CollegeBoard
connect to college success™

Research Report
No. 2006-6

Relationships Between PSAT/NMSQT® Scores and Academic Achievement in High School

Glenn B. Milewski and Ellen A. Sawtell

www.collegeboard.com

College Board Research Report No. 2006-6

Relationships Between PSAT/NMSQT® Scores and Academic Achievement in High School

Glenn B. Milewski and Ellen A. Sawtell

The College Board, New York, 2006

Glenn B. Milewski is an associate research scientist at the College Board.

Ellen A. Sawtell is an associate director of Research and Analysis at the College Board.

The College Board: Connecting Students to College Success

The College Board is a not-for-profit membership association whose mission is to connect students to college success and opportunity. Founded in 1900, the association is composed of more than 5,000 schools, colleges, universities, and other educational organizations. Each year, the College Board serves seven million students and their parents, 23,000 high schools, and 3,500 colleges through major programs and services in college admissions, guidance, assessment, financial aid, enrollment, and teaching and learning. Among its best-known programs are the SAT®, the PSAT/NMSQT®, and the Advanced Placement Program® (AP®). The College Board is committed to the principles of excellence and equity, and that commitment is embodied in all of its programs, services, activities, and concerns.

For further information, visit www.collegeboard.com.

Additional copies of this report (item #060481916) may be obtained from College Board Publications, Box 886, New York, NY 10101-0886, 800 323-7155. The price is $15. Please include $4 for postage and handling.

Acknowledgments

This report benefited from many helpful comments by Brent Bridgeman, Wayne Camara, Gretchen Rigol, Beth Robinson, Amy E. Schmidt, Ellen Wentland, and the College Board's Research Advisory Committee. We thank these individuals for their thoughtful reviews.

We would also like to thank Jeff Wyatt and Stephen Frustino for their help developing an index of Academic Intensity.

Contents

Abstract

The current study investigated relationships between scores on the verbal, mathematics, and writing sections of the PSAT/NMSQT® (as well as the PSAT/NMSQT composite: verbal + mathematics + writing scores) and the following indicators of academic achievement in high school: years of study, participation in specific math and English language arts courses, high school grade point average (HSGPA), academic intensity, and participation and performance in Advanced Placement Program® (AP®) courses. It was hypothesized that students who have greater academic achievements in high school earn higher scores on the PSAT/NMSQT. This hypothesis was evaluated by analyzing PSAT/NMSQT scores, questionnaire responses, and AP grades from 857,375 students. The results showed that there are moderate to strong relationships between indicators of academic achievement in high school and PSAT/NMSQT scores.

Introduction

The Preliminary SAT/National Merit Scholarship Qualifying Test (PSAT/NMSQT) is cosponsored by the College Board and National Merit Scholarship Corporation (NMSC). It serves as a practice test for the SAT Reasoning Test™ (SAT®) and provides students with an opportunity to enter NMSC scholarship competitions. More than 2.5 million students from more than 20,000 high schools take the PSAT/NMSQT each year. About half the students who take the test are in their junior year of high school, which is the year they are eligible for NMSC scholarship competitions.

The PSAT/NMSQT measures skills in three general academic areas that are important for success in college: verbal reasoning, mathematics problem solving, and writing skills. It shares much of the SAT's statistical and content specifications, but the PSAT/NMSQT has a slightly lower overall difficulty than the SAT, contains fewer items, and does not cover content that would typically be found in a third-year college-preparatory math course.

This study analyzed relationships between scores on the verbal, mathematics, and writing sections of the PSAT/NMSQT, as well as the PSAT/NMSQT composite (verbal + mathematics + writing scores) or Selection Index, and the following indicators of academic achievement in high school: years of study within several academic areas, participation in specific math and English language arts courses, HSGPA, academic intensity, and participation and performance in AP courses. This study was conducted because one of the reasons the NMSC uses the PSAT/NMSQT to identify pools of candidates who qualify for recognition by merit-based scholarships is that PSAT/NMSQT scores are reflective of achievement in high school. This study simply provides evidence to validate that claim.

It is important to explain why using high school grades or some other measure of high school achievement instead of PSAT/NMSQT scores as an initial screen of scholarship entrants would be unfeasible and unfair. Many high schools are unwilling or unable to provide individual course grades for all of the juniors in their school. Individual course grades would be needed to compute a standardized indicator of high school performance since students complete different courses and high schools often employ different grading systems. Also, because grades often lack comparability within and between high schools, basic issues of fairness are associated with using them as an initial screen for scholarship determination. Finally, high school grades cannot be used to make fine distinctions between students in the top 2 to 3 percent of the population. According to the *2005 College-Bound Seniors* report, which presented data for high school graduates in the year 2005 who participated in the SAT Program, 42 percent of students reported an HSGPA equivalent to a grade of A- or higher and 24 percent reported an HSGPA equivalent to a grade of A or higher; 6 percent had an HSGPA equivalent to a grade of A+ (College Board, 2005, p. 2). So high school grades would provide an insufficient source of information for an initial screen of scholarship entrants.

It is also important to note that the NMSC does rely heavily on grades and other information about students' high school course work and academic performance in designating Finalists and in selecting students who receive scholarships. This information, however, is considered only after PSAT/NMSQT scores have been used as an initial screen of scholarship entrants.

This study hypothesized that students who have greater academic achievements in high school earn higher scores on the PSAT/NMSQT.

Method

Participants

The analysis began with a data set that contained all of the students who graduated in May or June 2002 and participated in at least one College Board program (i.e., AP, SAT, or PSAT/NMSQT). This data set was assembled by matching separate data files from each College Board testing program. In order to protect against redundancy, multiple records for a student were purged and only the latest score information from each testing program was preserved. There were 2,012,028 students in the original data set.

This data set was reduced to include only the students who took the PSAT/NMSQT in October 2000 during their junior year and the SAT sometime before they graduated in May or June 2002. AP Exam grades for these students, if available, were preserved. It was desirable to focus the analysis on these students because students are only eligible for NMSC scholarship competitions in their junior year and because indicators of academic achievement were provided by information collected during SAT registration (e.g., SAT Questionnaire responses). The reduced data set that was ultimately used for this study was composed of 857,375 students.

