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ABSTRACT

This integrative study of student socioeconomic status (SES), race and gender focused on mathematics achievement and self-esteem in the school context. Data for the study were derived from the Pennsylvania Educational Quality Assessment Program for the years 1981 through 1984. Analyses were conducted at the fifth, eighth, and eleventh grade levels. Replicable achievement differences in mathematics were observed across grade levels for student SES and race, but not for gender. The only replicable interaction to emerge was a relatively weak, but persistent SES by race effect that occurred for all analyses involving students attending low SES schools. Although achievement increased across student SES level for both white and black students the increment tended to be slightly larger for white students. Replicable differences in self-esteem occurred for student SES and gender. Race differences, in the form of a grade level by race interaction, occurred only within low SES schools. Supplementary analyses of mathematics achievement incorporating school SES and race were also performed. In addition to significant results for each main effect several interactions were found, the most prominent being a race by school SES effect, which occurred at each grade level. Tables and a list of references are included. (Author/YP)

THE INFLUENCE OF RACE, CLASS AND GENDER ON MATHEMATICS ACHIEVEMENT AND SELF-ESTEEM FOR FIFTH, EIGHTH AND ELEVENTH GRADE STUDENTS IN PENNSYLVANIA SCHOOLS

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This integrative study of student SES, race and gender focused on mathematics achievement and self esteem in the school context. Data for the study were derived from the Pennsylvania Educational Quality Assessment Program for the years 1981 through 1984. Analyses were conducted at the fifth, eighth and eleventh grade levels. Replicable achievement differences in mathematics were observed across grade levels for student SES and race, but not for gender. The only replicable interaction to emerge was a relatively weak but persistent SES by Race effect that occurred for all analyses involving students attending low SES schools. Although achievement increased across student SES level for both white and black students the increment tended to be slightly larger for white students. Replicable differences in self esteem occurred for student SES and gender. Race differences, in the form of a grade level by race interaction, occurred only within low SES schools. Supplementary analyses of mathematics achievement incorporating school SES, student SES and race were also performed. In addition to significant results for each main effect several interactions were found, the most prominent being a race by school SES effect, which occurred at each grade level.

INTRODUCTION

Grant and Sleeter (1986) recently presented a review of the research literature which focused upon investigations involving the variables of race, class and gender in educational research. They summarized the results of studies in the *American Educational Research Journal*, *Harvard Educational Review*, the *Review of Educational Research* and the *Teachers College Record* for the years 1973 through 1983. Grant and Sleeter concluded from their review of the 71 studies that few of the investigators had integrated the three factors in their designs and analyses. Rather, the great majority had attended to only one or at most two of the three factors. They argued that this lack of integration of race, gender and socioeconomic status (SES) oversimplifies the analysis of student behavior in school. It provides a narrow focus, treating individuals as if they are members of just one group and ignores the joint contribution of each of the factors.

Reyes and Stanic (1985) presented similar arguments. They pointed out that when race-related differences are investigated without taking SES into consideration there is a likelihood that race and SES are confounded. This is true because, as they stated, there are a disproportionate number of minority group members who are low in SES and, similarly, a disproportionate number of majority group members who are high in SES. The end result of ignoring SES when comparing the achievement of whites and blacks can be the unintentional comparison of economically advantaged white students with economically disadvantaged black students. The conclusions drawn in such a study can certainly lead to misconceptions about racial differences.

Articles such as those just discussed provided the motivation for this paper. It was recognized that the conclusions drawn by Grant and Sleeter and by Reyes and Stanic were in agreement with the findings of Pennsylvania's statewide student testing program. It was also recognized that the extremely large data base available at the state level in Pennsylvania and the routine collection of SES, gender and racial information on all tested students, provided a

readily available situation for carrying out a study in which all three types of factors could be integrated in a way in which their confounding could be statistically controlled. The study to be described was performed at grades 5, 8 and 11 using student mathematics achievement results as well as a measure of student self-esteem in school. In addition, since it is well known that the type of school a student attends is a major factor in his or her achievement, analyses were performed for two separate samples of students, those attending low SES schools and those attending high SES schools.

REVIEW OF RELATED RESEARCH

Mathematics Achievement Studies Focusing Upon Race and SES

For a number of years now, National Assessment of Educational Progress (NAEP) has served as a major vehicle for studying differences in achievement of specific groups. The reports issued as a result of the testings of this agency have indicated that, over the years, black students and students from economically depressed homes have made a great deal of progress. For example, NAEP reported (1979) that in the first assessment black 9-year olds scored, on the average, 15 percentage points below the national average in mathematics. In the 1978 testing this difference had decreased to 10 percentage points. Similarly, black 13-year olds had decreased the degree to which they scored below the national average from 21 percentage points in 1973 to 18 percentage points in 1978. After examining NAEP results from these years, Burton and Jones (1982, p. 12) concluded that there was a "rather steady decline in the average white-black achievement difference with advancing year of birth, regardless of learning area or age of assessment."

As reported by NAEP (1979), low SES students were found to have gained in a similar manner to blacks from 1973 to 1978. The decrease for 9-year olds was from 13 percentage points below the national average in 1973 to 9 below in 1978; for 13-year olds this difference had decreased from 18 to 14.

In the third NAEP testing of mathematics, black students again progressed. Jones (1984) reported that in this testing blacks scored well below the national average, but that the difference between whites and blacks had decreased even more from 1978 to 1982 than it had from 1973 to 1978. This difference was interpreted as primarily the result of increases in test scores for black students rather than declines for white students. The increase in mathematics achievement for black students was larger in schools composed of less than 60 percent white students than in schools composed of at least 60 percent white students. Jones indicated that a portion of the difference remaining between black and white student mathematics achievement could be due to differences between them in the degree to which they enrolled in mathematics courses in high school, such as algebra and geometry courses, since at age 17 the best predictor of mathematics achievement for both boys and girls was the number of mathematics courses completed. On the average, students who took two years of algebra and one year of geometry answered 82 percent of the items correctly; whereas, students who did not take these courses answered 47 percent of the items correctly. Jones also described the finding that SES variables such as parents' occupational status and the amount of reading material in the home did relate to student performance.

White (1982) discussed a meta-analysis investigation in which SES and achievement were related in 101 studies. The average correlation for all studies was .25, but there were major differences between the results of individual student correlations and correlations involving aggregated units of analysis. In studies in which the student was treated as the unit of analysis correlations between achievement and SES averaged .22. These relationships decreased as students became older. White found, however, that when the school or community served as the unit of analysis, the correlations were much higher, averaging .73. He concluded that, contrary to the beliefs of many that SES is strongly related to measures of academic achievement, the relationship is actually a weak one for individuals. Results from Pennsylvania Department of Education studies have provided similar conclusions. As one example, Kohr (1986) reported individual student correlations between parental education and a composite of student achievement of .25 at the grade 5 level, .29 at grade 8 and .30 at grade 11. When school building means for these two variables were correlated, these relationships increased to .52, .48 and

.51 at the grades 5, 8 and 11 levels, respectively. In summarizing such results, Reyes and Stanic (1985, p. 5) stated: "Thus, SES appears to account for less than 10 % of the variance in mathematics achievement when the student is the unit of analysis and considerably more when the school or community is the unit of analysis." Their overall conclusion about the research they had seen was: "There has been no definitive study of SES as it relates to mathematics achievement"(pp. 4-5).

Results such as those just cited raise questions about the degree to which the specific characteristics of students are important determiners of their achievement and the degree to which the type of school and student population are important. The widely known Equality of Educational Opportunity Survey (EEOS), also referred to as the Coleman, et al. study (1966), examined such questions. It has been the subject of debate for a number of years and such debate has resulted in a variety of reanalyses of the data. Bradley and Bradley (1977, p. 401) described the major finding of this study as the conclusion that "...black students in desegregated schools may acquire the achievement-related values of white students and thereby increase their own achievement levels." Cohen, et al. (1972) questioned the degree to which the results found were a consequence of racial differentials in level of social class rather than solely a function of racial composition. Their analyses revealed that school social class and racial composition shared much of the same variance and this confounding was an important factor in attempting to interpret the results.

