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New Perspectives on the Correlation of Scholastic Assessment Test Scores, High School Grades, and Socioeconomic Factors

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In studies of the SAT, correlations of SAT scores, high school grades, and socioeconomic factors (SES) are usually obtained using a university as the unit of analysis. This approach obscures an important structural aspect of the data: The high school grades received by a given institution come from a large number of high schools, all of which have potentially different grading standards. SAT scores, on the other hand, can be assumed to have the same meaning across high schools. Our analyses of a large national sample show that, when pooled within-high-school analyses are applied, high school grades and class rank have larger correlations with family income and education than is evident in the results of typical analyses, and SAT scores have smaller associations with socioeconomic factors. SAT scores and high school grades, therefore, have more similar associations with SES than they do when only the usual across-high-school correlations are considered.

The association between standardized test scores and socioeconomic status (SES), though well known in the measurement community, frequently draws comment in the popular press, particularly when the test in question is the SAT. Harvard law professor Lani Guinier proposed that, in the interest of truth in advertising, the SAT should simply be called a "wealth test,"[1] test critic Alfie Kohn (2001, p. B12) suggested that the verbal section of the SAT merely measures "the size of students' houses," and journalist Peter Sacks claimed that "one can make a good guess about a child's standardized test scores simply by looking at how many degrees her parents have and at what kind of car they drive" (Sacks, 1997, p. 27).

College Board data from 2005 show the disparity between average SAT Reasoning Test scores for those with family incomes of over $100,000 and those with family incomes of less than $10,000 to be slightly more than one standard deviation unit on the verbal section and just under one standard deviation on the math section (College Entrance Examination Board, 2005, p. 7). What are the reasons for the SAT-SES correlation?

The section "Content and Coaching Hypotheses" of this article outlines (and dismisses) two hypotheses—one about the nature of the test content and one about test coaching—and gives some examples of the association between SES and other academic achievement measures. The section "Why do SAT scores have higher SES correlations than grades?" demonstrates that when evaluating evidence on the

An initial version of some portions of this paper appears in Zwick (2005). We are thankful to Wayne Camara, Andrew Wiley, and Jennifer Kobrin of the College Board for providing us with the College-bound Seniors dataset and answering our questions about it.

test-score-SES correlation, it is crucial to consider the distinction between within-high-school and across-high-school correlations. The section "Data Analyses" presents the results of our analyses of SAT data, which reveal the disparate conclusions that are obtained from these two types of analyses. Q1

We demonstrate that typical analysis approaches confound within-high-school and between-high-school relationships between academic indicators and socioeconomic factors. When pooled within-school analyses are used, high school grades and class rank have *larger* correlations with family income and education than is evident in the results of typical analyses, and SAT scores have *smaller* associations with socioeconomic factors. In effect, the within-school analyses account for differences across high schools in grading stringency, which increases the correlations involving grades. The within-school analyses reduce the correlations involving SAT by "removing" the portion of the SAT-SES relationship that results from a between-school effect—the tendency of schools with high *average* SES to have high *average* SAT scores.

The final section "Summary and Discussion" of the article places the theoretical and analytical results in a broader perspective and considers the goal of finding "socioeconomically neutral" achievement measures (see Rothstein, 2004, p. 310) from a societal viewpoint.

Content and Coaching Hypotheses

Two conjectures are frequently offered as explanations for the recurrent finding that test performance—particularly SAT performance—is correlated with family income and education. One hypothesis is that this association stems from a White middle-class perspective that is presumed to be ingrained in the content of standardized admissions tests. Some SAT critics have claimed that changing the test to emphasize material taught in the classroom would yield smaller differences among income groups. The other prevailing theory is that the correlation occurs because the scores of test takers from wealthy families are artificially boosted by test coaching.

But as described in Zwick (2004), neither of these hypotheses hold up well on closer examination. An examination of student performance on tests that focus on course content and on tests for which no coaching takes place can help to shed some light on the well-established association between test scores and family income and education. Also relevant is the documented association between socioeconomic factors and other forms of educational achievement, discussed further below.

First, consider the hypothesis regarding test content. If this were indeed the explanation for the SAT-SES correlation, then we would expect tests that were more clearly tied to classroom instruction to have smaller associations with SES. Zwick (2004) considered results for 2001 on the ACT, which is based on an analysis of Q2
the material that is taught in grades 7 through 12 and the skills that are most relevant to college courses; University of California results for 1996–1999 on the SAT Subject Tests, which are intended to assess high school students' knowledge in particular areas; results for 2001 on the California High School Exit Exam (CAHSEE),

which is tied to California's curriculum standards; and results for grades 4, 8, and 12 on the 2000 National Assessment of Educational Progress (NAEP) mathematics assessment, which is intended to be representative of material that is being taught in schools around the country. Despite the fact that these tests are more grounded in classroom instruction than the SAT, all were shown to have large performance differences across socioeconomic groups.

The NAEP results are particularly relevant to the present discussion in that the NAEP assessment differs from college admissions testing in two fundamental ways. First, as already mentioned, NAEP is linked to classroom study: The content of the assessment is intended to be representative of material that is being taught in schools around the country. Consider the 2005 NAEP math assessment. The objectives and test specifications for the assessment had their roots in the 1990 NAEP math framework (Perie, Grigg, & Dion, 2005, p. 24) developed by the Council of Chief State School Officers (CCSSO) under a contract with the National Assessment Governing Board, a body created by Congress to oversee NAEP. In determining the content of the math assessment, the CCSSO examined math objectives used by states, districts, and schools around the country, consulted with leading mathematics educators, and considered the curriculum standards of the National Council of Teachers of Mathematics (Braswell, Dion, Daane, & Jin, 2005; Braswell et al., 2001). A second reason that NAEP is particularly relevant to the issue at hand is that NAEP is a low-stakes assessment on which there is no incentive for students to be coached. In each assessment year, schools and students are chosen for participation using statistical sampling procedures. Results are reported only at the aggregate level. In fact, legislation prohibits NAEP from reporting scores at the student level.