To examine whether the sample was representative of the population it was drawn from, its characteristics were compared to the 2000 College-Bound Juniors (all juniors who took the PSAT/NMSQT in October 2000). Table 1 presents the demographic characteristics and Table 2 presents the average PSAT/NMSQT scores of the current sample and the 2000 College-Bound Juniors. A comparison of the two groups reveals that they are roughly equivalent by gender, but that the sample has a slightly lower proportion of ethnic-minority students. Students in the current data set also have average PSAT/NMSQT verbal, mathematics, and writing scores that are about 2 points higher (on the 20-to-80 PSAT/NMSQT score scale) than those of the 2000 College-Bound Juniors.

Table 1

Demographic Characteristics of Study Participants (n = 857,375) and 2000 College-Bound Juniors (n = 1,298,576)

Characteristic	*Participants*		*College-Bound Juniors**	
	n	%	n	%
Gender				
Male	382,806	44.6	577,679	44.5
Female	473,901	55.3	719,649	55.4
No Response	668	0.1	1,248	0.1
Ethnicity				
American Indian	3,735	0.4	7,788	0.6
Asian American	74,942	8.7	90,229	6.9
African American	73,705	8.6	121,518	9.4
Mexican American	32,775	3.8	60,444	4.7
Puerto Rican	10,085	1.2	15,342	1.2
Other Hispanic	26,151	3.1	36,562	2.8
White	595,592	69.5	909,136	70.0
Other	25,597	3.0	35,495	2.7
No Response	14,793	1.7	22,062	1.7

*Source: PSAT/NMSQT 2000 State Summary Reports: College-Bound Juniors.

Table 2

Descriptive Statistics on the PSAT/NMSQT for Study Participants and 2000 College-Bound Juniors

PSAT/NMSQT Scores	*Participants* (n = *857,375*)		*College-Bound Juniors** (n = *1,298,576*)	
	M	*SD*	*M*	*SD*
Verbal	50.5	10.8	48.3	11.1
Mathematics	51.6	10.8	49.4	11.1
Writing	50.4	10.1	48.7	10.0
Composite	152.5	28.5	146.4	29.0

*Source: PSAT/NMSQT 2000 State Summary Reports: College-Bound Juniors.

Materials

The PSAT/NMSQT is a 2-hour-and-10-minute test. It has two 25-minute verbal sections (52 questions), two 25-minute mathematics sections (40 questions), and one 30-minute writing skills section (39 questions). Verbal questions measure critical reading, sentence-level reading, and analogical reasoning. Mathematics questions measure algebra and functions, geometry and measurement, number and operations, and data analysis, statistics, and probability. Writing questions measure grammar, usage, and word choice.[1]

Scores on each section of the test (verbal, mathematics, and writing) range from 20 to 80. NMSC computes a composite that is the sum of unweighted scores on each section of the PSAT/NMSQT. This composite is known as the Selection Index because it is used as an initial screen of entrants to NMSC scholarship programs.

The PSAT/NMSQT generally demonstrates excellent psychometric properties. Data based on a sample of sophomores and juniors who took the PSAT/NMSQT in 2002 showed that the test was highly reliable. Reliability coefficients were .88 for the verbal sections (*SEM* = 3.8), .87 for the mathematics sections (*SEM* = 4.0), and .82 for the writing section (*SEM* = 4.0) (College Board, 2003a).

Several indicators of academic achievement were provided by responses to SAT Questionnaire items. The SAT Questionnaire is a 43-item measure of high school background, interests, activities, and college plans (College Board, 2003b, pp. 9–11). Students usually complete the SAT Questionnaire 6 to 18 months after they take the PSAT/NMSQT.

The SAT Questionnaire items analyzed in the current study included: (a) total number of years of high school courses from grades 9 through 12 in arts and music, English, foreign and classical languages, mathematics, natural science, and social science and history; and (b)

[1] A new PSAT/NMSQT with revised test specifications (i.e., no analogies or quantitative comparison questions) was introduced in October 2004. Since the students that participated in this study took the PSAT/NMSQT in October 2000, the results presented in this report are based on a previous version of the PSAT/NMSQT.

content of high school courses in English (American literature, British literature, composition, grammar, literature of a country other than the United States or Britain, literature of different historical periods, speaking and listening skills, and English as a second language) and math (algebra, geometry, trigonometry, precalculus, calculus, computer math, and other mathematics); and (c) self-reported cumulative high school grade point average (equivalent to an A+, A, A-, B+, B, B-, C+, C, C-, D+, D, or F). Several SAT Questionnaire items were also used in combination with AP Exam grades to create two indicators of academic intensity (see Procedure). AP Exam grades were also used to examine the relationship between PSAT/NMSQT scores and AP participation and performance.

Two studies support the accuracy of self-reported SAT Questionnaire data. Freeberg (1988) reported that "key items of student-reported information were shown to possess high levels of accuracy" (p. 15) and Freeberg, Rock, and Pollack (1989) reported that the self-reported academic information from the SAT Questionnaire is adequate for predicting first-year college achievement.

Procedure

A table was created to present mean PSAT/NMSQT scores and standard deviations by number of years of study in each academic area covered by the SAT Questionnaire. Mean PSAT/NMSQT scores and standard deviations were also presented for students who took honors courses within each academic area. A figure was created to graphically display the relationship between composite PSAT/NMSQT scores and years of study within an academic area.

Tables were created to present mean PSAT/NMSQT scores and standard deviations by course participation. Separate tables were created for English language arts and math courses. Table rows were ordered by largest mean PSAT/NMSQT scores.

Pearson product-moment correlations between PSAT/NMSQT scores and HSGPA were calculated. A table was created to present mean PSAT/NMSQT scores and standard deviations by HSGPA intervals (e.g., equivalent to an A+, A, A-, etc.); the number and percent of cases on which these means and standard deviations were based were also presented. A figure was created to graphically display the relationship between HSGPA and PSAT/NMSQT scores.