The EEOS study made it very clear that the variables being studied were complex and highly correlated. A general conclusion of the original study (1966, p. 325) was that the "...schools bring little to bear on a child's achievement that is independent of his background and social context." This conclusion was questioned by the Mayeske et al. (1973) reanalysis, which concluded that the percentage of achievement which could be associated statistically with family background was only 48 and the percentage associated with type of school was 10. The remaining 42 percent was found to be common to both sets of factors. More recently, Morgan and McPartland (1981) raised the issue of whether the grouping factor of interest should really

be the classroom rather than the school. They found that tracking or ability grouping tended to reduce the opportunities for cross-racial contact in classrooms of integrated schools.

The same types of concerns as those described above led to the conclusions of recent writers who were examining the research on the relationships between student achievement and both race and SES. Fleming and Malone (1983), in reviewing science achievement research, pointed out that in the studies they reviewed race and SES were likely to be confounded, since the authors did not tend to report subjects' SES. Scott-Jones and Clark (1986) stated that investigators should describe their subjects in terms of race, gender and SES in future studies of achievement. They warned that researchers must seek to avoid confounding the variables of race and socioeconomic status.

Mathematics Achievement Studies Focusing Upon Gender

Studies of gender differences in mathematics achievement have not faced as many difficulties as those involving race and SES. This is true because few differential results have been found which would lead to conclusions that gender differences could be a function of some other major organismic variable. As an example of the type of result found, the NAEP results from a special 1975-76 mathematics study can be described. In this assessment, as summarized by Jones (1984), 13-year old black females and males did not differ in their mathematics achievement, and this same result was found for white males and females. By age 17, however, significant gender differences favoring males occurred for both blacks and whites. But the difference between the two racial groups was five times as large as the gender differences within racial groups.

Other reviews of research on sex differences have tended to find some differences between males and females in mathematics achievement, but not generally until above the elementary school level. Fleming and Malone (1983) described cognitive achievement differences attributable to race as three times as great as those attributable to gender. Fox (1977), after reviewing the research literature, concluded that sex differences on tests of mathematics

achievement were repeatedly found in adolescent and adult populations. Fennema (1977, p. 85) reviewed the mathematics research literature in 1976 and concluded the following: "1. There are no sex-related differences evident in elementary school years. This is at all cognitive levels from computation to problem solving. This conclusion has been accepted for a number of years. 2. After elementary school years, differences do not always appear. 3. Starting at about the 7th grade, if differences appear, they tend to be in the males' favor, particularly on tasks involving higher level cognitive skills. 4. There is some evidence that sex-related differences in mathematics learning in high school may not be as large in 1976 as they were in previous years. 5. Conclusions reached about male superiority have often been gathered from old studies or from studies in which the number of mathematics courses taken was not controlled. Therefore, a better mathematically educated group of males was being compared to a group of females who had participated in less mathematics education. In reality, what was being compared were not females and males but students who had studied mathematics 1-3 years in high school with students who had studied mathematics 2-4 years in high school."

The gender differences which have been found have spurred debate about how such differences have occurred. The analyses of Jones (1984) pointed to a similar conclusion to that stated by Fennema in the article quoted above. Jones suggested that the High School and Beyond project findings lead to the conclusion that both racial and sexual differences in mathematics achievement could be eliminated by encouraging blacks and white females to enroll in appropriate math courses.

The SAT quantitative test, or SAT-M, has served as a major instrument for examining gender differences in mathematics achievement. The national publications produced by the College Entrance Examination Board (CEEB) over the past 15 years (1972, 1973...1986) have shown rather major male-female differences on the SAT-M. These differences have been of the order of 40 to 50 points, with the largest difference, 52, occurring in 1977 and the smallest difference, 42, occurring in both 1973 and 1974. A similar pattern of difference took place in Pennsylvania over this time period However, as reported in the CEEB publications for the state of Pennsylvania (1972, 1973...1986), the male-female differences in Pennsylvania have not been quite as

large as those found nationally. These have not exceeded 46 points and, from 1972 through 1975 , were less than 35. The greatest magnitude of difference, 46, took place in both 1982 and 1983. In the last two years, 1985 and 1986, differences of 42 and 43 occurred.

A number of researchers have attempted to determine the reasons for the rather large gender differences which have been routinely found on the SAT-M. Benbow and Stanley (1980) questioned the validity of the hypothesis that the differences between mathematics achievement of males and females were due to the fact that females took fewer mathematics courses. They examined differences in mean SAT-M scores of highly able boys and girls who were primarily seventh graders. At this point in their lives there had been no differences in the amount of mathematics coursework of these gifted students, yet the researchers found significant differences in mathematics scores, favoring males. The authors hypothesized that the sex differences they found were due to superior male mathematical ability, which possibly could be related to greater male ability in spatial tasks.

Pallas and Alexander (1983), however, found an opposite result. They indicated in their discussion that it was well established that by the end of high school there were large sex differences in mathematics achievement and aptitude. They added that this finding was recurrent across countries and over time and on various standardized tests. Their intent was to determine the extent to which mathematics coursework could be responsible for these differences.

In their investigation, Pallas and Alexander chose a sample in which the males and females studied did not differ in race or SES or in their quantitative performance at the ninth grade level. But at the end of high school they found a mean difference of 36.78 points between these males and females in their SAT-M performance, a difference of about .3 of a pooled sample standard deviation. Their analyses of the reasons for this difference supported the differential coursework hypothesis. They concluded that most of it could be due to the sex-linked differential in students' high school programs.

Self appraisal instruments are numerous and varied with respect to theoretical assumptions and methodological considerations (Wylie,1979). Many of these measures may look similar in title and content, but there are subtle, often unrecognized, differences between them. For example, Gray-Little & Applebaum (1979) found that, although the Tennessee Self Esteem Scale and the Coopersmith Self Esteem Inventory (SEI) purport to measure the same general constructs, the SEI is far more likely to be sensitive to racial and SES differences.

Self esteem as conceived by EQA measures teacher relationships, peer relationships in school, and school self image or concept of self as a learner. Of the many citations found in the self concept literature, few dealt with these specific issues, and fewer still dealt with this type of academic self concept in the light of race, gender or SES, the independant variables with which this study is concerned. According to Wylie evidence of one's school ability is indirect and relative to one's classmates. As a consequence, the accuracy of one's self conception is likely to be lowered. Wylie (1979, p.357) states "...upward distortion of self evaluations, especially self-evaluations of ability, are common. If this is true, the range of self-estimates of ability may be considerably truncated at the lower end." Statistically, this serves to reduce the relationship between self concept and measures of achievement or ability.

The relationship between self esteem and SES seems to depend primarily on whether the measuring instrument defines self esteem in general or specific terms. In her review of 48 studies examining the relationship between SES and general self esteem, or what she termed "overall self-regard", Wylie (1979) concluded results have been weak, contradictory and mostly nonsignificant. Examples of contradictory results with the same instrument, the SEI, occurred in the studies of Trowbridge (1972) and Kohr (1974). In the Trowbridge study higher self esteem scores were found for low SES children on all subscales of the SEI except home climate where higher scores were associated with the high SES group. By contrast, Kohr (1974) in a longitudinal study using the SEI, found significantly higher self esteem scores as SES level increased. This finding was consistent as the students progressed from fifth to seventh to ninth

grades. Wylie (1979) noted that only in the more specific measures of self concept of school ability, or academic self concept, did studies reveal a consistent positive association between SES and self esteem. She further hypothesized that a stronger relationship between SES and self esteem might exist within homogeneous middle or upper SES groups as a function of keener competition for status within these groups.

Race as a factor in self esteem has been widely explored, not without bias, with the expectation that minorities' self concept will be lower. In her review, Wylie (1979) pointed out that many investigators have mistakenly assumed that the self esteem of blacks must be less positive than for whites, however, studies not taking SES into account have tended to show little difference in the self esteem scores of these two racial groups.

Gray-Little & Applebaum (1979) point up the lack of unanimity in the assessment of self esteem by race, noting that the discrepancies found rest on differences in theory and methodology in measurement. They state that "studies of racial differences in self-esteem are not instructive either with regard to the nature of self-concept or racial differences in personality when the groups initially differ in ways that are confounded with race." (p.1229). Nonetheless, they found significant main effects for race in a study of young children using the Coopersmith Self-Esteem Inventory and Tennessee Self Concept Scale.

In terms of the interaction between Race and SES, Wylie found that, "...some of the alleged influences of racial/ethnic status are parallel precisely because most minority racial/ethnic groups tend to occupy lower SES levels." (p.119). In confirmation of this, Gray-Little & Applebaum (1979) found significant differences in self esteem by race with SES as a covariate, with whites scoring higher than blacks, but these differences disappeared when controlling for IQ or achievement in school.

