R_2) + \gamma_{13}(E_1 R_3) + \gamma_{22}(E_2 R_2) + \gamma_{23}(E_2 R_3) + u \quad (1)$$

where the E_i are dummy variables determining the point in time, the R_j are dummy variables determining racial/ethnic group affiliation, the $E_i R_j$ are multiplicative interaction terms, and T represents the student's test score. The disturbance term u is assumed to be normally distributed

Figure 1: Graphical Depiction of General Model
(Hypothetical Data)



with zero mean and constant variance. (The results of a test of the homoskedasticity assumption are presented and discussed in Section IV,) Note that each student is represented by three observations, one for each of the three points in time.

The null hypothesis of interest, then, is that all γ_{ij} in equation (1) are simultaneously equal to zero. If this were true, one could conclude that the test-score differences between the various racial/ethnic groups remain the same, on the average, over time. To clarify by example, γ_{12} can be interpreted as the difference between time periods E_1 and E_3 in the gap between racial/ethnic groups 1 and 2. Thus, if $\gamma_{12} = 0$, this gap is not significantly different between these two points in time. Note that the model does not constrain the slopes of any of the lines drawn in Figure 1 to be the same between E_1 and E_2 as between E_2 and E_3. Note also that the null hypothesis involves a two-tailed test. If it is rejected, we can then check the signs of the coefficients to determine whether the gaps have been widening or narrowing.

Since each student enters the regression model as three separate observations, we are not using the information that the test score data are, in fact, longitudinal. Although it would certainly be both useful and appropriate to incorporate this information, there seems to be no method available for doing so.

B. Controlling for Socioeconomic Status

It has frequently been argued theoretically and demonstrated empirically that a student's socioeconomic status is significantly related to academic achievement and, in particular, to test performance. There are three different ways in which socioeconomic status (SES) can be controlled for in the context of our current concerns:

(1) allowing test scores to vary between SES groups but by the same amounts for each racial/ethnic group and for each year;

(2) allowing differences in test scores resulting from SES to be different within each year;

(3) allowing differences in test scores resulting from SES to be different for each racial/ethnic group.

In terms of the regression model presented in equation (1) above, these are equivalent, respectively, to:

(1) including SES additively as a separate variable;

(2) including multiplicative interaction terms between SES and the E_i ;

(3) including multiplicative interaction terms between SES and the R_j.

All three effects could be simultaneously allowed by stratifying the sample on SES and running separate regressions. However, since the nature of the effect of SES is of interest and since there is no a priori reason for choosing any of the above possibilities over the others, it was decided to include the additive and multiplicative terms in the model using the entire sample. Since the SES variable in the data used here is a discrete ordinal variable with a finite number of categories, the regression model becomes:

$$\begin{aligned} T = {} & \alpha_o + \alpha_1 E_1 + \alpha_2 E_2 + \beta_2 R_2 + \beta_3 R_3 + \gamma_{12}(E_1 R_2) + \gamma_{13}(E_1 R_3) \\ & + \gamma_{22}(E_2 R_2) + \gamma_{23}(E_2 R_3) + \sum_{i=1}^{k} \delta_i \, SES_i \\ & + R_2 \sum_{i=1}^{k} \psi_i \, SES_i + R_3 \sum_{i=1}^{k} \phi_i \, SES_i \\ & + E_1 \sum_{i=1}^{k} \varepsilon_i \, SES_i + E_2 \sum_{i=1}^{k} \mu_i \, SES_i + u \, , \end{aligned} \qquad (2)$$

where k equals the number of SES categories.

III. DATA

The school district for which data are analyzed in this study includes all public elementary schools in a middle-sized southwestern city. The city had a 1970 population of about 300,000, of whom slightly more than 20 percent were identified by the 1970 Census as persons of Spanish origin, while 3 percent were identified as Blacks. Median family income of the city was about $8,800 in 1970, and slightly more than 10 percent of all families were below the poverty line at that time (including 25 percent of Black families and 17 percent of Spanish families).

Ninety-three percent of all students enrolled in elementary schools (grades 1-8) in this district were in public schools in 1970. Total enrollment in the district's public elementary schools increased between 1968 and 1972 by about 17 percent, to more than 43,000. While minority students[10] represented a fairly constant one-third of the public elementary school enrollment over those years, they accounted for over 40 percent of the increased enrollment. By far the predominant minority group in the district schools is composed of children of Spanish origin (about 27 percent), with Black students representing less than 6 percent of the total and American Indians and Orientals each less than 2 percent.

From 1968 to 1972, the elementary schools remained substantially segregated. By 1972, about 62 percent of the minority students would have needed to be transferred between schools in order to equalize the minority percentage across all schools. This figure in 1968 was about 70 percent.

The data analyzed in this study were provided to the Office for Civil Rights in HEW by the district during the course of a civil rights compliance review. The school district provided historical test records for all current (as of spring, 1973) eighth-grade students for whom the following information was available:

(1) Lorge-Thorndike verbal-ability test scores for grades 3, 5, and 7;

(2) reading test scores for grades 3 and 4.

In addition, a survey of these students was conducted, from which the district calculated an index of socioeconomic status (SES) for each student. The survey included information on the sex. occupation, education level, and source of income (full-time work, part-time work, or other compensation) as reported by each student for the adult head of his or her household. A ranking was constructed based on statewide Census data relating these characteristics to income levels. The resulting index was a ten-point scale with the value 1 representing the lowest SES category. In order to avoid imposing a cardinal interpretation on this index, SES is represented in all regression analyses as a set of dummy variables.