Scores on academic intensity variables were computed using an approach that Bridgeman, Pollack, and Burton (2004) developed based on Adelman (1999). For academic intensity in math and science, students earned three points if they took two or more AP Exams in a math or science field (i.e., biology, chemistry, physics, calculus, statistics, computer science, or environmental science), two points if they took one AP Exam in a math or science field, and one point if they took at least three years of study in a lab science and a math course in trigonometry, precalculus, or calculus; all other students earned zero points. For academic intensity in humanities and social science, students earned three points if they took two or more AP Exams in a humanities or social science field (i.e., geography, history, government, English, foreign language, economics, or psychology), two points if they took one AP Exam in a humanities or social science field, and one point if they took at least three years of study in a foreign language, four years of study in English, four years of study in social science and/or history, and an honors course in at least one of these course categories; all other students earned zero points. Students were assigned missing values on the two academic intensity variables if they did not meet the AP criteria and did not answer some or all of the SAT Questionnaire items and were unable to be classified. The sum of the two academic-intensity variables was also computed. Scores on this new variable—labeled *overall* academic intensity—ranged from zero to six points.

Relationships between PSAT/NMSQT scores and all three measures of academic intensity (math/science, humanities/social science, and overall academic intensity) were examined. Pearson product-moment correlations between PSAT/NMSQT scores and the three academic intensity variables were computed. The multiple regression of PSAT/NMSQT composite scores on academic intensity in math/science and humanities/social science was also computed. A table was constructed to present mean PSAT/NMSQT scores and standard deviations by each academic intensity score in math/science and humanities/social science, and a figure was created to plot the PSAT/NMSQT means by level of academic intensity. A table was also constructed to present the proportion of students by PSAT/NMSQT mathematics, verbal, and writing scorebands (i.e., 20–29, 30–39, etc.) who had received a score of a 1, 2, 3, …, or 6 on overall academic intensity. Three sets of histograms (one for each PSAT/NMSQT section) were also produced to show the distribution of PSAT/NMSQT scores for each level of overall academic intensity.

Relationships between PSAT/NMSQT scores and participation and performance in AP courses were also examined. (Unlike the previously described academic-intensity variable, AP participation and performance variables were based on 35 AP courses.) A table was constructed to present the proportion of students within each PSAT/NMSQT mathematics, verbal, and writing scoreband by five categories of AP participation: 0, 1, 2, 3, and 4 or more AP courses taken; and three categories of average AP grades: less than or equal to 3, 3.01 to 3.99, and greater than or equal to 4. It is important to note that a student was deemed an "AP participant" if that student

took an AP Exam, and that approximately 20 percent of students in AP courses do not actually take an AP Exam. These latter analyses were examined to investigate relationships between other sources of academic rigor and the PSAT/NMSQT. Mean PSAT/NMSQT scores and standard deviations were also computed by intended college major (see Appendix A).

Results and Discussion

Years of Study

Table 3 shows the relationship between mean verbal, mathematics, writing, and composite PSAT/NMSQT scores and years of study in several different academic areas; Figure 1 plots these relationships graphically. The results indicate that students with more years of study (across all academic areas) obtained higher mean PSAT/NMSQT scores. Large differences in mean PSAT/NMSQT scores were found between students who participated in honors courses and those who did not and between students who took three years of study and those who took four years of study. The highest mean difference (2.7 points) was observed on the mathematics section between students who took more than four years of math and students who took three years of math.

In order to more fully interpret the results in Table 3, another table is presented to provide the number and percent of test-takers by years of study within each academic area (see Appendix B). This table allows the reader to refer to the number of students used to compute each of the means presented in Table 3.

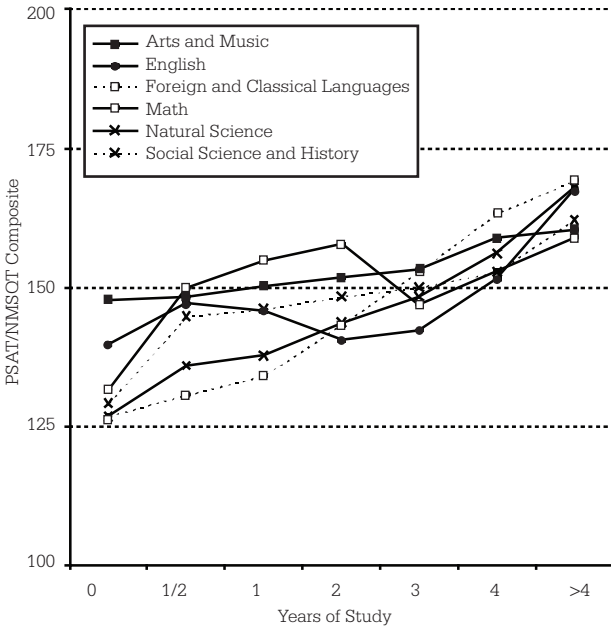

Figure 1. Mean composite PSAT/NMSQT scores by years of study within an academic area.

Course Participation

Table 4 shows the mean verbal, writing, and composite PSAT/NMSQT scores by participation in various English language arts courses. Slight differences in mean PSAT/NMSQT scores were observed between students who participated in courses like British literature or literature of a country other than the United States and Britain and those who did not, with students who participated in these courses having higher PSAT/NMSQT scores on average. One possible explanation of this difference is that high-achieving students take these courses because their content goes beyond the standard high school curriculum.

Table 5 shows the mean mathematics and composite PSAT/NMSQT scores by math course participation. Normally, the order of high school math courses from least rigorous to most rigorous is algebra, geometry, trigonometry, precalculus, and calculus. Table 5 shows that students who took more rigorous math courses had higher mean PSAT/NMSQT scores. It is important to note, however, that most students take courses like trigonometry, precalculus, and calculus after they take the PSAT/NMSQT, but the students who go on to take these courses are most likely preparing with more rigorous courses (relative to the standard curriculum) at the time that they take the PSAT/NMSQT.