As to whether self esteem was related to gender, Gray-Little and Applebaum (1979) found no significant effects for sex in a study of young children using the Coopersmith Self- Esteem Inventory and Tennessee Self Concept Scale. Likewise, the studies conducted by Trowbridge

(1972) and Kohr (1974) also found no significant differences in the self esteem scores of male and female school children. In their literature review, West, Fish & Stevens (1980) reported a general lack of agreement among studies as to sex differences in self concept of academic ability. Wylie's 1979 review of the self concept literature in relation to gender reports that, of the many studies using the Coopersmith Self-Esteem Inventory (SEI), virtually all showed no difference between boys' and girls' self concept or were ambiguous because of methodological problems. None of the research done with well known self concept scales demonstrated male-female differences of any significance.

A recent study conducted by Richman, Clark & Brown (1985) attempted to investigate the interaction of gender, race and SES. Their results are somewhat mixed due to their use of several instruments which define self esteem differently. Most relevant to the present study are the results from the Brookover Self Concept of Ability and School Achievement Scale on which a significant gender by race interaction was observed. The interaction indicated that black females felt more positively about their academic success than black males while white males exhibited slightly more confidence in their school achievement than white females. Middle and high SES adolescents had higher scores than their low SES counterparts.

METHOD

Pennsylvania's Educational Quality Assessment (EQA) program has provided a school building assessment on each of the state adopted goals of quality education for the past 17 years. This study involved analyses of assessment results from the years 1981 through 1984, at a time period during which all school districts in the state participated at least once. During these years students at fifth, eighth and eleventh grades were tested in 14 areas, half of which were cognitive and half non-cognitive. Data were also collected on a series of student background variables such as parental education and occupation, amount of reading material in the home, race, gender, etc. This information together with data obtained from a teacher questionnaire were summarized in an extensive 24 page school report returned to the school district during a two to three hour interpretation session conducted by an EQA staff member.

Data Source

Participating school districts were assessed during the first two weeks of March while results were returned starting in July. Every building in the district housing a fifth, eighth or eleventh grade underwent assessment and all students within those grade levels were involved. The testing procedure involved multiple matrix sampling to reduce testing time for individual students. Answer sheets were scanned and scored electronically.

Data from four years, 1981 through 1984, were selected for inclusion in the analysis. Since school districts were not required to participate in assessment each year, and when and how often a district participated was voluntary, strong efforts were made to insure geographic balance and representativeness in terms of district size and wealth. The number of districts involved in assessment was 228 in 1981, 216 in 1982, 239 in 1983 and 186 in 1984. Since the Commonwealth has a total of 500 school districts the percentage of districts involved in any given year ranged from 37 percent to 48 percent. The number of students tested at a given grade level ranged from about 35,000 to 50,000 per year.

Student Outcome Measures

The present study focused on one cognitive area, mathematics, and one noncognitive area, self esteem. The number of items comprising the mathematics test was 60 at each grade level. For self esteem the number of items was 33 at grade 5 and 32 at grades 8 and 11. The mathematics test, measuring conceptual, computational and problem solving levels, contained multiple choice items dealing with number systems, numeration, notation, geometry, measurement, number patterns, relationships and other topics. The self esteem measure consisted of self descriptive statements reflecting the school context. Categorically, the items reflect three major clusters: (1) relationship with teachers, (2) peer relationships and (3) self image in school, or academic self concept. An extensive description of these instruments and the rest of the test package along with technical properties is given in the test interpretation manuals *Getting Inside the EQA Inventory* (Kohr, Hertzog & Seiverling , 1984) and *EQA Manual for Interpreting School Reports* (Hertzog & Seiverling, 1984a, 1984b, 1984c). Previous research found that the EQA mathematics test correlated between .76 and .89 with similar measures in six major commercial standardized test packages when school mean data from spring testing was analyzed (Blust & Kohr, 1981).

Student outcome scores were converted into standard scores with a mean of zero and standard deviation of one in order to control for slight differences that occur depending on which form a student received. The matrix sampling technique employed by EQA involved three forms at grade 5 and four forms at grades 8 and 11. During test administration, booklets were distributed in such a way that an essentially random third (or fourth) of the students within each testing room received a given form. All students responded to an equal number of items on each of the areas assessed. For instance, there were 60 items in mathematics in the overall school assessment, with each form consisting of a different set of 20 (or 15) items. The self esteem measure consisted of 33 items at grade 5 and 32 items at grades 8 and 11. Thus, a fifth grade student would have responded to 11 items and an eighth or eleventh grade student, 8 items. The original allocation of items to forms was done in such a way as to minimize form to form differences in difficulty.

Student Background Variables

An index of student socioeconomic status was developed by combining data collected from the EQA student questionnaire on parental education, parental occupation and amount of reading material in the home. Parental education was measured on a scale ranging from zero (some grade school) to nine (Ph.D. or professional degree). The value used corresponded to the highest level of education reached by the student's mother or father (or guardians). From a list of 148 occupations and six special categories, students indicated the occupations most like the ones held by their mother and father (or guardians). The occupational categories were converted into a weighted score reflecting socioeconomic level. Again, the larger of the two values was used. Amount of reading material in the home was a weighted score based on student responses to five items. For this study, student scores on the three socioeconomic measures were converted into standard scores (z-scores) and summed. The distributions of summed or combined z-scores were then partitioned into low, middle and high student socioeconomic subgroups defined as the lowest 30 percent, middle 40 percent and highest 30 percent. In the paper this index is referred to as student SES. The final two student characteristics involved in the study were gender and race. Only two racial groups were studied, black and white.

School Socioeconomic Status

Another variable incorporated in the study was school SES defined in terms of the percentage of low income families in the area served by the school. In contrast to student SES, which is represented by a score which is unique to the individual student, school SES is a constant value for all students within a particular school. For grades 5 and 8, a low SES school was defined as having 30 percent or more of its students classified as from low income families. At grade 11, 20 percent was the cutoff used. If a school had ten percent or less of its students classified as from low income families, it was defined as a high SES school. Students attending schools falling between the Low-High cutoff points were excluded from the analysis.

Data Analysis

To examine the effect of student SES, race and gender a three factor analysis of variance (ANOVA) model was selected. A 3 x 2 x 2 design was employed since student SES was partitioned into three levels and the factors of race and gender consisted of two groups each. There are several problems inherent in this analytic approach. First, the variables serving as factors in this study are known as organismic variables, meaning that they are obtained through the measurement of research subjects rather than being manipulable or treatment variables. As Games (1975) pointed out, organismic variables often possess limited reliability which results in extreme groups showing differential regression when remeasured. The issue of reliability applies to student SES but not to race and gender in the present study. For instance, a typical internal consistency coefficient for the composite student SES index used in this investigation was .57. Most problematic is the fact that student SES is correlated with race. When factors are correlated the cell n's are unequal and nonproportional, resulting in nonorthogonal main effect and interaction vectors which is a clear violation of the independence assumption in conventional ANOVA. Therefore, a regression approach to ANOVA was taken in order to manage the analysis in a statistically appropriate way (Games, 1975). The general linear model has been advocated and described in a number of sources such as Kerlinger and Pedhazur (1973) and Cohen and Cohen (1975). In this approach, the descriptive means are inappropriate for examining an effect and must be replaced with the least squares estimates of the effect means.

School SES was treated separately rather than as an additional factor in ANOVA because of the added complexity of having to interpret potential three and four way interactions.

Assessment data from 1981 and 1982 were combined for analysis purposes as were data from 1983 and 1984. This served to promote data stability and provide two replications to enhance generalizability of results.

Characteristics of the Sample

As indicated previously, the general statistical approach was to conduct separate analyses of variance for groupings based on low and high SES schools and for different years of assessment. When the data were initially examined it was noted that, despite the large number of students in each year's assessment, certain cells contained relatively few cases. For instance, in high SES schools the number of male and female black students classified as having a high SES family background (student SES) was rather small, ranging between 70 and 100 for a particular gender grouping. To bolster the stability of results for the smaller cells, all analyses were conducted on combined data from two consecutive years. Thus, the analysis samples were for 1981 and 1982 combined and for 1983 and 1984 combined. The number of cases involved in the mathematics and self esteem analyses differed slightly due to missing data. Table 1 presents a breakdown of each analysis sample, giving the number of cases and the percentage of students in each student SES, race and gender category for the mathematics analysis.