Only data for Black, Spanish-surnamed, and Anglo[11] students are included in the following analyses, since the other two racial/ethnic categories (American Indians and Orientals) were represented by very few students. Although data were provided for five separate test scores, only three are analyzed here: third-, fifth-, and seventh-grade Lorge-Thorndike scores. The third- and fourth-grade reading scores are not analyzed for two reasons: first, the span of time covered by the scores, (third to fourth grade) is felt to be too small to reveal reliable patterns of change; second, and more important, the scores are from two different reading tests and therefore are not strictly comparable despite the standardized form of the scores.

Of almost 5,400 students enrolled in eighth grade in the school year 1972-73, 2,397 (45 percent) were found to have a complete set of the three Lorge-Thorndike test scores available. Thus a total of 7,191 observations was used in the regression analyses, since the specification requires that

each student be represented by three observations.

Table 1 presents the means and standard deviations of Lorge-Thorndike scores for each racial/ethnic group broken down by SES category. Two interesting and predictable patterns emerge from this table. First, mean test score increases as SES rises within each racial/ethnic group. Second, within SES categories, mean test scores for Anglos are higher than those for Spanish students, which are, in turn, higher than those for Blacks. Those patterns are consistent with other empirical investigations of test scores. Another point of interest is the apparent relationship between SES level and racial/ethnic affiliation. Figure 2 indicates that the SES levels of minority students tend to be lower than those of the Anglo students.

At the same time that this analysis was being conducted for the Office for Civil Rights, the school district's research department was performing a similar analysis of the same data. Their results were basically the same, but they had the benefit of an additional set of test scores: eighth-grade reading-achievement scores. Table 2 presents the simple correlation coefficients as reported by the district between all six test scores and SES level based on the 2,066 students for whom all of these scores were available. Note that the SES index was collapsed from ten to four categories in their analysis.

It appears from Table 2 that 58 to 70 percent of the variance in reading-achievement scores can be accounted for by the variance in verbal-ability scores from previous years when no other factor is held constant. On the other hand, past reading scores explain only slightly less of the variance in later reading scores than do past verbal-ability scores. Furthermore, the intercorrelations between verbal scores in

TABLE 1.

Sample Means and Standard Deviations of Test Scores

a. Black students

SES Level	Number of Students	Grade 3	Grade 5	Grade 7
2	5	2.200	2.600	2.400
		0.748	0.490	1.020
3	14	2.429	3.286	2.714
		1.348	0.958	1.160
4	19	2.421	3.526	3.105
		1.091	1.094	1.334
5	32	3.281	3.625	3.344
		1.807	1.596	1.651
6	20	3.600	3.850	3.700
		1.530	1.492	1.616
7	26	3.500	3.885	3.769
		1.715	1.450	1.280
8	5	3.400	3.200	2.800
		1.625	0.748	1.166
9	13	3.385	3.538	3.769
		1.546	1.447	1.120
10	9	4.444	5.000	4.333
		2.061	1.886	1.633
All	143	3.217	3.685	3.427
		1.686	1.465	1.489

Note: For each subgroup of the sample, the first number presented is that subgroup's mean score ($\bar{T}$) and the second is the standard deviation for that subgroup(s).

TABLE 1. (continued)

b. Spanish-surnamed students

SES Level	Number of Students	Grade 3	Grade 5	Grade 7
2	9	4.333	4.111	3.778
		1.054	0.994	1.133
3	151	3.404	3.570	3.338
		1.708	1.498	1.366
4	131	3.282	3.580	3.443
		1.668	1.493	1.415
5	112	3.875	4.098	3.732
		1.857	1.506	1.336
6	113	4.133	4.416	3.965
		1.907	1.533	1.463
7	75	4.413	4.360	3.960
		1.826	1.614	1.492
8	39	4.513	4.974	4.590
		1.838	1.747	1.822
9	25	4.720	4.840	4.440
		1.755	1.869	1.722
10	24	4.458	4.500	4.333
		2.020	2.062	1.908
All	679	3.853	4.054	3.750
		1.849	1.630	1.511