High School Grade Point Average

Cohen (1988) established guidelines regarding the strength of correlations, which state that correlations of about .10 are small, correlations of about .30 are medium, and correlations of about .50 are large (pp. 79–81). Table 6 shows that the correlations between verbal, mathematics, writing, and composite PSAT/NMSQT scores and HSGPA are medium to large. The correlation between PSAT/NMSQT composite scores and HSGPA was large (r = .53) and the correlations between scores on the PSAT/NMSQT sections and HSGPA were slightly smaller but still in the medium to large range (r = .46 to .50). Table 7 shows that average scores on PSAT/NMSQT sections increased by about 1 to 4 point(s) for each unit increase in HSGPA and that average PSAT/NMSQT composite scores increased by about 3 to 12 points for each unit increase in HSGPA. Figure 2, which plots the relationship between mean PSAT/NMSQT scores and HSGPA, and Table 7 shows that this relationship was not linear. Larger PSAT/NMSQT score gains were associated with unit

Table 3

Mean PSAT/NMSQT Scores and Standard Deviations by Years of Study Within an Academic Area

PSAT/NMSQT Scores	*Years of Study*								
	None	*1/2*	*1*	*2*	*3*	*4*	*More Than 4*	*Honors*	*No Response*
Arts and Music									
Verbal	48.6 (10.7)	48.9 (11.1)	49.5 (10.7)	50.3 (10.7)	51.0 (10.4)	53.0 (10.5)	53.5 (10.7)	55.5 (10.4)	50.1 (10.8)
Mathematics	50.6 (11.2)	50.3 (11.2)	51.2 (10.9)	51.3 (10.7)	51.4 (10.4)	53.1 (10.5)	53.7 (10.7)	55.9 (10.4)	51.4 (10.8)
Writing	48.6 (9.7)	49.0 (9.9)	49.5 (9.8)	50.2 (9.9)	50.8 (9.9)	52.8 (10.2)	53.1 (10.4)	55.0 (10.3)	50.0 (10.1)
Composite	147.8 (28.4)	148.2 (29.1)	150.2 (28.2)	151.8 (28.1)	153.2 (27.4)	158.9 (28.0)	160.3 (28.6)	166.4 (27.7)	151.5 (28.4)
English									
Verbal	43.0 (10.8)	48.7 (14.5)	50.6 (13.8)	51.6 (12.3)	48.5 (10.3)	50.6 (10.8)	52.9 (11.2)	55.4 (9.9)	50.5 (10.8)
Mathematics	44.8 (11.0)	51.4 (14.2)	53.5 (13.2)	54.6 (12.1)	49.9 (10.4)	51.7 (10.8)	53.5 (10.9)	55.9 (10.0)	51.6 (10.7)
Writing	43.8 (8.8)	49.8 (11.9)	50.9 (12.1)	51.5 (11.1)	48.5 (9.3)	50.6 (10.1)	52.6 (10.6)	55.0 (9.8)	50.4 (10.1)
Composite	131.6 (27.4)	149.9 (37.7)	155.0 (35.9)	157.8 (32.1)	146.9 (26.7)	152.9 (28.5)	159.0 (29.5)	166.2 (26.3)	152.5 (28.2)
Foreign and Classical Languages									
Verbal	41.2 (10.9)	42.8 (11.0)	44.2 (10.8)	47.4 (10.2)	50.6 (10.0)	54.2 (10.2)	56.1 (10.6)	55.8 (10.3)	50.0 (11.0)
Mathematics	43.2 (10.9)	44.3 (10.9)	45.4 (10.7)	48.5 (10.3)	51.8 (10.2)	55.1 (10.2)	57.3 (10.2)	57.0 (10.1)	51.3 (10.9)
Writing	42.4 (8.6)	43.6 (9.0)	44.6 (9.0)	47.4 (9.1)	50.4 (9.3)	54.0 (10.0)	55.9 (10.5)	55.7 (10.1)	50.0 (10.2)
Composite	126.9 (26.7)	130.7 (27.3)	134.1 (27.0)	143.3 (26.1)	152.9 (26.1)	163.3 (27.1)	169.2 (27.9)	168.5 (27.2)	151.2 (28.7)
Math									
Verbal	45.8 (11.5)	47.9 (12.9)	47.9 (12.3)	46.7 (11.0)	47.3 (10.2)	50.2 (10.5)	55.1 (10.5)	55.8 (10.0)	50.3 (10.8)
Mathematics	47.5 (12.2)	50.7 (13.5)	49.5 (12.6)	46.7 (10.8)	47.3 (9.7)	51.1 (10.3)	58.0 (10.0)	58.4 (9.3)	51.6 (10.8)
Writing	46.4 (9.8)	48.4 (10.7)	48.4 (10.8)	47.1 (9.1)	47.5 (9.1)	50.2 (9.8)	54.5 (10.3)	55.3 (9.9)	50.2 (10.1)
Composite	139.7 (30.5)	147.1 (34.0)	145.7 (32.5)	140.5 (28.0)	142.2 (25.6)	151.5 (27.4)	167.7 (27.4)	169.5 (25.7)	152.1 (28.4)
Natural Science									
Verbal	41.0 (10.4)	44.4 (12.3)	45.2 (11.3)	47.5 (10.6)	49.1 (10.4)	51.7 (10.5)	55.5 (10.8)	55.7 (10.0)	50.0 (10.9)
Mathematics	42.7 (10.5)	46.2 (12.3)	46.5 (11.1)	48.4 (10.5)	50.0 (10.3)	52.9 (10.5)	57.7 (10.8)	57.4 (9.8)	51.2 (10.9)
Writing	43.1 (8.4)	45.4 (10.6)	46.0 (9.5)	47.8 (9.4)	49.2 (9.6)	51.5 (10.0)	54.7 (10.5)	55.1 (9.9)	50.0 (10.1)
Composite	126.8 (26.0)	136.0 (31.9)	137.7 (28.5)	143.7 (27.1)	148.3 (26.9)	156.1 (27.8)	167.9 (28.7)	168.2 (26.1)	151.2 (28.7)
Social Science and History									
Verbal	41.7 (11.1)	47.1 (12.4)	47.8 (11.7)	48.7 (10.8)	49.5 (10.7)	50.7 (10.6)	54.1 (10.5)	55.5 (10.0)	50.2 (10.9)
Mathematics	43.9 (11.2)	49.7 (12.7)	50.1 (12.0)	50.8 (11.0)	51.0 (10.9)	51.5 (10.7)	54.6 (10.3)	56.2 (10.0)	51.4 (10.9)
Writing	43.6 (8.9)	48.0 (10.6)	48.2 (10.3)	48.9 (9.7)	49.6 (9.9)	50.6 (10.0)	53.4 (10.1)	54.9 (9.9)	50.1 (10.1)
Composite	129.1 (28.0)	144.8 (32.4)	146.1 (30.8)	148.4 (28.1)	150.0 (28.2)	152.7 (28.2)	162.2 (27.6)	166.7 (26.4)	151.7 (28.6)