Table 1

Composition of Analysis Sample in Terms of Student SES, Race and Gender for Each Year and School SES: MATHEMATICS

		Percentage of the Analysis Sample in Each Category						
		Student SES Level			Race		Gender	
School Year/ SES	N of Students	Low	Middle	High	White	Black	Male	Female
Grade 5								
81/82 Low	22,094	37.2%	51.0%	11.7%	83.9%	16.1%	50.6%	49.4%
83/84 Low	24,414	36.9	50.5	12.6	77.1	22.9	50.4	49.6
81/82 High	27,012	11.0	48.6	40.3	97.0	3.0	51.2	48.8
83/84 High	23,226	11.1	47.9	41.0	96.1	3.9	50.9	49.1
Grade 8								
81/82 Low	23,713	33.9%	51.7%	14.4%	83.6%	16.4%	50.4%	49.6%
83/84 Low	30,703	32.1	52.1	15.8	76.7	23.3	50.4	49.6
81/82 High	25,294	14.8	47.3	37.9	96.3	3.7	51.0	49.0
83/84 High	25,751	13.6	46.0	40.4	96.0	4.0	50.9	49.1
Grade 11								
81/82 Low	23,682	33.1%	52.9%	14.0%	88.5%	11.5%	49.4%	50.6%
83/84 Low	22,502	31.8	53.4	14.8	82.8	17.2	49.7	50.3
81/82 High	28,548	15.7	49.0	35.3	96.8	3.2	50.0	50.0
83/84 High	22,343	15.9	48.0	36.1	95.9	4.1	50.3	49.7

Notable in Table 1 is the obvious relationship between student SES level and school SES. Certainly one would expect to find a higher percentage of students from a high SES family background (defined by parental education, occupation and reading materials in the home) in a high SES community, referred to as school SES. The correlation of race and school SES is also clearly depicted by the very low percentage of black students in high SES schools, approximately three to four percent, relative to their representation in low SES schools which ranged from about 12 to 23 percent.

Table 2 presents a similar breakdown for the analyses conducted with self esteem as the dependent variable. The percentage figures are nearly identical to those depicted in Table 1.

Table 2

Composition of Analysis Sample in Terms of Student SES, Race and Gender for Each Year and School SES: SELF ESTEEM

		Percentage of the Analysis Sample in Each Category						
		Student SES Level			Race		Gender	
Year/ School SES	N of Students	Low	Middle	High	White	Black	Male	Female
Grade 5								
81/82 Low	21,480	37.1%	51.2%	11.8%	84.3%	15.7%	50.6%	49.4%
83/84 Low	23,719	36.7	50.7	12.6	77.5	22.5	50.4	49.6
81/82 High	26,313	11.0	48.5	40.5	97.1	2.9	51.2	48.8
83/84 High	22,745	11.1	47.9	41.0	96.1	3.9	50.9	49.1
Grade 8								
81/82 Low	23,191	33.8%	51.8%	14.4%	84.4%	15.6%	50.5%	49.5%
83/84 Low	30,013	32.1	52.1	15.8	77.6	22.4	50.5	49.5
81/82 High	24,918	14.8	47.3	37.9	96.4	3.6	51.0	49.0
83/84 High	25,538	13.6	46.0	40.4	96.0	4.0	50.9	49.1
Grade 11								
81/82 Low	23,271	33.0%	52.9%	14.1%	89.1%	10.9%	49.4%	50.6%
83/84 Low	22,053	31.7	53.5	14.8	83.7	16.3	49.5	50.5
81/82 High	28,139	15.8	49.0	35.2	96.8	3.2	50.0	50.0
83/84 High	22,191	15.9	48.1	36.0	95.9	4.1	50.2	49.8

RESULTS

Analysis of variance results are summarized below along with the least squares estimates of means for the significant main and interaction effects. Results are presented for mathematics and self esteem in separate sections.

Mathematics Achievement

This section is organized according to grade level. Accordingly, results of statistical analysis are presented and described for grade 5, then for grades 8 and 11.

Grade 5 Results

Summarized in Table 3 are the F-ratios from the grade 5 analysis of variance for each analysis sample.

Table 3

F-ratios for Student SES, Race, Gender and Their Interactions for Mathematics Grade 5 Students from Low SES Schools and High SES Schools

	Student SES	Race	Gender	Student SES x Race	Student SES x Gender	Race x Gender	Student SES x Race x Gender
Low SES Schools							
1981/1982	130.38*	570.44*	9.92*	8.88*	0.59	4.50	0.50
1983/1984	178.59*	909.17*	4.74	11.21*	0.20	12.06*	0.58
High SES Schools							
1981/1982	61.40*	98.14*	0.00	0.40	0.77	0.42	1.19
1983/1984	57.31*	113.74*	1.88	1.20	4.90*	0.23	6.53*

* $p < .01$

Replicable results were significant SES and race main effects for both low and high SES schools. A significant SES by race interaction was observed on both analysis samples for the low SES schools but not for high SES schools. Least squares estimates of significant main effect means are presented in Table 4. Shown in Table 5 are the means for the significant interaction observed for the low SES schools.

Table 4

Least Squares Estimates of Grade 5 Mathematics Means for Significant Main Effects

Main Effect	Low SES Schools 1981/1982	Low SES Schools 1983/1984	High SES Schools 1981/1982	High SES Schools 1983/1984
Student SES/Low	-0.377	-0.372	-0.062	0.014
Student SES/Middle	-0.125	-0.173	0.162	0.188
Student SES/High	0.047	0.078	0.465	0.471
Race/White	-0.097	-0.084	0.271	0.300
Race/Black	-0.733	-0.657	-0.108	-0.089

Table 5

Least Squares Estimates of Grade 5 Mathematics Means for the Significant SES by Race Interaction Effect Found in Low SES Schools

	Low SES Schools 1981/1982 White	Low SES Schools 1981/1982 Black	Low SES Schools 1983/1984 White	Low SES Schools 1983/1984 Black
Student SES/Low	-0.330	-0.845	-0.286	-0.778
Student SES/Middle	-0.016	-0.655	-0.014	-0.651
Student SES/High	0.213	-0.541	0.214	-0.378

For both low school SES analysis samples the full rank regression model resulted in a multiple R of .30, thereby accounting for nine percent of the test score variance. The reduced rank model testing the SES by race interaction revealed that only 0.1 percent of the variance was accounted for by this effect in both analysis samples. By contrast, reduced models testing each main effect found SES to account for about 1.2 percent of the variance in both instances. The race main effect accounted for 2.3 and 3.4 percent of test score variance in the 81/82 and 83/84 samples, respectively. The relative weakness of the SES by race interaction suggests that the most interpretable result is to be found in the main effects. That this is the case may be seen from an examination of the means presented in Table 5. Increases in mathematics achievement scores across student SES levels occurred for both white and black groups although the magnitude of increase was generally slightly less for black students. Overwhelmingly the greatest differences in mean scores occurred for the groups based on race and SES.

For students attending high SES schools the full rank regression model yielded a multiple R of .21 for both analysis samples, accounting for 4.4 percent of the test score variance. Reduced rank models testing the SES and Race main effects found that each accounted for approximately 0.4 to 0.5 percent of the variance. Here again, significant contrasts were found between student SES groups in the usual direction. White students scored higher than black students.

Table 6 contains a summary of the eighth grade analysis of variance findings for each of the four analysis samples.

Table 6

F-ratios for Student SES, Race, Gender and Their Interactions for Mathematics Grade 8 Students from Low SES Schools and High SES Schools

	Student SES	Race	Gender	Student SES x Race	Student SES x Gender	Race x Gender	Student SES x Race x Gender
Low SES Schools							
1981/1982	226.75*	1449.42*	0.03	34.51*	1.81	0.09	0.37
1983/1984	323.68*	2915.99*	10.26*	95.24*	1.10	2.72	0.79
High SES Schools							
1981/1982	177.85*	116.41*	0.04	0.39	0.44	0.01	2.44
1983/1984	184.16*	132.45*	1.01	0.21	0.57	0.06	1.00

* $p < .01$

The pattern of results for eighth grade students were very similar to those observed at grade 5 in that significant SES and race main effects were replicated within the low and high school SES analysis samples. Also replicated was the significant SES by race interaction for the low school SES samples and the nonsignificant result for high SES schools.