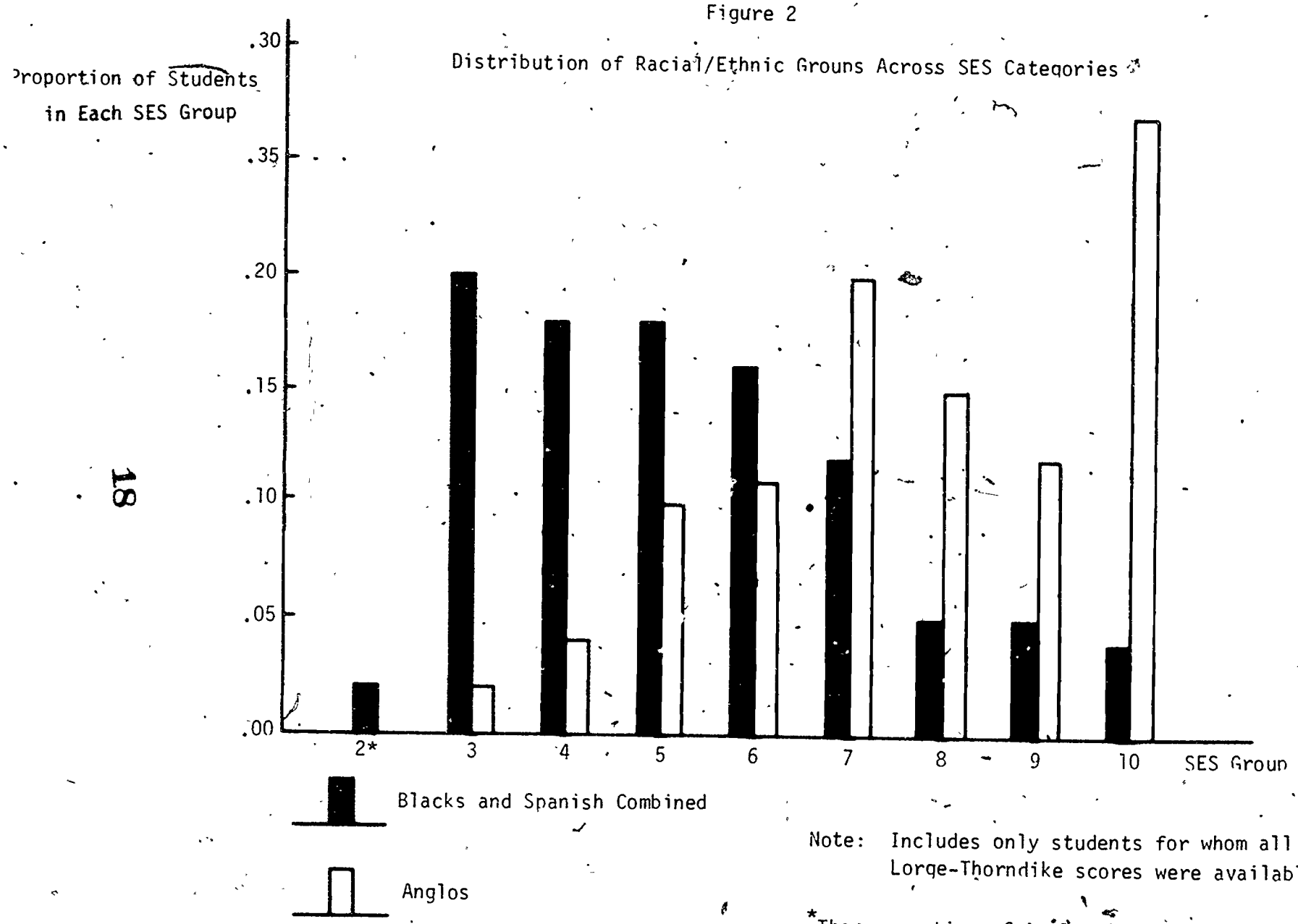
TABLE 1. (continued)

c. Anglo students

SES Level	Number of Students	Grade 3	Grade 5	Grade 7
2	1	2.000	3.000	1.000
		0.000	0.000	0.000
3	31	4.677	4.742	4.581
		2.161	1.917	1.774
4	59	4.593	4.814	4.525
		1.708	1.790	1.500
5	151	4.934	5.033	4.748
		1.918	1.839	1.645
6	167	5.317	5.485	5.138
		1.880	1.520	1.492
7	311	5.633	5.614	5.203
		1.848	1.703	1.618
8	230	5.796	5.752	5.391
		1.812	1.548	1.484
9	196	6.240	6.153	5.776
		1.761	1.521	1.623
10	429	6.455	6.431	6.098
		1.769	1.621	1.549
All	1575	5.796	5.806	5.455
		1.911	1.717	1.649

Figure 2

Distribution of Racial/Ethnic Grouns Across SES Categories



Note: Includes only students for whom all three Lorge-Thorndike scores were available.

*The proportion of Anglos in SES groun 2 was less than .01.

TABLE 2

Simple Correlations Between SES Index and Various Test Scores
(Sample Includes All Eight-Grade Students for Whom
All Information was Available)
N = 2066

			Verbal Ability			Reading Achievement	
		SES	3rd Grade	5th Grade	7th Grade	3rd Grade	4th Grade
Verbal Ability	3rd Grade	.43					
	5th Grade	.42	.84				
	7th Grade	.43	.81	.86			
Reading Achievement	3rd Grade	.36	.77	.74	.72		
	4th Grade	.41	.78	.78	.77	.83	
	8th Grade	.44	.76	.80	.84	.72	.77

Note: The SES index was collapsed by the school district's researchers into four discrete categories corresponding to SES levels 1-3, 4-5, 6-7, and 8-10.

different years are only slightly higher than those for reading-achievement scores. Although one would like to interpret verbal-ability scores as measurements of reading-achievement potential, it is not clear that this assumption is warranted. No assumptions are made in any of the following analyses concerning the reliability of the Lorge-Thorndike test as a measure of innate "ability." As discussed in Section I, we interpret the test scores as measures of current ability to perform on tests, which we assert to be some combination of inherent and learned "ability." Thus, we accept the Lorge-Thorndike results as a reasonably reliable measure of the gross effects of both the students' backgrounds and the "value added" by their schools.

IV. REGRESSION RESULTS

The following variable notation is used throughout this section:

Notation	Description
T	Stanine value of student's Lorge-Thorndike verbal test score
E_1	A dummy variable defined on third grade (= 1 for a third-grade score, = 0 otherwise)
E_2	A dummy variable defined on fifth grade (= 1 for a fifth-grade score, = 0 otherwise)
R_2	A dummy variable defined on Spanish-surname (= 1 if student identified as Spanish-surnamed, = 0 otherwise)
R_3	A dummy variable defined on Anglo (= 1 if student identified as Anglo, = 0 otherwise)
SES_i $i=2,\ldots,10$	Nine dummy variables defined on socioeconomic level (= 1 if student's SES value equals i, = 0 otherwise)

All of the regression models are normalized on racial/ethnic group 1 (Blacks), grade 7, and socioeconomic group 6. Variables for these categories are therefore omitted from the estimated equations, and the

estimated constant term can be interpreted as the expected test score, when SES is controlled for, for seventh-grade Black students in SES group 6.