On the NAEP math assessment, the percentages of students attaining or exceeding three achievement levels—Basic, Proficient, and Advanced—are obtained separately for students who were or were not eligible for the federal-free or reduced-price lunch program. In 2005, as in previous years, the differences between the eligibility groups were striking, with the performance of the ineligible (wealthier) students always exceeding that of the eligible students by a substantial amount. For example, at grade 8, only 51% of eligible students, compared with 79% of ineligible students, performed at or above the Basic level; only 13% of eligibles, compared with 40% of ineligibles, performed at or above the Proficient level (Perie, Grigg, & Dion, 2005, p. 9). Similar patterns were obtained when the results were reported for groups that differ in terms of parental education. For example, only 48% of grade 8 students included in the "less than high school" category (indicating neither parent graduated from high school) attained at least the Basic level, compared with 80% of those with at least one parent who graduated from college. For the Proficient level, the corresponding percentages were 11% and 42%.[2] If coaching were a major source of score discrepancies among SES groups, we would expect much smaller differences on an anonymous low-stakes assessment such as NAEP.

It can be argued, however, that NAEP is not tied to material that is taught in any particular state or district, and is therefore not an ideal example of a an assessment linked to classroom teaching. From this perspective, the CAHSEE might be regarded as a more pertinent example of a classroom-based assessment. The CAHSEE was first offered in 2001; beginning with the 2005–2006 school year, a passing score is required for graduation from California's public high schools. The two sections of the test, English-language arts (ELA) and mathematics, are designed to assess content that, according to the state standards, must be taught in junior high and high schools. According to the California Department of Education website, "the ELA part addresses state content standards through grade 10. In reading, this includes vocabulary, decoding, comprehension, and analysis of information and literary texts. In writing, this covers writing strategies, applications, and the conventions of English . . . The mathematics part of the CAHSEE addresses state standards in grades 6 and 7 and Algebra I. The exam includes statistics, data analysis and probability, number sense, measurement and geometry, mathematical reasoning, and algebra." (California Department of Education, 2006).

In 2005, the percentages of students passing the CAHSEE in the 10th grade (when the test is first taken) showed a remarkable discrepancy between students who were considered economically disadvantaged and those who were not. On the English-language arts test, 88% of students who were not economically disadvantaged received passing scores, while only 63% of economically disadvantaged students passed. Similarly, 85% of nondisadvantaged students passed the mathematics test, while only 61% of disadvantaged students received passing scores.[3] These results indicate that even on an exam intended to assess only material that is taught in school, a significant relationship exists between test performance and SES.

In addition, if middle-class content and coaching were responsible for the relation between SES and standardized test scores, we might expect performance tests that include hands-on tasks to show smaller differences across socioeconomic groups. Performance tests are presumably less reliant on vocabulary and recall of facts, less influenced by testwiseness, and more difficult to coach. However, as Camara and Schmidt (1999) noted, based on their review of studies published between 1989 and 1997, group differences on these tests tend to be similar to those on traditional tests.

Furthermore, the content and coaching hypotheses seem to suggest that an association with income and parental education is unique to test scores. But how do socioeconomic groups compare on grades and other measures of achievement? College Board surveys indicate that average high school grades, like SAT scores, are higher for students from families with larger incomes. College Board data from 1997 (Camara & Schmidt, 1999, p. 9; see Zwick, 2004, p. 212) show that, as income increases from less than $20,000 to more than $100,000, the percentage of students with an A average increases from 30% to 46%; the percentage with a C or below decreases from 19% to 10%. Camara and Schmidt (p. 9) also show that the percentage of students with an A average increases from 27% for students whose parental education is "some high school" to 47% for those whose parental education consists of at least some graduate work.

Additional pertinent results come from a National Center for Education Statistics (NCES) study (Owings, McMillen, & Burkett, 1995; see Zwick, 2004, p. 213). The NCES researchers considered five academic standards, which were intended to resemble those used by selective colleges in admissions decisions. For each of the standards, the percentage of students satisfying the criterion increased with socioeconomic level. For example, 32% of the high-SES group, compared with only 9% of the low-SES group, had SAT scores of at least 1100. The remaining criteria, however, did not involve test scores. In particular, 24% of the high-SES group, compared with only 10% of the low-SES group, had high school grade-point averages of at least 3.5. Also, 65% of the high group, compared with 40% of the low group, had completed a specified number of course credits in key areas. Students from high-SES families also received better teacher ratings and reported more extracurricular activities.

Why Do SAT Scores Have Higher SES Correlations Than Grades?

The examples in the previous section show that the achievement measures other than test scores—in particular, grades—are also associated with SES. But it is typically the case that these associations are smaller than the association of test scores with SES. As an example of these differential correlations, consider Table 1, which shows some results from the University of California. (These data were originally analyzed by Geiser and Studley, 2001, and later by Zwick, Brown, and Sklar, 2004.). Within each of seven campuses (Berkeley, UCLA, San Diego, Santa Barbara, Irvine, Riverside, and Davis), correlation matrices were obtained for high school GPA (HSGPA), first-year GPA at University of California (UCGPA), SAT Reasoning Test total score, SAT Subject Test writing score, and two SES variables (parent income, transformed to a log scale,[4] and parent education), for students who entered UC between 1996 and 1999. Table 1 shows the median correlations across the campuses. The median correlations between the SES variables and test scores are much higher than the correlations between SES and HSGPA or between SES and UCGPA. Why is this the case? Willingham, Pollack, and Lewis (2002), whose study is described further below, considered this question in the context of data from the National Education Longitudinal Study (NELS), which included scores on a test in reading, math, science, and social studies. They speculated that the “social advantages implied by

TABLE 1
Median Correlations Across Seven University of California Campuses

	HSGPA	UCGPA	SAT Reasoning Test Total	SAT Subject Test in Writing	Log Parent Income	Parent Education
HSGPA	1					
UCGPA	.330	1				
SAT reasoning test total	.196	.293	1			
SAT subject test in writing	.194	.318	.687	1		
Log parent income	.035	.140	.327	.316	1	
Parent education	.011	.163	.412	.354	.534	1

Notes. The seven campuses are Berkeley, UCLA, San Diego, Santa Barbara, Irvine, Riverside, and Davis. Data are for students entering between 1996 and 1999. These data were originally analyzed by Geiser and Studley (2001) and later by Zwick, Brown, and Sklar (2004).

a higher SES . . . would presumably act over a lifetime on the development of general cognitive skill in and out of school. The test is more likely to reflect such general skills than is the school average that focuses on specific learning objectives and behavior in the classroom" (p. 18). But an important methodological factor also contributes to the differentia correlations of grades and test scores with SES, as detailed in the following section.

Across-School Versus Within-School Correlations

For purposes of institutional research or test validity studies, correlations such as those in Table 1 are typically calculated: The unit of analysis is a college or university. The high school GPAs received by a given college, however, come from a wide variety of high schools, all of which have potentially different grading standards. What effect would this is expected to have on the correlation of SES and high school GPA within a college?