For low SES school analysis samples the full rank regression model resulted in a multiple R of .35 and .38, which accounts for about 12 and 15 percent of the test score variance for the 81/82 and 83/84 years. The reduced rank model testing the SES by race interaction revealed that only 0.3 and 0.5 percent of the variance was accounted for by this effect in the 81/82 and 83/84 analysis samples. In comparison, the reduced models testing each main effect found SES to account for about 1.7 percent of the variance in both instances. The race main effect accounted for 5.4 and 8.1 percent of test score variance in the 81/82 and 83/84 samples, respec-

tively. As observed at grade 5, the relative weakness of the SES by race interaction indicates that the most interpretable result is found in the main effects.

Nearly identical results were found for the two high SES school analysis samples. In both instances the multiple R for the full model was .30 which accounted for nine percent of the variance. The SES and race main effects accounted for about 1.3 and 0.4 percent of the variance in both samples. Relevant least squares estimates of the means are displayed in Tables 7 and 8.

Table 7

Least Squares Estimates of Grade 8 Mathematics Means for Significant Main Effects

Main Effect	Low SES Schools 1981/1982	Low SES Schools 1983/1984	High SES Schools 1981/1982	High SES Schools 1983/1984
Student SES/Low	-0.391	-0.428	-0.225	-0.207
Student SES/Middle	-0.159	-0.218	0.129	0.181
Student SES/High	0.130	0.040	0.596	0.606
Race/White	-0.074	-0.071	0.266	0.315
Race/Black	-0.787	-0.817	-0.096	-0.066

Table 8

Least Squares Estimates of Grade 8 Mathematics Means for the Significant SES by Race Interaction Effect Found in Low SES Schools

	Low SES Schools 1981/1982		Low SES Schools 1983/1984	
	White	Black	White	Black
Student SES/Low	-0.359	-0.876	-0.361	-0.870
Student SES/Middle	-0.038	-0.733	-0.055	-0.757
Student SES/High	0.366	-0.560	0.366	-0.661

Contrasts between the low-middle and the middle-high SES groups were statistically significant. For students attending low SES schools the magnitude of the differences between SES groups was very similar for the 81/82 and 83/84 analysis samples. Although the size of the differences were slightly larger, a similar pattern occurred for the two analysis samples within the high SES schools. White students outscored black students by a rather large amount which was nearly identical on the two analysis samples. Although smaller in magnitude, similar differences were observed for students attending high SES schools.

Worthy of comment is a trend observed in relatively weak interaction effect means portrayed in Table 8. In both analysis samples, the difference between white and black students showed a progressive increase across student SES levels.

Table 9 contains a summary of the eleventh grade analysis of variance findings for each of the four analysis samples.

Table 9

F-ratios for Student SES, Race, Gender and Their Interactions for Mathematics Grade 11 Students from Low SES Schools and High SES Schools

	Student SES	Race	Gender	Student SES x Race	Student SES x Gender	Race x Gender	Student SES x Race x Gender
Low SES Schools							
1981/1982	134.57*	961.44*	5.77	12.86*	1.46	0.92	0.14
1983/1984	137.87*	1403.90*	2.92	32.04*	1.24	1.30	0.14
High SES Schools							
1981/1982	186.54*	133.77*	0.77	5.21*	1.65	0.02	2.45
1983/1984	129.78*	171.19*	0.11	1.07	2.61	0.57	1.81

* $p < .01$

The patterns of results for eleventh grade students were very similar to those already described for fifth and eighth graders. Once again, significant SES and race main effects were replicated within the low and high school SES analysis samples. Also replicated was the significant SES by race interaction for the low school SES samples and the nonsignificant result for high SES schools.

For low SES school analysis samples the full rank regression model resulted in a multiple R of .30 and .34, which accounts for about nine and 11 percent of the test score variance for the 81/82 and 83/84 years. The reduced rank model testing the SES by race interaction revealed that only 0.1 and 0.2 percent of the variance was accounted for by this effect in the 81/82 and 83/84 anaiysis samples. In comparison, the reduced models testing each main effect found SES

to account for about 1.1 percent of the variance in both instances. The race main effect accounted for 3.7 and 5.5 percent of test score variance in the 81/82 and 83/84 samples, respectively. As observed at grades 5 and 8, the relative weakness of the SES by race interaction indicates that the most interpretable result is found in the main effects.

Very similar results were found for the two high SES school analysis samples. The multiple rs for the full model were .28 and .30 respectively, which accounted for eight and nine percent of the variance. The SES main effect accounted for about 1.1 percent of the variance in both samples. The race effect accounted for 0.4 and 0.7 percent of the variance. Relevant least squares estimates of the means are displayed in Tables 10 and 11.

Table 10

Least Squares Estimates of Grade 11 Mathematics Means for Significant Main Effects

Main Effect	Low SES Schools 1981/1982	Low SES Schools 1983/1984	High SES Schools 1981/1982	High SES Schools 1983/1984
Student SES/Low	-0.303	-0.335	-0.328	-0.209
Student SES/Middle	-0.119	-0.155	0.063	0.094
Student SES/High	0.190	0.096	0.561	0.521
Race/White	-0.057	-0.049	0.190	0.219
Race/Black	-0.751	-0.780	-0.210	-0.236

Table 11

Least Squares Estimates of Grade 11 Mathematics Means for the Significant SES by Race Interaction Effect Found in Low SES Schools

	Low SES Schools 1981/1982		Low SES Schools 1983/1984	
	White	Black	White	Black
Student SES/Low	-0.287	-0.838	-0.302	-0.833
Student SES/Middle	-0.028	-0.727	-0.019	-0.755
Student SES/High	0.347	-0.486	0.327	-0.599

Contrasts between the low-middle and the middle-high SES groups were statistically significant. For students attending low SES schools the magnitude of the differences between SES groups was very similar for the 81/82 and 83/84 analysis samples. While the size of the differences were slightly larger, a similar pattern occurred for the two analysis samples within the high SES schools. White students outscored black students by a rather large amount which was nearly identical on the two analysis samples. Although smaller in magnitude, similar differences were observed for students attending high SES schools.

As noted in the fifth and eighth grade analyses for low SES schools, there was a relatively weak SES by race interaction effect. The means for this effect are portrayed in Table 11. In both analysis samples, the difference between white and black students showed a progressive increase across student SES levels.

Summary of Mathematics Results

The analytic strategy employed in this study utilized two analysis samples as a way of strengthing generalizability. Findings were reported and discussed whenever both analysis samples revealed the same results. A number of consistent findings were observed for mathematics achievement across grade levels. Significant student SES and race main effects occurred for all analyses. Not surprisingly these results conformed to well established evidence from previous studies of SES and race. Specifically, mathematics achievement increased as student SES increased and white students scored at a higher level than black students. Gender differences only occurred in two of the 12 analyses, neither of which was a replicable finding. The only replicable interaction to emerge was a relatively weak but persistent effect that occurred for all analyses dealing with students attending low SES schools. Although achievement increased across student SES level for both white and black students the increment tended to be slightly larger for white students. Stated another way, the differences between white and black mathematics scores showed a small but progressive increase across student SES levels. Typically the difference between white and black z scores was approximately .50 for the low student SES level, about .70 at the middle student SES level and about .90 for the high student

SES level. This effect did not occur for analyses dealing with students attending high SES schools.

Self Esteem

This section is organized according to grade level. Accordingly, results of statistical analysis is presented and described for grade 5, then for grades 8 and 11. A summary of findings is offered at the end of this section.

Grade 5 Results

Summarized in Table 12 are the F-ratios from the grade 5 analysis of variance for each analysis sample.

Table 12

F-ratios for Student SES, Race, Gender and Their Interactions for Self Esteem Grade 5 Students from Low SES Schools and High SES Schools

	Student SES	Race	Gender	Student SES x Race	Student SES x Gender	Race x Gender	Student SES x Race x Gender
Low SES Schools							
1981/1982	80.85*	24.35*	15.83*	1.26	1.71	0.66	0.46
1983/1984	79.41*	59.75*	9.34*	7.65*	0.12	0.06	1.07
High SES Schools							
1981/1982	10.32*	0.58	0.43	0.89	0.87	0.06	0.97
1983/1984	12.69*	9.17*	1.17	1.30	2.85	1.93	2.54

* $p < .01$

Replicable results included significant SES, race and gender main effects for low SES schools. A significant SES by race interaction effect occurred for the 83/84 low SES school

sample but was not replicated for the 81/82 sample. Replicable findings for the high SES school analyses were sparse, with only the student SES main effect demonstrating significance. Table 13 presents the least squares estimates of mean self esteem scores for the replicated significant main effects.