One of the assumptions required for the regression analysis performed here is that the variance of the test scores be the same within each subgroup. A test for heteroskedasticity was performed and resulted in rejecting the null hypothesis of equal variances at the .05 level of significance.[12] Although the coefficient estimates are unbiased and consistent under heteroskedasticity, the standard errors will be both biased and inconsistent. Characteristics of the data imply that this bias is negative and, therefore, that the probability of rejecting any null hypothesis based on the standard errors of the estimates will be higher than the chosen level of significance indicates.[13] Rather than adjusting for the heteroskedasticity, therefore, it was decided to use extra caution in hypothesis testing. Thus, null hypotheses tested from the regression results are rejected only when the appropriate test statistic exceeds the .005 critical value.

A. General Model

Table 3a presents the regression results from equation (1) above. The results of the two F-tests presented at the bottom of the table imply that the test-score gap between racial/ethnic groups changed significantly between third and fifth grades but not between fifth and seventh grades. Furthermore, the positive signs on the estimates of γ_{12} and γ_{13} indicate that the gap actually narrowed between the two lower grades. Thus, there is certainly no indication that the relative test performance of minority students declined over time. The top half of Figure 3 shows this conclusion clearly. The significance and relative

TABLE 3.

Results of Regression Analysis
Without Controlling for Socioeconomic Status
a. No restrictions

Model 1a: $T = \alpha_0 + \alpha_1 E_1 + \alpha_2 E_2 + \beta_2 R_2 + \beta_3 R_3 + \gamma_{12}(E_1 R_2) + \gamma_{13}(E_1 R_3) + \gamma_{22}(E_2 R_2) + \gamma_{23}(E_2 R_3) + u$

Variable	Estimated Coefficient	Standard Error	t-Ratio	Marginal R^2
Constant	3.4266	.1443	23.747	
E_1	-.2098	.2041	-1.028	.0001
E_2	.2587	.2041	1.268	.0026
R_2	.3231	.1588	2.035	.0025
R_3	2.0280	.1507	13.457	.2088
E_1R_2	.3129	.2245	1.394	.0002
E_1R_3	.5507	.2131	2.584	.0034
E_2R_2	.0461	.2245	.205	.0000*
E_2R_3	.0924	.2131	.433	.0000*

$R^2 = .2177$ $F(9, 7182) = 249.826$

Adjusted $R^2 = .2168$

Hypothesis Tests:

$H_0: \gamma_{22} = \gamma_{23} = 0$ $F(2, 7182) = 0.1547 \Rightarrow$ cannot reject H_0 at .005 level

$H_0: \gamma_{12} = \gamma_{13} = \gamma_{22} = \gamma_{23} = 0$ $F(4, 7182) = 2.7585 \Rightarrow$ reject H_0 at .05 level but cannot reject H_0 at .005 level

*Less than .0001.

TABLE 3. (continued)

b. Score changes from grade 5 to grade 7 restricted to be the same for all three racial/ethnic groups

Model 1b: $\alpha_0 + \alpha_1 E_1 + \alpha_2 E_2 + \beta_2 R_2 + \gamma_{12}(E_1 R_2) + \gamma_{13}(E_1 R_3) + u$

Variable	Estimated Coefficient	Standard Error	t-Ratio	Marginal R^2
Constant	3.3897	.1050	32.278	
F_1	-.1729	.1784	-.969	.0001
E_2	.3325	.0498	6.672	.0026
R_2	461	.1122	3.084	.0025
R_3	2.0742	.1066	19.467	.2088
E_1R_2	.2898	.1944	1.491	.0002
E_1R_3	.5046	.1846	2.734	.0034

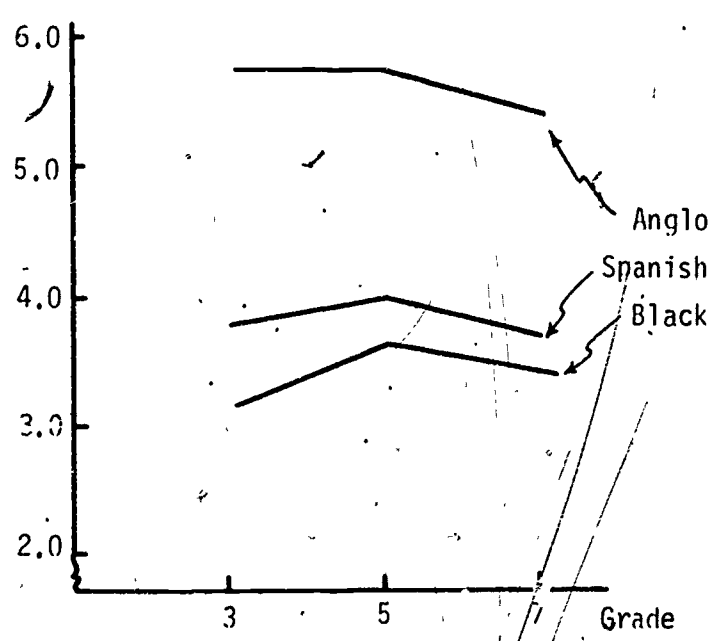
$R^2 = .2177$ $F(7, 7184) = 333.1283$

Adjusted $R^2 = .2170$

Hypothesis Tests:

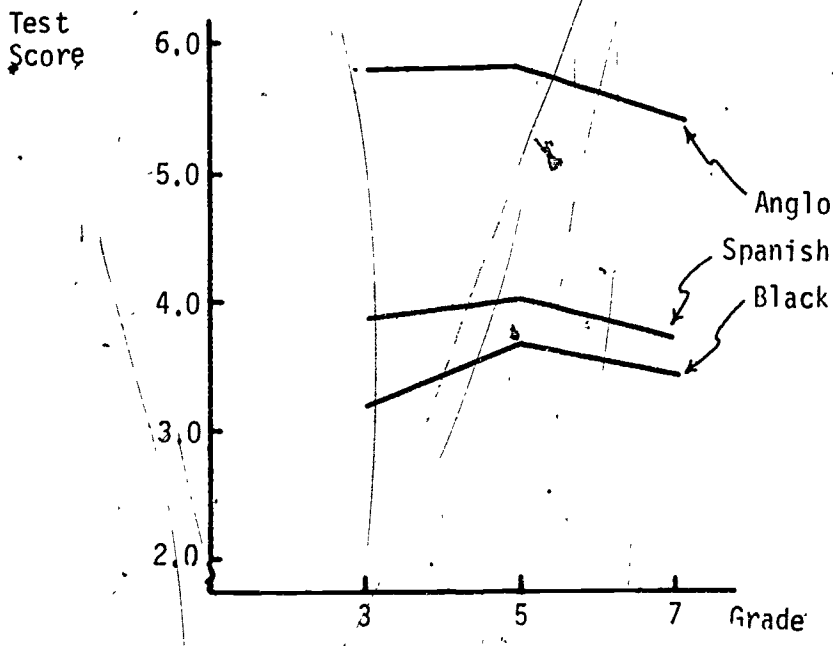
$H_0: \gamma_{12} = \gamma_{13} = 0$ $F(2, 7184) = 5.3635 \Rightarrow$ reject H_0 at .005 level

Figure 3: Test Scores Predicted from Regressions With No Control for SES



	Grade		
	3	5	7
Anglo	5.800	5.806	5.455
Spanish	3.853	4.054	3.750
Black	3.217	3.685	3.427

With No Restrictions (model 1a)



	Grade		
	3	5	7
Anglo	5.796	5.796	5.464
Spanish	3.853	4.068	3.736
Black	3.217	3.722	3.390

Restricting Score Changes from Grade 5 to Grade 7 to be the Same for all Three Racial/Ethnic Groups (Model 1b)

sizes of the coefficients on both race dummies indicate simply that Anglo mean scores are higher than Spanish mean scores, which are higher than Black mean scores.

Part b of Table 3 presents results for the same model but with γ_{22} and γ_{23} constrained to be zero. Inspection of the coefficient estimates reveals little change from Part a, as the lower part of Figure 3 emphasizes.

B. Controlling for SES

Table 4 presents the regression results for equation (2). There is no dummy variable for SES group 1 since there are no observations in that group. Note that the basic model corresponds to that in Table 3b, that is, that γ_{22} and γ_{23} are again constrained to be zero. The results of hypothesis tests indicate that there is no significant interaction between grade level and SES category, that is, that test-score differences resulting from SES are not significantly different within each year. On the other hand, the coefficients on the SES and race interaction terms were jointly different from zero, indicating that socioeconomic factors (to the extent that they are accurately measured by our SES index) alone do not fully account for racial/ethnic performance differences. This last point is further substantiated by the significance of the coefficients on R_2 and R_3 in Table 4.

Model 2b, presented in Table 5, constrains those coefficients to be zero that were found to be not significantly otherwise, namely the coefficients on the SES and grade level interaction variables. The hypothesis test results presented at the bottom of this table again substantiate the claim that, while SES does indeed significantly affect test scores within grade and racial/ethnic groups, differences in test scores between those racial/ethnic groups persist even when this interaction is accounted for.

TABLE 4.

Results of Regression Analysis
Controlling for Socioeconomic Status
With No Restrictions

Model 2a:

$$T = \alpha_0 + \alpha_1 E_1 + \alpha_2 E_2 + \beta_2 R_2 + \beta_3 R_3 + \gamma_{12}(E_1 R_2) + \gamma_{13}(E_1 R_3) + \delta_2 SES_2$$
$$+ \delta_3 SES_3 + \delta_4 SES_4 + \delta_5 SES_5 + \delta_7 SES_7 + \delta_8 SES_8 + \delta_9 SES_9 + \delta_{10} SES_{10}$$
$$+ R_2(\psi_2 SES_2 + \psi_3 SES_3 + \psi_4 SES_4 + \psi_5 SES_5 + \psi_7 SES_7 + \psi_8 SES_8 + \psi_9 SES_9 + \psi_{10} SES_{10})$$
$$+ R_3(\phi_2 SES_2 + \phi_3 SES_3 + \phi_4 SES_4 + \phi_5 SES_5 + \phi_7 SES_7 + \phi_8 SES_8 + \phi_9 SES_9 + \phi_{10} SES_{10})$$
$$+ E_1(\varepsilon_2 SES_2 + \varepsilon_3 SES_3 + \varepsilon_4 SES_4 + \varepsilon_5 SES_5 + \varepsilon_7 SES_7 + \varepsilon_8 SES_8 + \varepsilon_9 SES_9 + \varepsilon_{10} SES_{10})$$
$$+ E_2(\mu_2 SES_2 + \mu_3 SES_3 + \mu_4 SES_4 + \mu_5 SES_5 + \mu_7 SES_7 + \mu_8 SES_8 + \mu_9 SES_9 + \mu_{10} SES_{10})$$
$$+ u$$