To explore this issue, we can consider two distinct types of correlation matrices when studying the association between academic performance variables and socioeconomic factors: the *across-high-schools matrix* (the type of matrix that is ordinarily obtained) and the *pooled within-high-schools matrix*. The *across-high schools matrix* ("across" matrix for short) is obtained by combining the data from all high schools before computing the correlations. Information on the specific schools attended by the students does not enter into the analysis in any way. The across matrix reflects both within-school associations among variables and between-school associations among variables (i.e., the covariances of the school means). The *pooled within-high-schools matrix* ("within" matrix for short) can be obtained by calculating the pooled within-high-school covariance matrix and then converting it to a correlation matrix. (Computations are discussed in a later section.) Unlike the across matrix, the within matrix does not reflect between-schools associations among variables.

To better understand this distinction, consider the (intentionally extreme) data example portrayed in Table 2. Each high school data set consists of six students. Within each high school, the correlation between high school GPA (HSGPA) and annual family income (expressed in thousands) is .378, and because all schools have the same correlation, the pooled within-school correlation is also .378. Across the three high schools, however, the correlation is only .096. Why? The reason is that, in this example, all the high schools have the same average HSGPA. This is intended to reflect the fact that high schools, which are concerned with ranking students within and not across schools, can be expected to assign the entire range of grades. High school teachers, for example, do not refrain from assigning high grades merely because other high schools are perceived to be of superior quality. This leads to a situation in which high schools have similar average grades. In this extreme example, average grades are identical, and therefore, there is no between-high-school covariance between income and HSGPA. That is, all the high schools in Table 2 have a mean HSGPA of 2.25, although their average income ranges from 25,000 for High School A to 85,000 dollars for High School C. The equations used to compute the within-high-school and across-high-school correlations for the example data in Table 2 are as follows:

TABLE 2
Hypothetical Example of Large Within-School Correlation and Small Across-School Correlation of Family Income and High School Grade-Point Average

	High School A		High School B		High School C	
	HSGPA	Income	HSGPA	Income	HSGPA	Income
Student data	1.000	25	1.000	55	1.000	85
	1.500	15	1.500	45	1.500	75
	2.000	30	2.000	60	2.000	90
	2.500	20	2.500	50	2.500	80
	3.000	35	3.000	65	3.000	95
	3.500	25	3.500	55	3.500	85
Mean	2.250	25	2.250	55	2.250	85
Variance	.875	50	.875	50	.875	50
Sum of squares	4.375	250	4.375	250	4.375	250
Sum of cross-products	12.500		12.500		12.500	

Notes. Each high school has six students. "Income" is annual family income in thousands of dollars. Within each school, the correlation between HSGPA and income is .378. Across the three schools (18 students), the correlation is .096.

The within-high school correlation is

$$\frac{\sum_{i=1}^{n_j}(H_{ij}-\bar{H}_j)(S_{ij}-\bar{S}_j)}{\sqrt{\sum_{i=1}^{n_j}(H_{ij}-\bar{H}_j)^2}\sqrt{\sum_{i=1}^{n_j}(S_{ij}-\bar{S}_j)^2}} \tag{1}$$

and the pooled within-*high school correlation is*

$$\frac{\sum_{j=1}^{J}\sum_{i=1}^{n_j}(H_{ij}-\bar{H}_j)(S_{ij}-\bar{S}_j)}{\sqrt{\sum_{j=1}^{J}\sum_{i=1}^{n_j}(H_{ij}-\bar{H}_j)^2}\sqrt{\sum_{j=1}^{J}\sum_{i=1}^{n_j}(S_{ij}-\bar{S}_j)^2}}, \tag{2}$$

where H_{ij} and S_{ij} are the HSGPA and income (SES), respectively, of student i in school j, $\bar{H}_j$ and $\bar{S}_j$ are the means of HSGPA and income for school j, n_j is the number of students in school j, and J is the number of schools. The across-school (ordinary) correlation can be expressed in terms of its within-school and between-school components as:

$$\frac{\sum_{j=1}^{J} n_j(\bar{H}_j - \bar{H})(\bar{S}_j - \bar{S}) + \sum_{j=1}^{J}\sum_{i=1}^{n_j}(H_{ij} - \bar{H}_j)(S_{ij} - \bar{S}_j)}{\sqrt{\sum_{j=1}^{J} n_j(\bar{H}_j - \bar{H})^2 + \sum_{j=1}^{J}\sum_{i=1}^{n_j}(H_{ij} - \bar{H}_j)^2}\sqrt{\sum_{j=1}^{J} n_j(\bar{S}_j - \bar{S})^2 + \sum_{j=1}^{J}\sum_{i=1}^{n_j}(S_{ij} - \bar{S}_j)^2}}, \tag{3}$$

where $\bar{H}$ and $\bar{S}$ are the grand means of HSGPA and income, respectively, and all other terms are defined as above.

For the data of Table 2, $n_j = 6$ for all j, and $J = 3$. We find that the expression in Equation (1) is equal to $\frac{(12.5)}{\sqrt{(4.375)}\sqrt{(250)}} = .378$, the expression in Equation (2) is equal to $\frac{3(12.5)}{\sqrt{3(4.375)}\sqrt{3(250)}} = .378$, and the expression in Equation (3) is equal to

$$\frac{0 + 3(12.5)}{\sqrt{0 + 3(4.375)}\sqrt{6(25-55)^2 + 6(25-25)^2 + 6(85-55)^2 + 3(250)}}$$
$$= \frac{37.5}{\sqrt{13.125}\sqrt{11,550}} = .096.$$

How realistic are the assumptions made in constructing the example of Table 2? Is it true that the within-high-school association of HSGPA and SES typically exceeds the across-high-school correlation? Is it true that there is ordinarily little variation across high schools in average HSGPA? Because the interrelationship between test scores, grades, and SES is typically examined with the college as the unit of analysis, the data required for such analyses are not usually available. However, two analyses conducted prior to our own study provided some support for these speculations.

Willingham et al. (2002) considered the question of why high school grades and test scores are not more highly correlated with each other, based on extensive analyses of NELS data. They concluded that one of the primary reasons is that grading stringency varies across both high schools and across courses. Although they did not focus on SES and did not explicitly address the distinction between within-school and across-school correlations, some of their analyses are directly relevant to the situation portrayed in Table 2. Willingham et al. conducted analyses aimed at adjusting HSGPA for course and high school effects and then reexamined the relation between HSGPA and other variables. Their course effect correction involved adding an adjustment factor to each student's HSGPA to reflect the stringency of grading in that student's courses. Interestingly, their means of correcting for high school effects was simply to make use of a pooled within-high-school correlation matrix for HSGPA and other variables (p. 14). This approach substantially affected the correlation of high school grades and SES. The uncorrected HSGPA had a correlation of .35 with an SES composite consisting of parental education, income, and occupation. This correlation was considerably smaller than the correlation of .48 between the total score on the NELS test (in reading, math, science, and social studies) and SES. After adjustment for course and high school effects, the correlation of HSGPA with SES rose to .43—a correlation only slightly lower than the correlation of NELS test score with SES.