Table 13

Least Squares Estimates of Grade 5 Self Esteem Means
for Significant Main Effects

Main Effect	Low SES Schools 1981/1982	Low SES Schools 1983/1984	High SES Schools 1981/1982	High SES Schools 1983/1984
Student SES/Low	-0.185	-0.179	-0.076	-0.054
Student SES/Middle	0.029	-0.029	0.067	0.084
Student SES/High	0.163	0.128	0.176	0.204
Race/White	-0.012	-0.029		
Race/Black	-0.152	-0.184		
Gender/Male	-0.090	-0.094		
Gender/Female	0.023	-0.033		

For the low school SES analysis samples the full rank regression model resulted in a multiple R of .15 and .14, accounting for about two percent of the score variance. The reduced rank model testing each main effect revealed that SES accounted for 0.7 percent of the variance in both analysis samples, race accounted for 0.1 and 0.2 percent respectively, and gender accounted for 0.07 and 0.04 percent. For the high SES school analysis samples the full rank regression model resulted in a multiple R of .10 and .11, accounting for only one percent of the score variance. The reduced rank model testing the significant SES main effect revealed that SES accounted for 0.1 percent of the variance in each instance. Clearly the magnitude of these statistically significant main effects are quite small.

An examination of the means in Table 13 shows the following consistent pattern. Self esteem scores increased as student SES level increased for analyses involving students attending low SES schools as well as for high SES schools. Within analyses for students attending

low SES schools, higher self esteem scores were observed for white students and for female students.

Grade 8 Results

Summarized in Table 14 are the F-ratios from the grade 8 analysis of variance for each analysis sample.

Table 14

F-ratios for Student SES, Race, Gender and Their Interactions for Self Esteem Grade 8 Students from Low SES Schools and High SES Schools

	Student SES	Race	Gender	Student SES x Race	Student SES x Gender	Race x Gender	Student SES x Race x Gender
Low SES Schools							
1981/1982	142.07*	6.59*	33.67*	3.19	0.39	2.05	0.12
1983/1984	163.20*	0.68	92.43*	26.79*	0.15	8.75*	3.33
High SES Schools							
1981/1982	45.75*	0.81	18.28*	3.02	0.24	3.38	0.50
1983/1984	78.70*	0.11	15.17*	1.10	1.21	1.71	0.58

* $p < .01$

Replicable findings for the grade 8 self esteem analyses included significant student SES and gender main effects for both low and high SES schools. Only one significant interaction occurred; however it was not replicated. Shown in Table 15 are the least squares estimates of mean self esteem scores for the replicated SES and gender effects.

Table 15

Least Squares Estimates of Grade 8 Self Esteem Means
for Significant Main Effects

Main Effect	Low SES Schools 1981/1982	Low SES Schools 1983/1984	High SES Schools 1981/1982	High SES Schools 1983/1984
Student SES/Low	-0.212	-0.177	-0.208	-0.308
Student SES/Middle	0.038	0.012	0.008	0.009
Student SES/High	0.220	0.198	0.224	0.249
Gender/Male	-0.082	-0.096	-0.014	-0.002
Gender/Female	0.042	0.058	0.133	0.130

For the low school SES analysis samples the full rank regression model resulted in a multiple R of .17 which accounted for about three percent of the score variance. The reduced rank model testing each main effect revealed that SES accounted for 1.1 percent of the variance in both analysis samples and gender accounted for 0.1 and 0.3 percent respectively. For the high SES school analysis samples the full rank regression model resulted in a multiple R of .19, accounting for nearly four percent of the score variance. The reduced rank model testing the significant SES main effect revealed that SES accounted for 0.4 and 0.6 percent of the variance while gender accounted for 0.07 and 0.06 percent, respectively. As in the grade 5 results the magnitude of these statistically significant main effects are quite small.

An examination of the means in Table 15 shows the following consistent pattern. Self esteem scores increased as student SES level increased for analyses involving students attending low SES schools as well as for high SES schools. Within analyses for students attending low SES schools, higher self esteem scores were observed for females than for males.

Summarized in Table 16 are the F-ratios from the grade 11 analysis of variance for each analysis sample.

Table 16

F-ratios for Student SES, Race, Gender and Their Interactions for Self Esteem Grade 11 Students from Low SES Schools and High SES Schools

	Student SES	Race	Gender	Student SES x Race	Student SES x Gender	Race x Gender	Student SES x Race x Gender
Low SES Schools							
1981/1982	113.98*	111.83*	42.00*	9.29*	1.84	0.02	0.64
1983/1984	113.56*	80.02*	48.92*	1.72	4.40*	7.70*	4.95*
High SES Schools							
1981/1982	65.64*	0.24	6.82*	0.28	0.23	0.20	0.83
1983/1984	64.33*	0.04	35.84*	0.34	0.09	13.21*	0.24

* $p < .01$

Replicable findings for the grade 11 self esteem analyses included significant student SES, race and gender main effects for the low SES schools. Several significant interactions occurred; however they were not replicated. Replicable findings for the high SES school analyses included significant student SES and gender main effects. The race main effect was not significant for high SES schools. Only one analysis revealed a significant interaction but it was not replicated. Table 17 presents the least squares estimates of mean self esteem scores for the replicated significant main effects.

Table 17

Least Squares Estimates of Grade 11 Self Esteem Means
for Significant Main Effects

Main Effect	Low SES Schools 1981/1982	Low SES Schools 1983/1984	High SES Schools 1981/1982	High SES Schools 1983/1984
Student SES/Low	-0.206	-0.118	-0.290	-0.235
Student SES/Middle	0.034	0.133	-0.003	0.057
Student SES/High	0.258	0.259	0.242	0.318
Race/White	-0.038	0.035		
Race/Black	0.182	0.265		
Gender/Male	-0.101	0.001	-0.007	-0.004
Gender/Female	0.071	0.142	0.084	0.214

Regardless of whether analyses dealt with students attending low or high SES schools the full rank regression model yielded a multiple R between .19 and .20 which accounted for approximately four percent of the self esteem score variance. For analyses involving low SES schools the reduced rank model testing the significant SES main effect revealed that SES accounted for one percent of the variance. Race accounted for 0.3 and 0.5 percent, respectively and gender accounted for 0.2 percent in both analyses. In the high SES schools the reduced rank model for student SES accounted for 0.4 and 0.6 percent of the variance while gender accounted for 0.02 and 0.2 percent. As in the grade 5 and 8 results the magnitude of these statistically significant main effects were quite small.

An examination of the means in Table 17 shows the following profile. Self esteem scores increased as student SES level increased for analyses involving students attending low SES schools as well as for high SES schools. Likewise, females consistently showed slightly higher self esteem scores than males. For students attending low SES schools, higher self esteem scores were observed for black students than for white students.

Summary of Self Esteem Results

The analytic strategy employed in this study utilized two analysis samples as a way of strengthing generalizability. Findings were reported and discussed whenever both analysis samples revealed the same results. A number of consistent findings were observed for self esteem across grade levels. In the following description it should be remembered that on the self esteem scale, a high score was indicative of a positive self esteem. Significant student SES main effects were found for all analyses at grades 5, 8 and 11. Uniformly, means increased as student SES increased regardless of whether students attended low or high SES schools. Gender differences were statistically significant for all analyses except within high SES schools at grade 5. In all instances females had higher scores than males. A significant race effect occurred only for low SES schools at grades 5 and 11. Interestingly, fifth grade white students had higher scores than their black counterparts; however, at eleventh grade black students manifested higher scores than white students. None of the interaction effects replicated in demonstrating significant differences.

The pattern of mean self esteem scores just described suggested an interaction between grade level and race which was confirmed through a special two way analysis of variance ($F = 185.21$, $p < .01$). This finding suggests an interesting developmental trend in which black students attending low SES schools exhibit slightly lower self esteem scores at the elementary level which becomes indistinguishable from white students at the middle school or junior high level. By high school, black students displayed higher self esteem scores than their white counterparts in low SES schools.