Table 4

Descriptive Statistics on the PSAT/NMSQT by English Language Arts Course Participation

			Verbal		*Writing*		*Composite*	
English Language Arts Course	**n**	**%**	***M***	***SD***	***M***	***SD***	***M***	***SD***
Literature of a Country Other Than the U.S. or Britain	144,581	16.9	53.9	10.8	53.4	10.4	161.5	28.6
British Literature	268,903	31.4	53.2	10.6	52.8	10.3	159.4	28.3
Literature of Different Historical Periods	320,748	37.4	53.1	10.3	52 .7	10.1	159.3	27.6
Composition	450,040	52.5	52.1	10.5	51.8	10.1	156.7	28.0
Speaking and Listening Skills	249,387	29.1	51.7	10.6	51.5	10.1	155.6	28.0
Grammar	468,927	54.7	51.4	10.5	51.2	10.1	154.8	28.0
American Literature	543,055	63.3	51.2	10.6	51.0	10.0	154.3	28.0
English As a Second Language	23,129	2.7	42.1	11.0	44.5	9.0	135.7	27.4

Table 5

Descriptive Statistics on the PSAT/NMSQT by Math Course Participation

			Mathematics		*Composite*	
Math Course	**n**	**%**	***M***	***SD***	***M***	***SD***
Calculus	204,158	23.8	59.5	9.2	171.6	25.9
Precalculus	363,456	42.4	55.9	9.7	162.9	26.5
Computer Math	52,219	6.1	55.0	11.6	158.7	30.2
Trigonometry	345,100	40.3	54.2	10.2	158.6	27.4
Geometry	662,350	77.3	51.7	10.7	152.7	28.2
Algebra	672,578	78.4	51.5	10.8	152.2	28.4
Other Math	175,918	20.5	50.7	11.2	150.1	29.1

Table 6

Correlations Between Verbal, Mathematics, Writing, and Composite PSAT/NMSQT Scores, Self-Reported High School Grade Point Average (HSGPA), and Three Measures of Academic Intensity

Variable	***1***	***2***	***3***	***4***	***5***	***6***	***7***	***8***
1. PSAT/NMSQT Verbal	--	.69	.78	.92	.46	.46	.48	.54
2. PSAT/NMSQT Mathematics		--	.65	.87	.49	.59	.44	.58
3. PSAT/NMSQT Writing			--	.90	.46	.44	.48	.53
4. PSAT/NMSQT Composite				--	.52	.55	.52	.61
5. HSGPA					--	.45	.43	.50
6. Academic Intensity: Math and Science						--	.53	.85
7. Academic Intensity: Humanities and Social Science							--	.90
8. Academic Intensity: Math/Science and Humanities/ Social Science								--

Note: Correlations between HSGPA and PSAT/NMSQT scores were based only on those students who reported their HSGPA (n = 720,998). Correlations between academic intensity and PSAT/NMSQT scores were based only on those who provided enough information to determine their academic intensity in math and science (n = 740,998), humanities and social science (n = 750,381), and overall (n = 721,211). Correlations between verbal, mathematics, writing, and composite PSAT/NMSQT scores were based on the entire sample (n = 857,375).

Table 7

Descriptive Statistics on the PSAT/NMSQT by Self-Reported High School Grade Point Average (HSGPA)

			Verbal		*Mathematics*		*Writing*		*Composite*	
HSGPA	**n**	**%**	***M***	***SD***	***M***	***SD***	***M***	***SD***	***M***	***SD***
A+	60,628	7.1	59.5	9.5	61.2	8.9	59.2	9.8	179.9	24.6
A	142,731	16.6	55.6	9.9	57.1	9.5	55.3	9.8	168.1	25.6
A-	136,853	16.0	52.8	9.5	54.3	9.4	52.5	9.2	159.6	24.4
B+	131,830	15.4	49.2	9.5	50.3	9.5	49.1	8.7	148.7	24.0
B	129,631	15.1	46.7	9.4	47.4	9.3	46.7	8.2	140.8	23.2
B-	58,989	6.9	44.6	9.3	45.2	9.2	44.9	7.9	134.7	22.5
C+	34,803	4.1	42.3	9.4	42.9	9.2	43.1	7.6	128.3	22.3
C	19,818	2.3	41.4	9.3	41.7	8.9	42.4	7.4	125.5	21.8
C-	4,550	0.5	40.4	9.6	40.9	9.0	41.6	7.4	122.9	22.1
D+	846	0.1	39.4	9.8	40.0	9.1	40.9	7.3	120.3	22.6
D	279	0.0	39.4	10.4	40.0	8.6	41.0	7.3	120.4	22.6
F	40	0.0	41.4	13.5	42.9	13.6	43.1	12.4	127.3	36.9
No response	136,377	15.9	49.9	11.0	50.9	10.9	49.8	10.1	150.6	28.6