Some additional supportive evidence comes from Rothstein (2005, p. 19), who used data on within-state applicants to the University of California in 1993–1994 to examine the within- and between-high-school variation in HSGPA and SAT total score. Whereas 27% of SAT variation was between high schools, only 13% of HSGPA variation was between schools (representing a less extreme version of Table 2 of the current article).

The conjectures described earlier, bolstered by the previous research findings, led to the hypothesis that in general, the pooled within-school correlation of high school grades with SES is higher than the across-school correlation because the between-school variability in high school grades is very small. By contrast, the SES-SAT correlations are expected to be smaller within schools than across schools since between-school variance in mean SAT scores is likely to be substantial. Therefore, it is expected that, within high schools, the correlation of grades with SES will be much more similar to the correlation of SAT scores with SES than is the case when across-high-school correlations are considered. To investigate these ideas, we obtained a College Board data set on SAT takers, which is ideal for these purposes because it includes information on high school attended. We then compared the two types of correlation matrices for key academic performance and socioeconomic factors.

Data Analyses

Data

The College Board supplied us with a 25% random sample of the 2004 "College-bound Seniors" data set (College Entrance Examinations Board, 2004). This data set contains the records of all high school graduates in the year 2004 who took the SAT through March 2004. If students took that SAT more than once, only their latest scores and demographic information are included in the data set. The complete data set contains 1,419,007 students; the 25% sample consisted of 336,216 students from a total of 15,768 high schools. Information that could be used to identify students had been stripped from the records.[5] Descriptive information on the College-bound Seniors and on this 25% sample appears in Table 3.

The key variables for our analyses were gender, ethnicity, class rank, income, mother's highest level of education, father's highest level of education, SAT verbal score, SAT math score, overall HSGPA, and high school GPA for courses in social studies, natural sciences, mathematics, foreign languages, and English. (As shown in Table 3, income, parent education, class rank, and all GPAs were reported in terms of ordered categories.) All data except SAT scores are based on responses to the Student Descriptive Questionnaire, a self-report measure.

Prior to analysis, data were screened for missing values. First, students who were missing data on any one of the 14 key variables (described above) were excluded from all analyses. As shown in Table 4, there is a substantial amount of missing data,

TABLE 3

Summary of Subsets of the College Board Data

	Analysis Sample	25% Sample	Complete 2004 Data
Number of Students in Data set	98,391	336,216	1,419,007
Percentage of Students in Each Response Category			
Female	55.0	53.8	53.5
Ethnicity			
African-American	13.6	12.1	12
Hispanic/Latino	11.6	10.7	10
White	63.7	64.6	63
Asian-American	3.1	8.1	10
HSGPA			
A+	8.1	6.2	6
A	20.3	17.6	18
A–	18.1	17.4	17
B	43.4	47.2	47
C	9.8	11.3	11
D, E, or F	.3	.3	0
Class rank			
Top Tenth	23.6	28.2	29
2nd Tenth	23.5	24.0	24
2nd Fifth	24.6	22.2	22
Mid Fifth	23.6	21.0	20
4th Fifth	3.9	3.7	4
5th Fifth	.9	.9	1
Citizenship			
US Citizen	94.8	94.6	92
Permanent resident	3.7	3.5	3
Foreign citizen	1.2	1.4	4
First language spoken			
English only	81.5	80.8	79
English and another	10.8	11.6	13
Another language	7.7	7.6	9

	Included in Analyses	25% Sample	Complete 2004 Data
Family Income			
Less than $10,000	4.1	4.3	5
$10,000–$20,000	8.1	8.0	8
$20,000–$30,000	9.9	9.7	10
$30,000–$40,000	11.1	10.9	11
$40,000–$50,000	9.2	9.1	9
$50,000–$60,000	9.6	9.4	9
$60,000–$70,000	8.7	8.5	8
$70,000–$80,000	8.5	8.4	8
$80,000–$100,000	12.2	12.0	12
More than $100,000	18.7	19.7	20

(Continued.)

TABLE 3
Continued.

	Included in Analyses	25% Sample	Complete 2004 Data
Highest level of parent education			
No high school diploma	5.1	4.5	5
High school diploma	34.7	33.9	33
Associate's degree	9.5	9.0	9
Bachelor's degree	23.1	23.3	28
Graduate degree	22.7	24.4	25
Mean Values for Key Variables			
SAT verbal	504.5	508.4	508
SAT math	512.9	514.5	518
HSGPA	3.37	3.30	3.28
Social studies GPA	3.42	3.37	3.34
Natural sciences GPA	3.29	3.23	3.20
Math GPA	3.15	3.10	3.07
Languages GPA	3.30	3.26	3.23
English GPA	3.35	3.30	3.27

Note. Complete 2004 data (column 3) are from College Entrance Examination Board (2004). The precision of these values is as given in the original document (i.e., many values had been rounded to the nearest whole number).

TABLE 4
Missing Data on Key Variables

Variable	*N* Missing Out of 336,216 Cases	Percent Missing
Sex	0	0
Ethnicity	62,638	18.6
Income	137,645	40.9
Mother's education	81,574	24.3
Father's education	88,378	26.3
SAT verbal	0	0
SAT math	0	0
Class rank	167,931	49.9
HSGPA	51,061	15.2
Social studies GPA	74,830	22.3
Natural sciences GPA	76,410	22.7
Mathematics GPA	73,877	22.0
Foreign languages GPA	81,694	24.3
English GPA	73,597	21.9

particularly on income and class rank. Our sample was further reduced because, in order to compute within-high-school correlations, it is necessary to have at least two students from each school. Therefore, any student who was the sole student from his or her school was excluded from analyses. Furthermore, when all of the students from a school had the same values on a variable (e.g., the same level of mother's education), it was not possible to compute within-high-school correlations involving that variable. This problem, which mainly occurred in schools with very few students, resulted in further exclusions. After applying all the exclusion criteria, 98,391 students remained in our sample, representing 29% of the original 25% sample from the College Board. These students came from 7,330 high schools (out of the 15,768 attended by members of the original sample).