Supplementary Analyses

As this paper was in the final stages of preparation and review a recommendation was made to conduct an analysis incorporating school SES along with student SES and race. This would permit a comparison of black-white performance for each level of student SES within low and high SES schools. These analyses were conducted for mathematics but not for self esteem because the observed differences were considerably larger and the results were more consistent. Since gender was found to be a nonsignificant effect generally, it was dropped and replaced by school SES. Once again a three factor ANOVA was performed with student SES, race and school SES serving as factors. Student SES is obviously correlated with school SES and since the former is an organismic variable of imperfect reliability, regression effects must be considered when interpreting the interaction means, especially in cells combining low student SES and high school SES or vice versa. Table 18 contains the ANOVA results for each grade level and Table 19 summarizes the least squares estimate of the means for significant main and interaction effects.

Table 18

F-ratios for Student SES, Race, School SES and Interaction Terms for Mathematics

	Student SES	Race	School SES	Student SES x Race	Student SES x School SES	Race x School SES	Student SES x Race x School SES
Grade 5							
1981/1982	110.22*	477.72*	240.20*	2.64	3.29	29.05*	1.35
1983/1984	139.85*	532.88*	272.80*	3.82	0.30	19.29*	0.17
Grade 8							
1981/1982	351.27*	831.02*	357.74*	7.87*	16.15*	79.72*	8.89*
1983/1984	395.74*	1061.00*	544.93*	19.91*	30.09*	107.71*	16.24*
Grade 11							
1981/1982	328.71*	749.13*	162.53*	0.06	26.64*	51.43*	13.36*
1983/1984	259.34*	932.65*	208.89*	10.37*	18.27*	51.07*	4.17

* $p < .01$

Table 19

Least Squares Estimates of Mathematics Means
for Significant Main and Interaction Effects

Main Effects	Grade 5		Grade 8		Grade 11	
	81/82	83/84	81/82	83/84	81/82	83/84
Student SES/Low	-0.199	-0.183	-0.286	-0.319	-0.292	-0.267
Student SES/Middle	0.043	0.004	0.008	-0.018	0.002	-0.015
Student SES/High	0.280	0.269	0.379	0.322	0.397	0.326
Race/Black	-0.412	-0.387	-0.454	-0.482	-0.476	-0.520
Race/White	0.098	0.094	0.090	0.085	0.073	0.075
School SES/Low	-0.146	-0.139	-0.148	-0.183	-0.105	-0.129
School SES/High	0.215	0.205	0.209	0.223	0.150	0.152
Interaction Effects						
Stud SES x Race						
Low Std SES/Black			-0.729	-0.748		-0.740
Low Std SES/White			-0.286	-0.297		-0.271
Mid Std SES/Black			-0.485	-0.487		-0.558
Mid Std SES/White			0.059	0.044		0.050
Hi Std SES/Black			-0.164	-0.240		-0.265
Hi Std SES/White			0.479	0.478		0.441
Stud SES x Schl SES						
Low Std SES/Low Sch SES			-0.418	-0.432	-0.349	-0.346
Low Std SES/Hi Sch SES			-0.197	-0.208	-0.296	-0.216
Mid Std SES/Low Sch SES			-0.185	-0.224	-0.164	-0.163
Mid Std SES/Hi Sch SES			0.159	0.187	0.108	0.104
Hi Std SES/Low Sch SES			0.105	0.030	0.146	0.089
Hi Std SES/Hi Sch SES			0.610	0.612	0.587	0.535
Race x School SES						
Black/Low Schl SES	-0.660	-0.593	-0.709	-0.745	-0.675	-0.720
Black/High Schl SES	-0.173	-0.157	-0.184	-0.159	-0.276	-0.300
White/Low Schl SES	-0.025	-0.020	0.003	0.002	0.017	0.013
White/High Schl SES	0.211	0.233	0.191	0.227	0.128	0.155
Std SES x Race x Sch SES						
Lo Schl/Lo Stud/Black			-0.876	-0.867	-0.838	
Lo Schl/Lo Stud/White			-0.359	-0.361	-0.288	
Lo Schl/Md Stud/Black			-0.732	-0.758	-0.728	
Lo Schl/Md Stud/White			-0.039	-0.055	-0.029	
Lo Schl/Hi Stud/Black			-0.558	-0.668	-0.481	
Lo Schl/Hi Stud/White			0.368	0.364	0.346	
Hi Schl/Lo Stud/Black			-0.582	-0.587	-0.779	
Hi Schl/Lo Stud/White			-0.212	-0.193	-0.241	
Hi Schl/Md Stud/Black			-0.238	-0.175	-0.313	
Hi Schl/Md Stud/White			0.156	0.185	0.102	
Hi Schl/Hi Stud/Black			0.230	0.228	0.243	
Hi Schl/Hi Stud/White			0.591	0.632	0.504	

Replicable results included significant main effects for student SES, race and school SES at all grade levels. The pattern of significant interaction effects differed across grade levels. At grade 5, only the race by school SES showed up as significant while all interactions reached significance at grade 8. The pattern was somewhat inconsistent at grade 11 as two interactions, student SES by school SES and race by school SES, were significant on both analysis samples. The remaining two interactions were significant for one of the analysis samples, but not for the other.

The full rank regression model resulted in a multiple R of .34 and .36 for grade 5, .38 and .43 for grade 8 and .32 and .36 for grade 11. The percentage of test score variance accounted for in each instance ranged from 11 to 13 for grade 5, 15 to 18 for grade 8 and 10 to 13 for grade 11. Reduced rank model testing each main effect found that student SES accounted for approximately 0.5 percent of the variance at grade 5 and about 1.1 percent at grades 8 and 11. Race accounted for about 1.5 percent at grade 5 and 1.5 percent at grades 8 and 11. School SES was highly consistent across grade levels, accounting for 0.4 to 0.7 percent of the variance.

Reduced model tests of the interactions revealed that the significant effects were relatively weak compared to the main effects. The only interaction to be significant in all analyses was race by school SES which accounted for about .05 percent of the variance at grade 5, approximately .15 percent at grade 8 and .10 percent at grade 11. Next in terms of amount of variance accounted for was the student SES by school SES interaction. Although it was nonsignificant at grade 5 it accounted for about .08 percent of the variance at grades 8 and 11. The student by race interaction was the weakest of the two-way interactions as it was nonsignificant at grade 5 and for the 81/82 analysis sample at grade 11. At grade 8 it accounted for approximately .05 percent of the variance and .04 percent for the 83/84 grade 11 sample. Weakest of all was the triple interaction effect which was nonsignificant at grade 5 and for one analysis sample at grade 11. Grade 8 was the only level at which this interaction replicated in reaching statistical significance although it only accounted for about .04 percent of the variance.

An examination of the least squares estimates of means in Table 19 reveals familiar SES and black-white patterns of mathematics achievement. Z-score differences between the lowest and highest student SES levels averaged about .46 at grade 5, and .65 at grades 8 and 11. Black-white differences averaged about .50 at grade 5, .55 at grade 8 and .57 at grade 11. Of particular interest is the replicated race by school SES interaction which revealed that the black-white discrepancy was characteristically greater in low SES schools than in high SES schools. In low SES schools, the z-score difference averaged about .60 at grade 5 and approximately .72 at grades 8 and 11. By contrast, the differences in high SES schools ranged from about .38 at grades 5 and 8 to about .43 at grade 11.

DISCUSSION

Mathematics Achievement

The mathematics achievement results of the study were very consistent across grade levels. At all three levels, whites scored significantly higher than blacks and achievement varied directly with the SES level of students. Gender differences were not found at any of the three grade levels.

A strength of the present study was that race, SES and gender were investigated within the framework of a common analysis. This analysis approach made it possible to statistically control for the confounding of race and SES which inevitably must take place because of the high degree of relationship between these variables. Thus, the racial differences which were found were unconfounded by SES and the SES differences which were found were unconfounded by race.

The differences in mathematics achievement related to race and SES are consistent with those reported by NAEP and by investigators who compiled analyses of the NAEP results (e.g., Burton and Jones, 1982; Jones, 1984). However, the longitudinal NAEP results could not be compared to the results of the present study since the intent of the study was not to investigate whether differences between groups have increased or decreased over time. A longitudinal analysis of Pennsylvania's statewide data for racial and SES groups would certainly be possible and could add to the knowledge base about the question of differential performance for these groups.