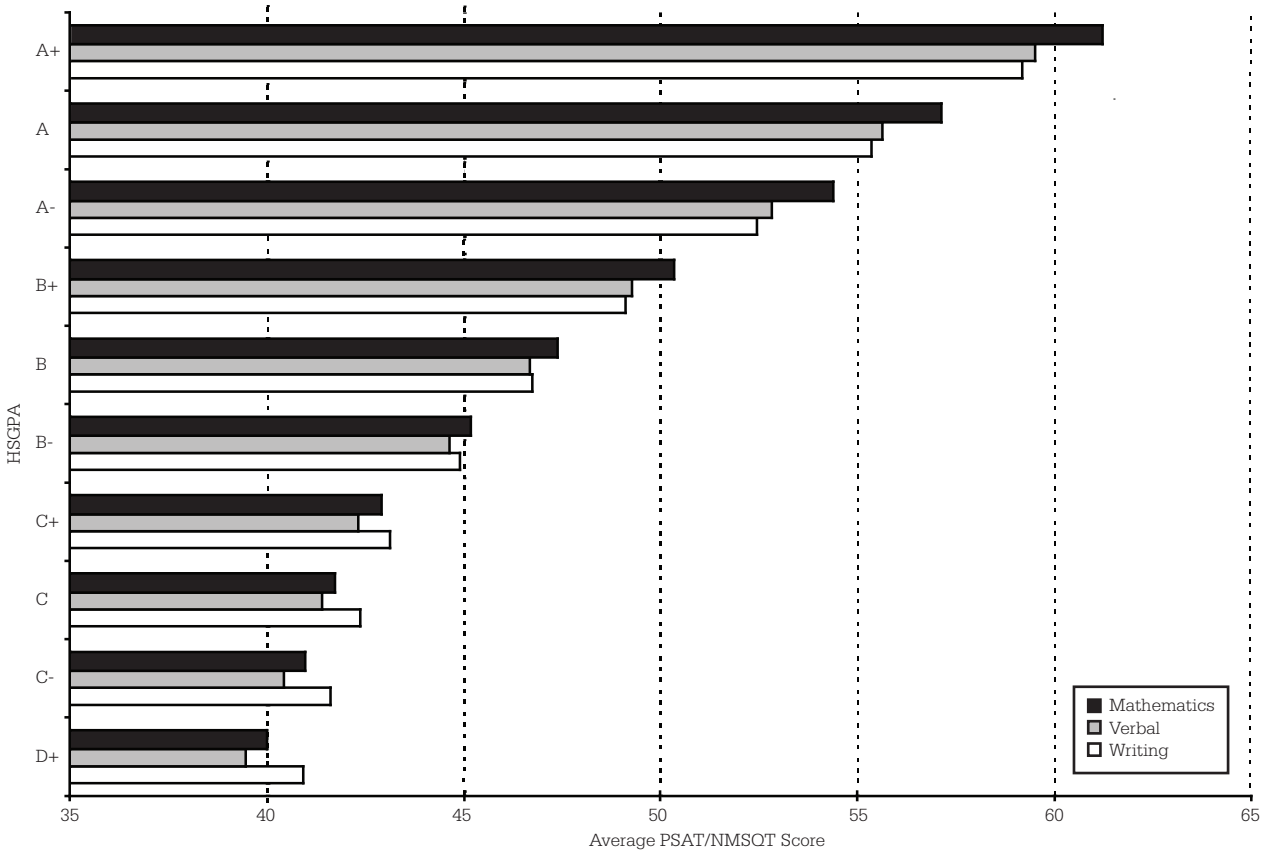

Figure 2. Mean verbal, mathematics, and writing PSAT/NMSQT scores by self-reported high school grade point average (HSGPA).

increases at the top of the HSGPA range. For example, students with an HSGPA equivalent to an A+ had a mean PSAT/NMSQT composite score that was 11.8 points higher than the mean for the students with an HSGPA equivalent to an A; whereas students with an HSGPA equivalent to a C- had a mean composite score that was only 2.6 points higher than the mean for the students with an HSGPA equivalent to a D+.

An anomaly in the relationship between PSAT/NMSQT scores and HSGPA was observed at the extreme bottom of the HSGPA distribution. Average PSAT/NMSQT scores either stayed the same or decreased as HSGPA units increased from F to D and from D to D+. A likely explanation for this anomalous finding is that mean PSAT/NMSQT scores at the bottom of the HSGPA distribution are unstable, as they are based on small numbers of students. For example, 40 students (0.0 percent) reported an HSGPA equivalent to an F, 279 students (0.0 percent) reported an HSGPA equivalent to a D, and 846 students (0.1 percent) reported an HSGPA equivalent to a D+; in comparison, 142,731 students (16.6 percent) reported an HSGPA equivalent to an A.

The results in Table 7 and Figure 2 suggest that there is a strong positive relationship between PSAT/NMSQT scores and HSGPA. That is, students with high HSGPAs are also likely to have high PSAT/NMSQT scores. The relationship between HSGPA and PSAT/NMSQT scores is probably the result of a combination of factors. For example, students might improve their reasoning skills by studying hard in high school while at the same time earning higher grades. Since students in the current study took the PSAT/NMSQT in their junior year and completed the SAT Questionnaire 6 to 18 months later, this effect would have to take hold by the junior year, which seems reasonable. It is also probably true that high-ability students might naturally earn higher grades in courses and higher scores on tests.

Academic Intensity

Table 6 also provides the correlations between PSAT/NMSQT scores and academic intensity in math and science, academic intensity in humanities and social science, and overall academic intensity (math/science + humanities/social science). The correlations with PSAT/NMSQT scores (by section and for the composite) were medium to large for academic intensity in math and science (r = .45 to .59), medium to large for academic intensity