To assess whether the students included in the final sample used for analysis were representative of the entire 25% sample and, more importantly, of the College-bound Seniors population, we examined data on key demographic and academic variables. The 98,391 students in the analysis sample were compared with the students in the 25% sample from the College Board. These students, in turn, were compared with the entire College-bound Seniors population (College Entrance Examinations Board, 2004, pp. 1–2, 6–7). Results are presented in Table 3. Overall, the sample included in these analyses appeared to be very similar to the 25% sample provided by the College Board and also fairly similar to the entire population of 2004 SAT test takers. Some notable differences are that the analysis sample and the 25% sample had fewer students who identified themselves as Asian, Pacific Islander, or Asian-American than the complete College-bound Seniors population. In addition, the analysis sample tended to have slightly lower SAT scores and class rank, but higher HSGPAs than the 25% sample and the 2004 College-bound Seniors.

Analyses

Two related analyses were conducted to address our research questions. First, the across and within correlation matrixes were compared, as described earlier. Second, for each of the key academic and socioeconomic variables, the percentage of variance accounted for by school membership was calculated. Analyses were conducted for the entire sample of 98,391 students in the final data set and for groups based on gender and ethnicity. Specifically, analyses were performed separately for males and females, and for African-American or Black; Hispanic or Latino background; White; and Asian, Asian-American, or Pacific Islander students. Table 5 gives the sample sizes for these groups, as well as the number of schools in which they are represented

TABLE 5
Numbers of Students and Schools for Each Student Group in the Analysis Sample

	Group						
	Total	Female	Male	African-American	Hispanic/Latino	White	Asian-American
Students	98,391	54,140	44,251	13,375	11,429	62,717	7,031
Schools	7,330	7,109	7,027	3,376	3,168	6,708	2,893
Average number of students per school	13.4	7.6	6.3	4.0	3.6	9.3	2.4

and the average number of students per school. This information is discussed in a later section.

Comparison of Across and Within Correlations

As noted earlier, the across correlation matrix is the ordinary correlation matrix obtained by combining data across high schools. The pooled within-school correlation matrix, $\mathbf{R}_W$ can be obtained by calculating, for the P variables, the pooled within-school covariance matrix **S** and then converting it to a correlation matrix, as follows:

$$\boldsymbol{R}_W = \mathrm{DSD}, \tag{4}$$

where **S** has diagonal elements, $\sum_{j=1}^{J}(n_j - 1)s^2_{p(j)}/(N - J)$ and off-diagonal elements $\sum_{j=1}^{J}(n_j - 1)s_{pp'(j)}/(N - J)$, $s^2_{p(j)}$ is the variance for variable p in school j, $s_{pp'(j)}$ is the covariance of variables p and $p' =$ in school j, where $p,\ p'$=1, 2, ...P, $N = \sum_{j=1}^{J} n_j$ is the total sample size, J is the number of schools, and **D** is a diagonal matrix containing the reciprocal square roots of the diagonal elements of **S**.

To compute $\mathbf{R}_W$, it is useful to start by noting that each student's value on a variable X can be decomposed into a high school mean and a deviation from that mean. The value of X for student i in school j can be expressed as follows:

$$X_{ij} = \bar{X}_j + (X_{ij} - \bar{X}_j). \tag{5}$$

Then we note that because these components are independent,

$$Var(X_{ij}) = Var(\bar{X}_j) + Var(X_{ij} - \bar{X}_j). \tag{6}$$

In other words, the total variance in X_{ij} values can be decomposed into the variance of the school means—the between-school variance—and the variance of the deviations from the school means—the within-school variance. This, of course, is the familiar decomposition encountered in the one-way of analysis of variance (ANOVA).

To facilitate our computations of correlations and percentages of variance, we created, for each student and each variable, a new variable (corresponding to $\bar{X}_j$ in Equation (5)) that was equal to the within-high school mean for that student, and a second new variable (corresponding to $(X_{ij} - \bar{X}_j)$ in Equation (5)) that represented the deviation of the student's X_{ij} value from the high school mean. To compute $\mathbf{R}_W$, we aggregated the data across high schools and obtained the correlation matrix for the deviation scores $(X_{ij} - \bar{X}_j)$. This approach yields a result identical to that of Equations (2) and (4).

Computation of Between-School Percentages of Variance

To obtain the between-school percentages of variance, we again made use of these new student-level variables. Specifically, we obtained the variance of the $\bar{X}_j$ values and divided it by the total variance, $Var(X_{ij})$, to obtain the percentage of between-school variance. (To check the accuracy of our computations, we also computed the within-high-school variance $\mathrm{Var}(X_{ij} - \bar{X}_j)$ and verified that the between and within variance components did in fact add to the total variance, computed in the ordinary way.) Note that, for the total sample, the percentages of between-school variance could have been obtained by performing a 1-way ANOVA and using resulting sums of squares. (Computing these percentages of variance for gender and ethnic groups would have required the estimation of 2-way ANOVA models.) The percentages of between- and within-school variance could also have been obtained using hierarchical linear models software. In fact, although we used no special software, our analyses do involve a hierarchical model. They take into account a structural aspect of college admissions data that is often ignored: the fact that the data emerge from different high schools.

Key Findings on Correlations

Tables 6–8 give the across and within correlations between SES variables (income, mother's education, and father's education) and academic performance variables (SAT scores, class rank, and the six GPA variables). Table 6 highlights key results for White students, for whom our research hypotheses were most clearly supported. (The SES variables included in Table 6 are income and father's education; results for mother's education were very similar to those for father's education.) Table 7 gives results for our entire sample and both genders; Table 8 (from which Table 6 was excerpted) gives the complete results for all the ethnic groups. To provide additional perspective on the results, Table 9 presents the correlations among the academic performance variables and Table 10 gives the correlations among the socioeconomic variables.