Variable	Estimated Coefficient	Standard Error	t-Ratio	Marginal R^2
Constant	3.6649	.2341	15.658	
E_1	-.2179	.2134	-1.021	0001
E_2	.3733	.1352	2.762	.0026
R_2	.3422	.2402	1.425	.0039
R_3	1.4483	.2342	6.158	.2088
E_1R_2	.3367	.1886	1.785	.0002
E_1R_3	.4451	.1823	2.441	.0034
SES_2	-1.4321	.5971	-2.398	.0003
SES_3	-.8424	.3557	-2.368	.0043
SES_4	-.5558	.3296	-1.686	.0025
SES_5	-.2822	.2941	-.960	.0001
SES_7	-.0750	.3023	-.248	.0062
SES_8	-.6580	.4911	-1.274	.0057
SES_9	-.2124	.3604	-.589	.0106
SES_{10}	.8477	.3967	2.137	.0283
R_2SES_2	1.2196	.5813	2.098	.0004
R_2SES_3	.1731	.3536	.490	.0000*
R_2SES_4	-.0368	.3298	-.112	.0000*
R_2SES_5	.0307	.3007	.102	.0005

TABLE 4 . (continued)

Variable	Estimated Coefficient	Standard Error	t-Ratio	Marginal R^2
R_2SES_7	.0721	.3179	.227	.0000*
R_2SES_8	1.1045	.5097	2.167	.0002
R_2SES_9	.6481	.4007	1.618	.0003
R_2SES_{10}	-.6165	.4396	-1.402	.0010
R_3SES_2	-1.9967	1.0710	-1.864	.0012
R_3SES_3	.2604	.3819	.682	.0000*
R_3SES_4	.0298	.3386	.088	.0000*
R_3SES_5	-.1083	.2928	-.370	.0018
R_3SES_7	.1687	.2987	.565	.0000*
R_3SES_8	.9163	.4876	1.879	.0003
R_3SES_9	.8953	.3550	2.522	.0004
R_3SES_{10}	.1386	.3934	.352	.0000*
E_1SES_2	.3196	.6222	.514	.0000*
E_1SES_3	-.0659	.2193	-.301	.0000*
E_1SES_4	-.2623	.2128	-1.232	.0004
E_1SES_5	.0046	.1921	.024	.0000*
E_1SES_7	.2114	.1790	1.181	.0001
E_1SES_8	.1358	.1978	.687	.0001
E_1SES_9	.2066	.2064	1.001	.0001
E_1SES_{10}	.1270	.1778	.714	.0001
E_2SES_2	.0267	.6193	.043	.0000*
E_2SES_3	-.1284	.2150	-.597	.0000*
E_2SES_4	-.1676	.2109	-.795	.0001
E_2SES_5	-.0581	.1919	-.303	.0000*
E_2SES_7	.0174	.1777	.098	.0000*
E_2SES_8	-.0084	.1956	-.043	.0000*
E_2SES_9	-.0272	.2042	-.133	.0000*
E_2SES_{10}	-.0422	.1736	-.243	.0000*

R^2 = .2839 F(47, 7144) = 61.5716

Adjusted R^2 = .2793

Hypothesis Tests:

H_0: $\epsilon_i = \mu_i = 0$ for all i F(16, 7144) = .6843 ⇒cannot reject H_0 at .005 level

*Less than .0001

TABLE 5.

Controlling for Socioeconomic Status and

Restricting Interaction between SES and Grade to Be Zero

Model 2b:

$$T = \alpha_0 + \alpha_1 E_1 + \alpha_2 E_2' + \beta_2 R_2 + \beta_3 R_3 + \gamma_{12}(E_1 R_2) + \gamma_{13}(E_1 R_3)$$
$$+ \delta_2 SFS_2 + \delta_3 SES_3 + \delta_4 SES_4 + \delta_5 SES_5 + \delta_7 SES_7 + \delta_8 SES_8 + \delta_9 SES_9 + \delta_{10} SES_{10}$$
$$+ R_2(\psi_2 SES_2 + \psi_3 SES_3 + \psi_4 SES_4 + \psi_5 SES_5 + \psi_7 SES_7 + \psi_8 SES_8 + \psi_9 SES_9 + \psi_{10} SES_{10})$$
$$+ R_3(\phi_2 SES_2 + \phi_3 SES_3 + \phi_4 SES_4 + \phi_5 SES_5 + \phi_7 SES_7 + \phi_8 SES_8 + \phi_9 SES_9 + \phi_{10} SES_{10})$$
$$+ u$$