Table 8

Descriptive Statistics on the PSAT/NMSQT by Academic Intensity

Academic Intensity	n	%	*Verbal*		*Mathematics*		*Writing*		*Composite*	
			M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Academic Intensity: Math and Science										
3	93,651	10.9	60.1	9.7	64.3	8.1	59.3	9.9	183.8	23.9
2	126,602	14.8	55.4	9.6	57.8	8.5	54.9	9.6	168.2	24.0
1	200,633	23.4	51.3	9.5	52.6	8.9	51.0	9.2	154.8	24.0
0	320,112	37.3	46.0	9.7	45.8	9.1	46.4	8.6	138.2	23.9
System Missing	116,377	13.6	48.3	10.0	48.9	9.6	48.3	9.2	145.5	25.3
Academic Intensity: Humanities and Social Science										
3	172,273	20.1	59.0	9.6	59.3	9.5	58.4	9.8	176.6	25.3
2	128,516	15.0	53.7	9.5	54.6	9.8	53.3	9.3	161.6	24.9
1	62,830	7.3	52.0	8.9	53.1	9.3	51.8	8.7	156.9	23.1
0	386,762	45.1	46.2	9.5	47.7	9.9	46.5	8.4	140.4	24.3
System Missing	106,994	12.5	47.3	9.7	48.8	10.0	47.4	8.8	143.4	24.8
Overall Academic Intensity										
6	57,611	6.7	62.5	9.1	65.2	8.0	61.6	9.6	189.3	22.9
5	68,663	8.0	58.7	9.1	60.3	8.4	58.0	9.4	177.0	22.9
4	64,294	7.5	56.2	9.1	57.0	8.5	55.7	9.1	168.8	22.8
3	75,708	8.8	54.0	9.3	54.9	9.2	53.5	9.0	162.3	23.3
2	92,164	10.7	51.2	9.2	52.6	9.2	50.9	8.7	154.7	23.2
1	124,586	14.5	48.7	9.0	50.5	8.9	48.5	8.4	147.7	22.5
0	238,185	27.8	44.3	9.2	44.7	8.9	44.9	7.9	133.8	22.2
System Missing	136,164	15.9	48.5	10.1	49.6	9.9	48.5	9.2	146.7	25.5

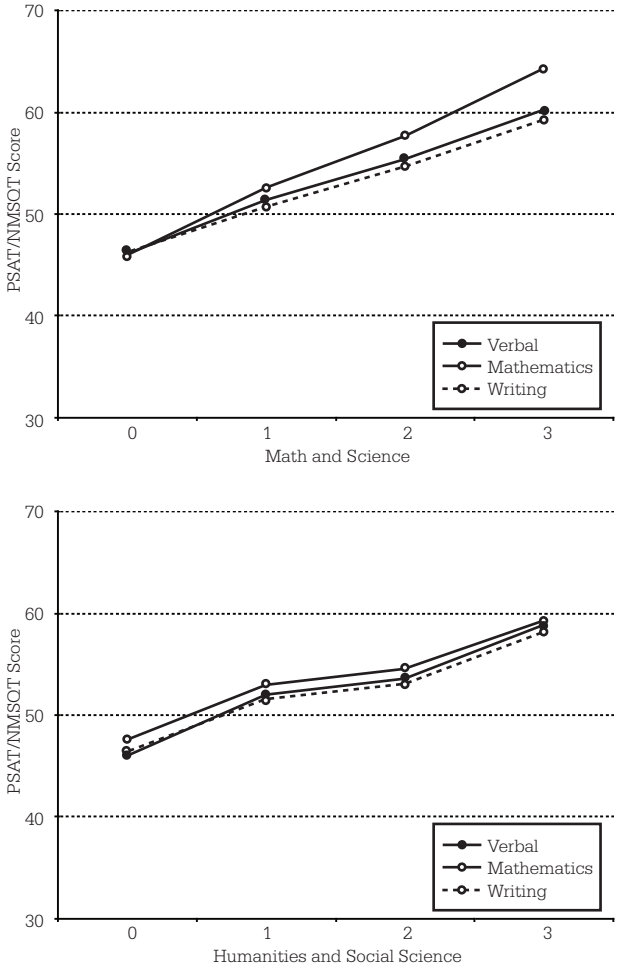

Figure 3. Mean verbal, mathematics, and writing PSAT/NMSQT scores by academic intensity for math and science and humanities and social science.

in humanities and social science (r = .44 to .52), and large for overall academic intensity (r = .53 to .61). Table 8 provides the mean verbal, mathematics, writing, and composite PSAT/NMSQT scores by academic intensity in math/science and humanities/social science and Figure 3 displays this information graphically. Both Table 8 and Figure 3 show a strong positive relationship between academic intensity and PSAT/NMSQT scores. This relationship was also supported by the large multiple correlation between PSAT/NMSQT composite scores and the two academic intensity variables (math/science and humanities/social science), which was .62 (R^2 = .38). Regression weights showed that each indicator of academic intensity provided a unique, nonredundant explanation of the variance associated with composite PSAT/NMSQT scores (see Table 9).

Table 9

Regression Analysis Summary for Academic-Intensity Variables Predicting Composite PSAT/NMSQT Scores

Variable	*B*	*SEB*	*β*
Academic Intensity: Humanities and Social Science	7.2	.03	.31*
Academic Intensity: Math and Science	10.7	.03	.39*

Note: R^2 = .38 (N = 721,211, $p < .01$).
*$p < .01$.

Table 10 shows, for each PSAT/NMSQT scoreband, the percent of students by overall academic intensity score. The results indicate that at the highest scoreband (e.g., 70–80), more than 60 percent of the students had an academic intensity rating of five or six. Conversely, at the lowest scoreband (e.g., 20–29) more than 85 percent of the students had an academic intensity rating of zero or one. This trend was found in every PSAT/NMSQT section. Table 10 also shows, for each PSAT/NMSQT scoreband, the percent of students by number of AP courses taken and by average AP grade. Consistently, across all PSAT/NMSQT sections, the results indicate that students with high PSAT/NMSQT scores tend to take more AP courses and earn higher AP grades.

Figures 4, 5, and 6 show PSAT/NMSQT score distributions for the verbal, mathematics, and writing sections, respectively, by level of overall academic intensity. The distributions show that PSAT/NMSQT scores are negatively skewed (with more frequent scores toward the top of the scale) for students with higher overall academic intensity scores. This means that students with high academic intensity scores tend to also earn high PSAT/NMSQT scores. The figures also show that students most often have an academic intensity score of zero.

Limitations

The current study had several limitations. First, most of the indicators of academic achievement were based on self-reported information from the SAT Questionnaire. Self-reported data usually aren't as accurate as data that are observed firsthand. Several studies, however, have supported the accuracy of these responses (Freeberg, 1988; Freeberg et al., 1989).