Table 6 shows that, for White students, the correlations of HSGPA with income and with father's education were slightly higher within than across schools, and this pattern was more pronounced for class rank. The reverse was true for SAT scores: within correlations were considerably smaller than across correlations. As a result, HSGPA, class rank, and SAT had within correlations with income and with father's education that were much more similar to each other than were the across correlations. For example, the across correlation with income was .211 for SAT verbal score, considerably larger than the correlation of .105 for class rank. By comparison,

TABLE 6
Key Correlation Results for White Students

Variables	Across	Within
Income × SAT Verbal	.211	.120
Income × SAT Math	.240	.150
Income × HSGPA	.096	.101
Income × Class Rank	.105	.129
Father's Education × SAT Verbal	.320	.230
Father's Education × SAT Math	.307	.213
Father's Education × HSGPA	.176	.178
Father's Education × Class Rank	.190	.211

TABLE 7
Across and Within Correlations for the Total Sample, Females, and Males

	Total		Female		Male	
Variables	Across	Within	Across	Within	Across	Within
Income × SAT Verbal	.371	.219	.388	.233	.344	.203
Income × SAT Math	.358	.210	.368	.219	.321	.182
Income × HSGPA	.171	.124	.211	.158	.155	.117
Income × Class Rank	.143	.152	.179	.183	.109	.124
Income × Social Studies/History	.178	.129	.200	.146	.160	.121
Income × Natural Sciences	.176	.121	.199	.139	.156	.112
Income × Mathematics	.169	.100	.193	.120	.136	.077
Income × Foreign Language	.087	.067	.126	.099	.081	.065
Income × English	.159	.115	.202	.146	.155	.119
Mother's Education × SAT Verbal	.344	.229	.356	.235	.323	.219
Mother's Education × SAT Math	.311	.196	.323	.206	.284	.176
Mother's Education × HSGPA	.165	.137	.195	.158	.148	.126
Mother's Education × Class Rank	.161	.166	.187	.187	.135	.144
Mother's Education × Social Studies	.159	.131	.179	.144	.141	.119
Mother's Education × Natural Sciences	.165	.130	.188	.148	.141	.112
Mother's Education × Mathematics	.147	.101	.169	.115	.120	.083
Mother's Education × Foreign Language	.091	.080	.117	.097	.084	.077
Mother's Education × English	.155	.127	.183	.143	.150	.126
Father's Education × SAT Verbal	.382	.252	.391	.255	.365	.248
Father's Education × SAT Math	.362	.232	.369	.235	.340	.219
Father's Education × HSGPA	.206	.176	.232	.194	.198	.173
Father's Education × Class Rank	.195	.206	.218	.223	.174	.192
Father's Education × Social Studies	.195	.162	.210	.171	.184	.156
Father's Education × Natural Sciences	.198	.157	.216	.170	.181	.147
Father's Education × Mathematics	.185	.133	.203	.146	.160	.117
Father's Education × Foreign Language	.121	.109	.145	.122	.123	.112
Father's Education × English	.188	.157	.217	.173	.188	.162

Notes. Correlations of class rank with other variables are negative because a "low" class rank indicates high achievement. To avoid confusion, all correlations involving class rank are given in terms of their absolute value, rather than their signed value.

the within correlation with income was .120 for SAT verbal score, slightly *smaller* than the correlation of .129 for class rank.

In general, class rank had larger correlations with SES within than across schools for the total sample (Table 7) and for the various student groups. It is likely that class rank conformed more closely to the research hypothesis than did HSGPA because class rank distributions are even more similar across high schools than HSGPA distributions (i.e., they more closely resemble the situation depicted in Table 2). One exception to this pattern was the Asian-American group, in which the across correlations of class rank and SES slightly exceeded the within correlations (Table 8). An additional minor exception to the pattern was that for females, the across and within correlations between mother's education and class rank were equal.

TABLE 8
Across and Within Correlations for Ethnic Groups

	African-American		Hispanic/Latino		White		Asian-American	
Variables	Across	Within	Across	Within	Across	Within	Across	Within
Income × SAT Verbal	.284	.193	.369	.232	.211	.120	.424	.311
Income × SAT Math	.266	.184	.346	.215	.240	.150	.298	.198
Income × HSGPA	.092	.082	.138	.079	.096	.101	.132	.100
Income × Class Rank	.063	.099	.109	.123	.105	.129	.120	.117
Income × Social Studies/ History	.104	.087	.150	.099	.103	.103	.141	.091
Income × Natural Sciences	.093	.071	.141	.091	.099	.093	.126	.068
Income × Mathematics	.088	.060	.135	.073	.100	.084	.112	.069
Income × Foreign Language	.062	.064	.011	−.014	.073	.073	.097	.067
Income × English	.092	.076	.133	.080	.091	.088	.141	.100
Mother's Education × SAT Verbal	.258	.183	.311	.194	.291	.212	.376	.241
Mother's Education × SAT Math	.217	.150	.266	.170	.274	.192	.297	.174
Mother's Education × HSGPA	.105	.094	.125	.110	.147	.146	.153	.125
Mother's Education × Class Rank	.072	.103	.102	.125	.164	.177	.155	.140
Mother's Education × Social Studies	.101	.083	.130	.114	.135	.133	.143	.109
Mother's Education × Natural Sciences	.103	.087	.127	.116	.137	.129	.160	.123
Mother's Education × Mathematics	.075	.054	.113	.088	.126	.110	.126	.092
Mother's Education × Foreign Language	.071	.063	.015	.009	.112	.109	.109	.067
Mother's Education × English	.098	.085	.113	.087	.136	.129	.145	.105
Father's Education × SAT Verbal	.257	.186	.325	.191	.320	.230	.415	.257
Father's Education × SAT Math	.231	.156	.286	.167	.307	.213	.360	.222
Father's Education × HSGPA	.115	.110	.147	.116	.176	.178	.202	.157
Father's Education × Class Rank	.086	.116	.126	.144	.190	.211	.182	.162
Father's Education × Social Studies	.122	.109	.133	.102	.163	.162	.183	.134
Father's Education × Natural Sciences	.117	.099	.145	.116	.156	.147	.197	.146
Father's Education × Mathematics	.099	.082	.136	.097	.145	.129	.181	.117
Father's Education × Foreign Language	.075	.073	.049	.037	.129	.128	.141	.093
Father's Education × English	.112	.095	.137	.104	.159	.153	.175	.129

Notes. Correlations of class rank with other variables are negative because a "low" class rank indicates high achievement. To avoid confusion, all correlations involving class rank are given in terms of their absolute value, rather than their signed value.

TABLE 9

Correlations Between Academic Performance Variables

Variables	Across	Within
SAT Verbal, SAT Math	.745	.692
SAT Verbal, HSGPA	.479	.483
SAT Math, HSGPA	.513	.525
SAT Verbal, Class Rank	.463	.502
SAT Math, Class Rank	.509	.556
HSGPA, Class Rank	.719	.735

TABLE 10

Correlations between Socioeconomic Variables

Variables	Across	Within
Income, Father's Education	.494	.375
Income, Mother's Education	.443	.340
Father's Education, Mother's Education	.588	.505

Although we focus on the finding that within-school correlations between income and grades were often larger than across-school correlations, the finding that the reverse was true for SAT scores is also noteworthy. As illustrated in Equation (3), an across school correlation is made up of a within-school and a between-school component. In the case of SAT scores, the between-school effect tends to be substantial—that is, schools with high *average* SES also tend to have high *average* SAT scores. When this effect is discounted, the resulting (student-level) correlation is smaller.