Variable	Estimated Coefficient	Standard Error	t-Ratio	Marginal R^2
Constant	3.6635	.2222	16.487	
E_1	-.1729	.1711	-1.011	.0001
E_2	.3325	.0478	6.958	.0026
R_2	.3578	.2399	1.492	.0039
R_3	1.4285	.2336	6.116	.2088
E_1R_2	.2898	.1864	1.555	.0002
E_1R_3	.5046	.1770	2.851	.0034
SES_2	-1.3167	.4776	-2.757	.0003
SES_3	-.9071	.3328	-2.726	.0043
SES_4	-.6991	.3060	-2.285	.0025
SES_5	-.3000	.2722	-1.102	.0001
SES_7	.0013	.2841	.005	.0062
SES_8	-.5833	.4776	-1.221	.0057
SES_9	-.1526	.3403	-.448	.0106
SES_{10}	.8759	.3834	2.285	.0283
R_2SES_2	1.2196	.5809	2.099	.0004
R_2SES_3	.1731	.3534	.490	.0000*
R_2SES_4	-.0368	.3296	-.112	.0000*
R_2SES_5	.0307	.3006	.102	.0005
R_2SES_7	.0721	.3177	.27	.0000*
R_2SES_8	1.1045	.5094	2.168	.0002
R_2SES_9	.6481	.4004	1.619	.0003
R_2SES_{10}	-.6165	.4394	-1.403	.0010

TABLE 5. (continued)

Variable	Estimated Coefficient	Standard Error	t-Ratio	Marginal R^2
R_3SES_2	-1.9967	1.0704	-1.865	.0012
R_3SES_3	.2604	.3817	.682	.0000*
R_3SES_4	.0298	.3384	.088	.0000*
R_3SES_5	-.1083	.2926	-.370	.0018
R_3SES_7	.1687	.2985	.565	.0000*
R_3SES_8	.9163	.4873	1.880	.0003
R_3SES_9	.8953	.3548	2.523	.0004
R_3SES_{10}	.1386	.3931	..353	.0000*

$R^2 = .2831$ $F(31, 7160) = 94.2562$

Adjusted $R^2 = .2801$

Hypothesis Tests:

H_0: $\psi_i = \phi_i = 0$ for all i — $F(16, 7160) = 2.7402 \Rightarrow$ reject H_0 at .005 level

H_0: $\delta_i = \psi_i = \phi_i = 0$ for all i — $F(24, 7160) = 26.9551 \Rightarrow$ reject H_0 at .005 level

*Less than .0001.