The general lack of significant interaction effects in the present analysis is consistent with the findings of Strauch (1975) who investigated Jensen's (1971) hypothesis regarding a sex by race by ability interaction in cognitive performance. To extend generalizability of results, Strauch utilized several data bases as replications. These included mathematics and verbal

skills data from the Pennsylvania Educational Quality Assessment program along with the WISC-R standardization data and Project Talent data. Analyses failed to find evidence in support of any of the interaction effects; however, significant differences were found for SES and race in all instances, with the largest differences occuring for race.

The gender findings both agree and disagree with the results of past investigations. More specifically, the finding of no significant difference between the mathematics performance of male and female fifth graders agrees with the general finding of many past studies for elementary school level students (e.g., Fennema, 1977). The finding of no significant gender differences for grade 8 students agrees with those of some investigators (e.g., Jones, 1984; Pallas and Alexander, 1983) and disagrees with others (e.g., Benbow and Stanley, 1980). The eleventh grade finding of no significant gender differences in mathematics achievement, however, disagrees with the findings of the majority of studies of high school age students (e.g., Jones, 1984; Fox, 1977; Benbow and Stanley, 1980; Pallas and Alexander, 1983).

It is not clear at this point why no significant gender differences were found for high school students in this study. As described above, Pennsylvania's SAT results have shown the same type of differential between males and females as has been found nationally, so there is no reason to expect a study performed at the high school level to differ from other similar studies performed at other places in the country. The test used to assess mathematics achievement would not be expected to differ greatly from many other test instruments in use, including the NAEP measures. However, it is possible that the EQA eleventh grade test is more oriented toward measuring basic mathematics than are many others in use. The test does not measure higher level concepts encountered in such courses as trigonometry, calculus or high school algebra. If the gender differences which have been found in past studies are truly a function of differential course selections of male and female high school students, such differences would not be expected to occur on the EQA eleventh grade mathematics test.

The statistical approach in the present investigation included the calculation of the amount of variance in mathematics achievement accounted for by the SES, race and gender variables

studied. It should be emphasized that these variance components were very small (i.e., generally less than ten percent). Although significant differences were found for the race and SES variables and although the adjusted means compared in these analyses were often different by one-half standard deviation or more, the variables being compared were not of major importance in explaining the mathematics achievement of individual students. These results agree with the statements of such investigators as White (1982), Kohr (1986) and Reyes and Stanic (1985) with respect to the impact of SES upon individual student achievement.

Thus, the SES and race differences which were found in mathematics achievement were large enough to warrant an effort to understand them, but the variables investigated certainly do not tell the complete story. Variables more directly related to the learning of mathematics would be expected to be more highly related to the achievement of individual students. Such variables as student mathematics ability, the quality of instruction received, the amount of time engaged in mathematics instruction and the particular curriculum studied all are important factors which would be expected to impact upon student performance.

To obtain valuable comparative information, the variables of student race, SES and gender were studied in both low and high SES schools. The mathematics results were, in general, very similar in the high and low SES school samples. The only real exception to this was an interaction between SES and race found in only the low SES schools. Examination of this finding revealed that in low SES schools there was more difference between the mathematics scores of black and white high SES students than low SES students. It is very difficult to explain this result since the relationship between individual student SES level and academic achievement is not a strong or well understood one. But the results would tend to suggest that black high SES students were more negatively affected than white high SES students by the generally low achieving environment of a low SES school.

The original analysis plan for the study called for examining the variables of race, student SES and gender separately for low and high SES schools. After these analyses had been completed, questions still remained about the very complex relationships existent among the

individual student variables and the school SES variable. The supplementary analyses were performed to address some of these questions. Because no significant gender differences had been found in the original analyses, it became possible to reduce the complexity of the supplementary analyses by leaving out this variable. In addition, only the mathematics achievement results were included. But the results would tend to suggest that black high SES students were more negatively affected than white high SES students by the generally low achieving environment of a low SES school.

The most interesting finding of the supplementary analyses was a race by school SES interaction, found at all three grades and replicated for both the 1981-82 sample and the 1983-84 sample. This interaction was a function of the fact that the differences between the mathematics achievement scores of whites and blacks were much greater in low SES schools than in high SES schools. This finding was primarily due to black students achieving much more poorly in low SES schools than in high SES schools. White students' scores were lower in low SES schools than in high SES schools but the magnitude of this difference was not great. These results are similar to others that have found very low achievement for blacks in low SES schools. The problem remains as to how environments in these schools can be changed to produce better achievement or whether students must be moved to more promising learning environments.

Self Esteem

Self esteem scores parallelled student SES scores significantly at all three grade levels, both in low and high SES schools. This seems to confirm the theory that SES would be correlated with self esteem in upper and middle SES groups, but confounds the notion that self esteem will be unaffected by lower-class status (Wylie, 1979). The findings suggest that self esteem in school is more universally a function of SES than was hitherto supposed, at least in the high and low school SES settings. This study does not show the extent to which the various ability levels affected the relationships between self esteem and SES. Since it has been well documented that SES and ability correlate to some degree, a follow-up to the present study is

suggested. If one can extrapolate about such a follow-up and presume that the higher ability associated with higher SES groupings affects the level of school self esteem, then it would perhaps be that student self perceptions of this kind tend to be realistic, at least with reference to the school setting in which the students find themselves. In this context, it is theoretically possible that the self esteem in school settings is derived to a great extent from self comparisons of the students with their peers or even special affiliation groups such as racial groups, gangs, etc. (Wylie, 1979).

Significant differences were found for self esteem by race only among the low SES schools. This lack of significance at the higher SES level may be due in large part to the fact that more black students are found in low SES schools than in high SES schools, causing the variance to be greatly reduced among high SES schools when the schools are partitioned into SES levels as they were in the present study. (Wylie 1979).

If it is true that black children tend to identify more with their racial peers than with white students when they are found in a low SES setting (Wylie, 1979, p. 199), then this may account for the lack of significance at the high 'school SES' level. Again, it is not precisely known which referent groups are used by racial groups as comparisons in their self assessment. It may be that upper or middle class status carries more prestige for a black student among her/his peers than the same status would for a white.

Further investigation needs to be done as to whether black students attending high SES schools tend to be more able than white students or more equal in ability to white students in their setting, as compared with black students attending low SES schools. If actual achievement is the variable driving the self esteem, then the relationship of achievement to SES could partially account for lack of significant difference in self esteem between races at the upper SES school level if the academic differences between races tend to be minimized in this group. (Wylie, 1979).

Black students scored lower than whites on self esteem in grade 5 and higher than whites on self esteem in grade 11. No difference was found in grade 8. This finding suggests that, over the sampled years, black students show gradual improvement, going from a relatively low self-esteem-to-a-high-one-by-the-time senior high school was reached.

If we can assume some positive correlation between school achievement and student SES, and if this kind of self esteem is based on the indirect evidence of grades and achievement tests, the effect becomes even more remarkable in view of the research which finds that the gap in achievement tends to widen even further as the grades are traversed. Accounting for this change, therefore, involves investigation of the referent data or referent groups upon which self esteem may be based. Such an investigation might explore the extent to which younger children are influenced by parental surrogates such as teachers in their self assessment as compared to older children, who are probably more influenced by those peers whose approval they would increasingly need. In such a case it may be hypothesized that black students achieve higher self esteem by finding acceptance in a social milieu where academic standards are more easily met. Further research is called for in this area, and in the extent to which such a scenario differs between black and white children. It may turn out that white students are more influenced by school value systems at a later age than black students.

Females showed significantly higher self esteem than males at all three grade levels in low SES schools and for grades 8 & 11 in high SES schools. Given the fact that few if any previous studies have found significant gender differences in self concept, one may be tempted to attribute more than the data warrant. Certainly the magnitude of the difference is small, significance having been affected by the size of the sample.

Considerations for Further Research

In considering the nature of the high and low SES schools involved in the analyses several features seem worthy of exploration. The high SES schools tend to be in affluent suburban areas or rural bedroom communities housing white collar commuters to large cities. Low SES

schools generally are of two types, those in urban areas which serve large percentages of minority students and those in rural, "Appalachia" areas or small towns economically ravaged by the loss of blue collar industry which tend to have few non-white families. Certainly, developmental and socialization experiences of children growing up and attending school in these culturally diverse conditions are quite different. Consequently, it seems reasonable to expect differential patterns of self esteem, and possibly of mathematics achievement, within the urban and rural/small town subgroupings of low SES schools.

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AUTHOR NOTES

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