Some further information on the correlation results follows.

Details on correlation results for the total sample. When our entire sample was considered, the across correlations of SAT scores (math and verbal) with the three SES variables ranged from .31 to .38, while the within correlations ranged from .20 to .25 (Table 7). The median decrease (for the above six correlations) in moving from the across to the within results was .13. Across correlations of HSGPA with the SES variables ranged from .17 to .21, while within correlations ranged from .12 to .18. The median decrease (across the three correlations) was .03. Although HSGPA did not have higher within-school than across-school correlations with SES in this total-sample analysis, as had been hypothesized, the disparity between the two types of correlations was much smaller than for SAT scores. Class rank, however, did have very slightly higher within than across correlations with SES. Across correlations of class rank with the three SES variables ranged from .14 to .20, while within correlations ranged from .15 to .21.[6] The median increase (across the three correlations) was .005.

Details on correlation results for ethnic and gender groups. For White students, within correlations of HSGPA and SES were very similar to across correlations; both types of correlations ranged from .10 to .18. In the case of the correlations of class rank and SES, across correlations ranged from .11 to .19, while within correlations ranged from .13 to .21. The median increase was .02. For African-American and Hispanic/Latino students, the hypothesized pattern held for class rank, but not for HSGPA. For Asian-Americans, across correlations were larger than within correlations for all variables (Table 8). Results for these groups are discussed further in the next section.

When correlations for females and males were examined separately, patterns were similar to those observed for the total group, but there were differences in the magnitude of the correlations. Both types of correlations between SES and academic performance tended to be higher for females than for males (Table 7).

Percentages of Between-School Variance

The obtained percentages of between-school variance are given for the total sample and for males and females in Table 11 and for ethnic groups in Table 12. The results were consistent with the results of the correlations. Class rank had the lowest percentage of between-school variance (10.6% for the total sample), followed by the individual-subject GPAs (12.5% to 14.7%), and then by HSGPA (15.8%). SAT verbal (26.1%) and math (26.7%) scores and SES variables (22.0% to 31.5%) had the largest percentages of variance accounted for by between-school factors. In terms of general pattern, the percentages of between-school variance for males and females (Table 11) and for each ethnic group (Table 12) were consistent with the findings for the overall sample. However, as with the correlations, there were differences in the magnitude of the percentages of variance accounted for by between and within-school factors. Most notably, percentages of variance accounted for by between-school factors were the lowest for White students and highest for Asian-American students.

In interpreting the results for the various demographic groups, it is important to keep several factors in mind. First, as shown in Table 5, the gender and ethnic groups are distributed among different subsets of the 7,330 schools included in the

TABLE 11
Percentage of Between-School Variance for the Total Sample, Females, and Males

Variable	Total Sample	Females	Males
Income	31.52	36.14	36.89
Mother's Education	22.01	27.47	28.00
Father's Education	26.20	31.37	31.99
SAT Verbal	26.06	31.91	31.69
SAT Math	26.68	31.97	32.10
HSGPA	15.83	22.70	23.52
Class Rank	10.58	16.34	19.42
Social Studies GPA	13.93	19.91	22.03
Natural Sciences GPA	14.54	20.85	22.16
Mathematics GPA	14.74	21.32	21.86
Foreign Language GPA	12.46	18.53	21.06
English GPA	14.00	20.30	22.15

TABLE 12
Percentage of Between-School Variance for Ethnic Groups

Variable	African-American	Hispanic/Latino	White	Asian-American
Income	37.76	46.91	25.54	55.50
Mother's Education	33.93	43.47	21.43	55.08
Father's Education	34.52	45.00	25.80	56.93
SAT Verbal	38.15	41.09	21.38	55.10
SAT Math	37.96	39.95	21.80	56.48
HSGPA	32.95	36.74	16.99	46.01
Class Rank	29.07	29.94	14.39	44.04
GPA: Social Studies	30.86	32.86	14.80	43.54
GPA: Natural Sciences	31.17	34.49	15.40	45.15
GPA: Mathematics	31.88	33.28	15.34	46.73
GPA: Foreign Language	30.85	30.89	15.03	44.59
GPA: English	30.96	33.55	15.16	45.20

total-sample analysis. In particular, African-American, Asian-American, and Hispanic/Latino students are represented in fewer than half of these schools. Second, in the subgroup analyses, the school means of Equations (5) and (6) are the school means *for the demographic group in question* and may be therefore less useful as general indexes of school quality. Furthermore, for African-American, Asian-American, and Hispanic/Latino students, the average number of students per school is very small—between two and four (Table 5), implying that the group-level school means may not be well estimated. For all these reasons, the interpretation of the results for these three groups should be interpreted cautiously.

Summary and Discussion

The overall implication of the findings is that across-school correlations confound within-school relationships with between-school differences, a fact that is not always recognized. Furthermore, because the degree of between-school differences is not the same for grades as it is for test scores, it is particularly difficult to discern the within-school relationships by examining only the across-school correlation matrices. When examined within high schools, the correlations between SES and high school grades on one hand, and between SES and SAT scores on the other, are more similar than they appear to be if the data are simply combined across schools before computing the correlation matrix.

Other factors can also affect the differential correlations of grades and standardized test scores with SES—in particular, the differences in reliability between grades and test scores. In previous studies, the reliability of grade-point averages has typically been estimated to be between the low .60's and the low .80's (Willingham et al., 2002, p. 17). Somewhat surprisingly, Willingham et al. (2002, p. 17) estimated the reliability of grades in their own study to be very high (.97). They attributed this somewhat unexpected result to the way in which they assessed reliability, which, they say, may have let to inflated estimates. The reliability of the NELS test score used by Willingham et al. was estimated to be .96 (which is approximately equal to the reliability of the SAT composite of math and verbal scores). If the actual reliability of HSGPA were .6 in the Willingham et al. study, this factor alone could explain most of the observed difference between the SES-test score correlation and the SES-HSGPA correlation. (The attenuation-corrected correlations would be .49 and .45, respectively, assuming perfect measurement of SES.) The differential correlations of Table 1 in the present article, on the other hand, cannot be satisfactorily explained by reliability differences alone.