Figure 4

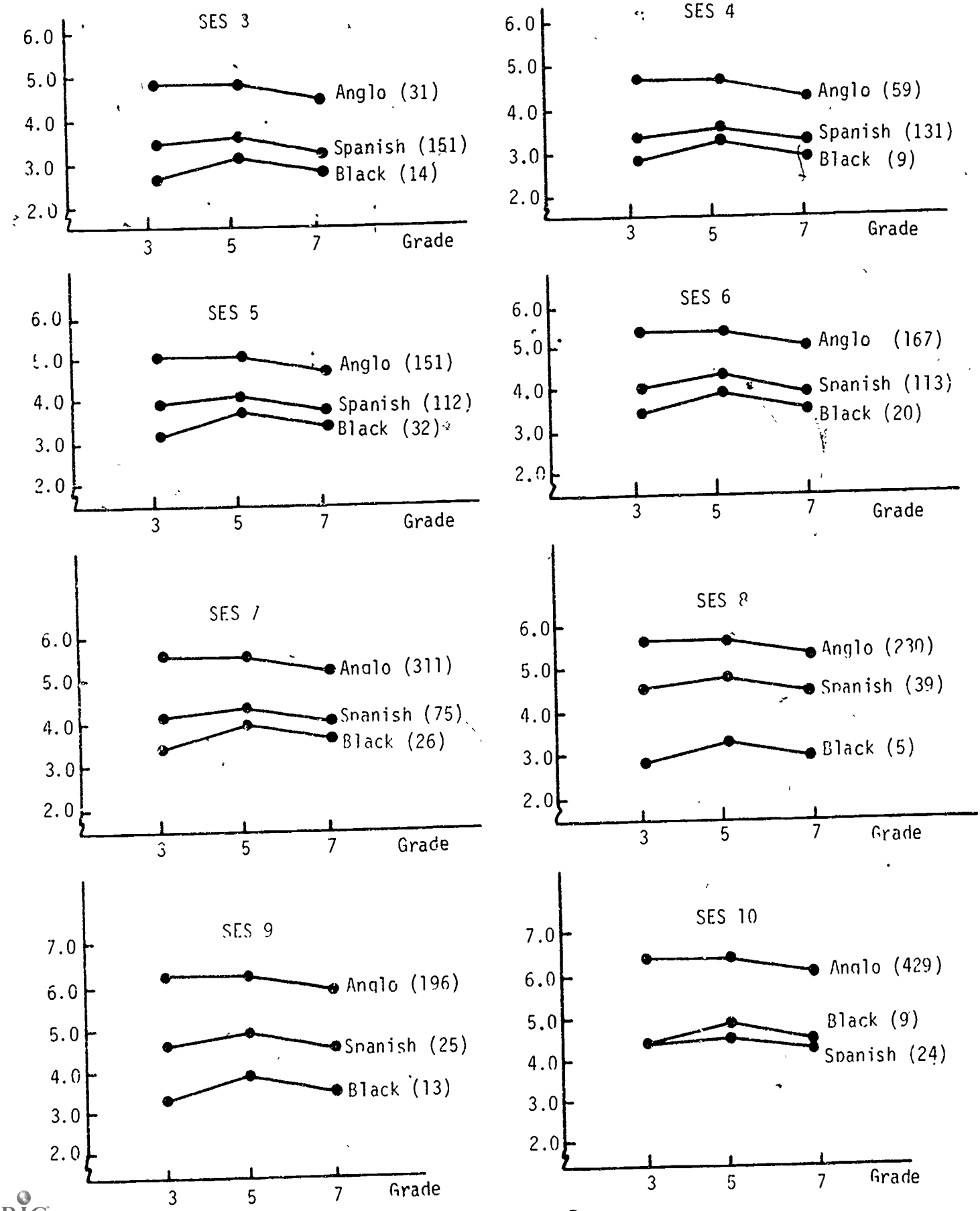

SES 3
6.0
5.0
4.0
3.0
2.0
Anglo (31)
Spanish (151)
Black (14)
3
5
7
Grade
SES 4
6.0
5.0
4.0
3.0
2.0
Anglo (59)
Spanish (131)
Black (9)
3
5
7
Grade
SES 5
6.0
5.0
4.0
3.0
2.0
Anglo (151)
Spanish (112)
Black (32)
3
5
7
Grade
SES 6
6.0
5.0
4.0
3.0
2.0
Anglo (167)
Spanish (113)
Black (20)
3
5
7
Grade
SES 7
6.0
5.0
4.0
3.0
2.0
Anglo (311)
Spanish (75)
Black (26)
3
5
7
Grade
SES 8
6.0
5.0
4.0
3.0
2.0
Anglo (230)
Spanish (39)
Black (5)
3
5
7
Grade
SES 9
7.0
6.0
5.0
4.0
3.0
2.0
Anglo (196)
Spanish (25)
Black (13)
3
5
7
Grade
SES 10
7.0
6.0
5.0
4.0
3.0
2.0
Anglo (429)
Black (9)
Spanish (24)
3
5
7
Grade

Figure 4 graphically presents the results of estimating Model 2b, from which we can see the differences between racial/ethnic groups within the various SES categories. Again it is readily apparent that the test score gap narrows somewhat from third to fifth grades and remains about the same from fifth to seventh grades across all SES groups.

An equation similar to Model 2b but combining Spanish and Black students into one group was also estimated. The results were qualitatively the same as those reported above with the resulting "minority" group behaving essentially the same as the Spanish group. This is not surprising, because of the relative sizes of the two groups and because within SES groups, there is not always a significant difference between Black and Spanish scores.

V. CONCLUSIONS

A. Change in Racial/Ethnic Test-Score Differences Over Time

(i) Anglo-Black and Anglo-Spanish test-score differences tend to decrease somewhat between third and fifth grades. This time period is characterized by rising scores for Black and Spanish students and by unchanging Anglo scores. The gap between Anglo and Black scores closes by more (about 1/2 of a stanine point) than does the gap between Anglo and Spanish scores (about 1/5 of a stanine point) over this period of time.

(ii) Anglo-Black and Anglo-Spanish test-score differences do not change significantly in either direction between fifth and seventh grades. This time period is characterized by falling test scores for all three racial/ethnic groups.

(iii) Spanish scores are consistently higher than Black scores on average, but this difference (approximately 1/3 of a stanine point) is not statistically significant.

(iv) Anglo test scores are always significantly higher than both Spanish and Black scores on the average (by about 2 and 2 1/3 stanine points respectively).

B. Effects of Controlling For Socioeconomic Status

All of conclusions (i) through (iv) remain qualitatively identical after the socioeconomic status of the students is controlled for. Furthermore, the only change in the numbers mentioned above is that the average difference between Anglo and Spanish scores drops to about 1.4 stanines (in conclusion (iv)) when interaction between SES and racial/ethnic group is allowed. This difference, however, remains statistically significant in all specifications of the model.

C. General Comments

The results of this study are consistent with others on the same topic in finding that the scaled scores of minority students relative to those of non-minority students do not appear to change much over time. The interesting additional finding is that socioeconomic factors, while accounting for a significant portion of test-score differences, do not account for all racial/ethnic differences. Finally, the persistence of significant test-performance differences between Anglos and minorities over time leads one to conclude that the school system described in this study succeeded in maintaining the relative performance position of the three major racial/ethnic groups but did not substantially succeed in eliminating the performance deficiency exhibited by minority students.

FOOTNOTES

[1]These primarily include compensatory education programs, such as Title I of the Elementary and Secondary Education Act, as well as judicial resolution of educational finance issues.

[2]This results from the commonly accepted presumption of a positive relationship between educational inputs and outcomes. Appendix A in Averch et al. contains summaries of nineteen separate studies of variations on this hypothesis.

[3]Indeed, it is not clear whether the district involved had made any significant commitment to this goal during the relevant time period.

[4]Again see the Appendix in Averch et al.

[5]Other indicators used by researchers include student attitudes, later earnings, the level of schooling eventually obtained, and assorted attempts to measure non-cognitive outcomes.

[6]See Averch et al., pp. 22-23.

[7]See Coleman and Karweit, pp. 7-16; and Cronbach, p. 98.

[8]See Coleman et al., p. 21; and Averch et al., pp. 20-21.

[9]See Coleman and Karweit, pp. 23-25.

[10]Minority is defined here as all students identified in the Office for Civil Rights survey of public schools as either American Indian, Negro, Oriental, or Spanish-surnamed.

[11]The term "Anglo" is used to identify all students who were neither Black, Spanish-surnamed, Oriental, nor American Indian.

[12]For a description of the test used, see Kmenta, pp. 267-269.

[13]The bias will be negative when the squared means and the variances of the subgroups are positively related. See Kmenta, p. 256.

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