One limitation of our study is that, with the exception of SAT scores, all data included in our analyses were collected using a student self-report measure. It is impossible to know how results would have been affected if we had had access to actual socioeconomic data and high school grades. Also, because of exclusions due to missing data, our analysis sample was not a random sample of the full College-bound Seniors data set, although it was demographically quite similar (Table 3).

A piece of evidence that appears to be inconsistent with the findings of our study is that, despite its noncomparability across high schools, HSGPA typically has a substantial correlation with first-year college GPA—usually higher than the correlation of SAT scores with college GPA (e.g., see Table 1). Why would not the similarity of HSGPA distributions across schools depress the HSGPA-college GPA correlation just as it depresses the HSGPA-SES correlation? One possibility is that the high correlation between college and high school GPA is due, in part to what Campbell and Fiske (1959; reprinted in Ward, Stoker, & Murray-Ward, 1996) might call a method effect: They state that each "test or task employed for measurement purposes is a *trait-method unit,* a union of a particular trait content with measurement procedures not specific to that content." They further note that the relationships among variables "can be due to responses to the measurement features as well as responses to the trait content" (1996, p. 226). We can consider admissions test scores, high school GPAs, and college GPAs as alternative measures of academic skill—the trait, in the terminology of Campbell and Fiske (used here with no implication of immutability). The two grade-point averages also have a common method, in that they both involve teacher evaluations based on a wide range of student data. Willingham et al. (2002, p. 19) identified several factors that were more highly correlated with high school grades than with test scores, such as attendance, class participation, work completed, class behavior, and educational motivation. Presumably, these factors also play a role in the determination of college GPA.

Under the assumption of a method effect that contributes to the HSGPA-college GPA correlation, the within-high-school correlation would be high enough so that, even after reduction due to the noncomparability of HSGPA across schools, the across-high-school correlation between HSGPA and college GPA would still exceed the SAT-college GPA correlation. Again, the analyses of Rothstein (2005) appear consistent with these hypotheses. He found that, in predicting college GPA, student-level HSGPA was a much better predictor than average high school GPA, while the opposite was true for SAT (i.e., the high school average on SAT was actually a better predictor than individual level SAT score). Rothstein noted that "within-school variation in HSGPAs is quite predictive of eventual [first-year college GPAs] but . . . across-school variation provides very little information" (2005, p. 11).

Regardless of methodological artifacts, however, it is indisputable that SAT scores and SES are positively correlated. Some researchers, along with test critics, regard the SES-test score association as a property of standardized tests themselves. Rothstein (2004), for example, views SAT scores as "proxies" for SES, and concludes that they are not "socioeconomically neutral," and Geiser and Studley (2001, p. 10) refer to the "sensitivity" of test scores to SES. This seems to be a puzzling perspective in that the mechanisms that lead to the SES-test score association are certainly not a mystery. In fact, the impact of school resources on educational achievement measures, including test scores, is widely acknowledged in other contexts.

The Public Policy Institute of California, for example, conducted a study of the impact of school resources on student achievement, as measured by 1998 performance on the math and reading sections of the Stanford-9 Achievement Test. The authors of the study concluded that "[b]y far, the most important factor related to student achievement [on the school level] . . . is our measure of SES—the percentage of students receiving free or reduced-price lunches" (Betts, Rueben, & Danenberg, 2000, p. 207).

A very public acknowledgment of the link between school resources and educational achievement, including test performance, emerged from the lawsuit, *Williams v. State of California*, which charged that many of the state's students did not have access to an adequate education. According to one portion of the complaint document, "the State has recently adopted a system of statewide education standards, a rigorous system of mandatory testing to monitor whether students satisfy those standards, and a system to bar students who fail to meet those standards from graduating or being promoted within their schools. Yet the State, in violation of every concept of fundamental fairness and due process, has failed to ensure that all students are accorded even the minimal educational tools needed to meet these standards" (*Williams v. State of California, August 14, 2000*). The 2004 settlement agreement for the case states that the order of priority for the allocation of resources resulting from the settlement should be based not on the financial status of the school, but on its ranking on California's Academic Performance Index, which is based heavily on standardized test scores (*Williams v. State of California, August 13, 2004*).

Of course, home environments, like school environments, reflect the economic status of the student's family and have implications for student learning. A government survey found that even the likelihood that young children are read to by family members varies with income. In households below the poverty threshold, 46% of 3-5-year-olds had been read to every day in the preceding week by a family member. For households above the threshold, 61% of children had been read to (National Center for Education Statistics, 1996). Disparities were even greater when reading frequency was compared across maternal education levels.

If we recognize that adequate resources are needed to foster student achievement, and that many students do not have the kinds of home and school environments that are conducive to learning, how can we expect test scores to be uncorrelated with socioeconomic factors? Until we have a socioeconomically equitable society, we will not have a socioeconomically neutral test.

Notes

[1]The comments were made at a lecture at the University of California, Santa Barbara on September 29, 2000.

[2]These results are based on analyses of the NAEP 2005 math results for grade 8, obtained using the NAEP Data Explorer, an online tool available at http://nces.ed.gov/nationsreportcard/nde/.

[3]These results are based on analyses of the CAHSEE 2006 English-language arts and mathematics results for grade 10, obtained using the California Department of Education DataQuest, an online tool available at http://data1.cde.ca.gov/dataquest/. **Q3**

[4]Paralleling Geiser and Studley (2001), Zwick, Brown, and Sklar (2004) used a log transformation of parental income in analyzing the UC data. In economic analyses, a log transformation is commonly applied to income to make the distribution more symmetric. A log transformation was not applied in the analyses of College Board data described in the present article, since income was reported in terms of ordered income categories, rather than actual dollar values.

[5]High school information was recoded by the College Board so that we could not identify the schools; however, we could determine which students came from the same school.

[6]Correlations of class rank with the other variables in these analyses are negative because a "low" class rank indicates high achievement. To avoid confusion, all correlations involving class rank are stated in terms of their absolute value, rather than their signed value.

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Queries

Q1 Author: As per the journal style, sections are unnumbered. Hence the reference to section 1, 2 etc. has been changed and the actual section heads have been put in their place. Please check.

Q2 Author: Please spell out ACT.

Q3 Author: The year of publication in reference citation CAHSEE in footnote 3 has been changed to 2006 to match that in the reference list. Please check.

Q4 Author: Please provide the name of the publisher in references College Entrance Examination Board (2004, 2005).

Q5 Author: Reference "Zwick (2005)" has not been cited in the text. Please check.