Second, students commonly omit questions on the SAT Questionnaire. This means that analyses of different indicators of academic achievement were based on only those who responded to the questionnaire; the number of students who responded to the questionnaire differed by question. In the current study, the proportion of nonrespondents was 16 percent for HSGPA, 20 percent for years of study within an academic area, 16 percent for course participation, and 16 percent for overall academic intensity.

Table 10

Proportion of Students Within PSAT/NMSQT Scoreband by Overall Academic Intensity, AP Participation, and Average AP Grade

PSAT/NMSQT Scoreband	n	*Percent of Cases by Level of Overall Academic Intensity*							*Percent of Cases by No. of AP Courses*					*Average AP Grade*		
		0	*1*	*2*	*3*	*4*	*5*	*6*	*0*	*1*	*2*	*3*	*≥ 4*	*≤ 3*	*3.01–3.99*	*≥ 4*
PSAT/NMSQT Verbal																
70–80	35,846	3.0	5.1	6.4	10.0	13.3	23.6	38.5	12.5	9.5	11.4	11.8	54.9	13.3	22.6	64.0
60–69	139,918	8.4	10.1	11.8	14.4	15.4	20.2	19.8	25.1	16.1	14.5	12.8	31.5	42.0	26.3	31.6
50–59	270,904	23.0	18.3	15.9	13.6	11.5	10.9	6.9	48.9	18.9	12.1	8.0	12.1	74.2	12.9	12.8
40–49	280,570	45.5	22.0	13.0	8.2	5.4	4.1	1.8	72.8	13.9	6.4	3.3	3.6	88.0	4.1	7.9
30–39	108,170	64.2	17.7	9.0	4.5	2.5	1.5	0.6	84.5	9.4	3.4	1.4	1.3	84.9	2.3	12.8
20–29	21,967	73.6	13.2	7.3	3.5	1.3	0.8	0.3	88.2	7.7	2.5	0.9	0.7	75.6	2.6	21.8
PSAT/NMSQT Mathematics																
70–80	43,362	1.6	4.6	6.6	10.0	10.2	22.4	44.6	9.8	9.6	11.0	12.4	57.2	19.2	24.5	56.2
60–69	163,020	7.6	12.3	13.0	13.6	14.9	20.3	18.4	27.0	17.2	14.9	12.3	28.6	49.0	23.3	27.7
50–59	282,695	24.6	20.5	15.8	13.2	11.4	9.8	4.7	52.8	18.5	11.4	7.3	10.0	75.2	11.8	13.0
40–49	254,352	49.1	21.0	12.7	8.3	5.0	3.1	0.8	74.8	13.5	5.9	3.0	2.9	87.0	4.3	8.7
30–39	99,944	70.3	14.5	8.1	4.2	1.8	0.9	0.2	86.7	8.4	2.9	1.1	0.9	85.8	1.8	12.5
20–29	14,002	79.7	10.6	5.8	2.6	0.8	0.3	0.1	91.3	6.0	1.7	0.5	0.5	79.8	2.0	18.1
PSAT/NMSQT Writing																
70–80	36,005	2.9	5.2	6.5	10.2	13.5	24.1	37.7	12.5	9.9	11.3	12.4	53.9	16.4	23.0	60.6
60–69	118,765	8.5	9.9	11.8	14.2	15.6	20.3	19.8	25.2	15.9	14.6	12.8	31.5	42.7	25.5	31.8
50–59	254,529	22.0	17.5	15.4	13.7	11.8	11.7	8.0	47.1	18.5	12.3	8.3	13.8	69.6	14.9	15.5
40–49	327,954	43.8	21.3	13.3	8.7	5.8	4.7	2.4	70.4	14.5	6.9	3.7	4.5	84.5	6.0	9.6
30–39	116,805	64.3	17.9	8.7	4.5	2.4	1.6	0.6	84.7	9.3	3.3	1.5	1.2	85.8	2.4	11.8
20–29	3,317	76.7	13.0	6.2	2.4	1.2	0.5	0.0	91.0	6.4	1.6	0.8	0.2	83.3	2.3	14.4

Note: Percentages by average AP grade pertain only to those students in this sample who actually took an AP course (n = 370,321). Percentages by overall academic intensity pertain only to those who provided enough information to determine their overall academic-intensity score (n = 721,211).

Third, the HSGPA of students within some schools might have been inflated, which would have produced noise in the data. Grade inflation refers to an increase in grades not associated with increases in other academic areas (e.g., test scores). Camara, Kimmel, Scheuneman, and Sawtell (2003) reported that "average grades in 2002 have far exceeded average grades reported in 1976 (3.31 versus 3.00), while SAT mathematics scores are only slightly higher today (516 versus 507) and verbal scores are lower (506 versus 514)" (p. 44). Grade inflation, if present in the current sample, would have artificially reduced the relationships between HSGPA and PSAT/NMSQT scores.

Fourth, correlations between HSGPA, academic intensity, and PSAT/NMSQT scores were not corrected for sampling error, range restriction, or predictor/criterion unreliability. Corrections for the bias associated with these factors will be addressed in a future study in which correlations between HSGPA and PSAT/NMSQT scores will be computed using a meta-analytic approach. That is, for the full population of College-Bound Juniors, correlations between HSGPA and PSAT/NMSQT scores will be computed within each high school, statistically corrected, weighted by the number of PSAT/NMSQT takers in the school, and averaged over all of the schools in the sample. This future study will be conducted with the 2005 College-Bound Juniors, which was composed of more than 1.4 million students from more than 20,000 schools. In addition to computing HSGPA and PSAT/NMSQT scores for the total group, this future study will also compute these correlations by gender, ethnic, and best language subgroups. These analyses will be conducted to provide a more accurate estimate of the correlation between HSGPA and PSAT/NMSQT scores and to evaluate whether the relationship between these variables differs between demographic subgroups.

Fifth, a ceiling effect on academic intensity, AP participation, and average AP grades will be present for students whose schools offer no or few AP courses. This ceiling effect will artificially restrict the correlations between academic intensity and PSAT/NMSQT scores.

Sixth, analyses of the relationships between PSAT/NMSQT scores and indicators of academic achievement were limited to only those students who

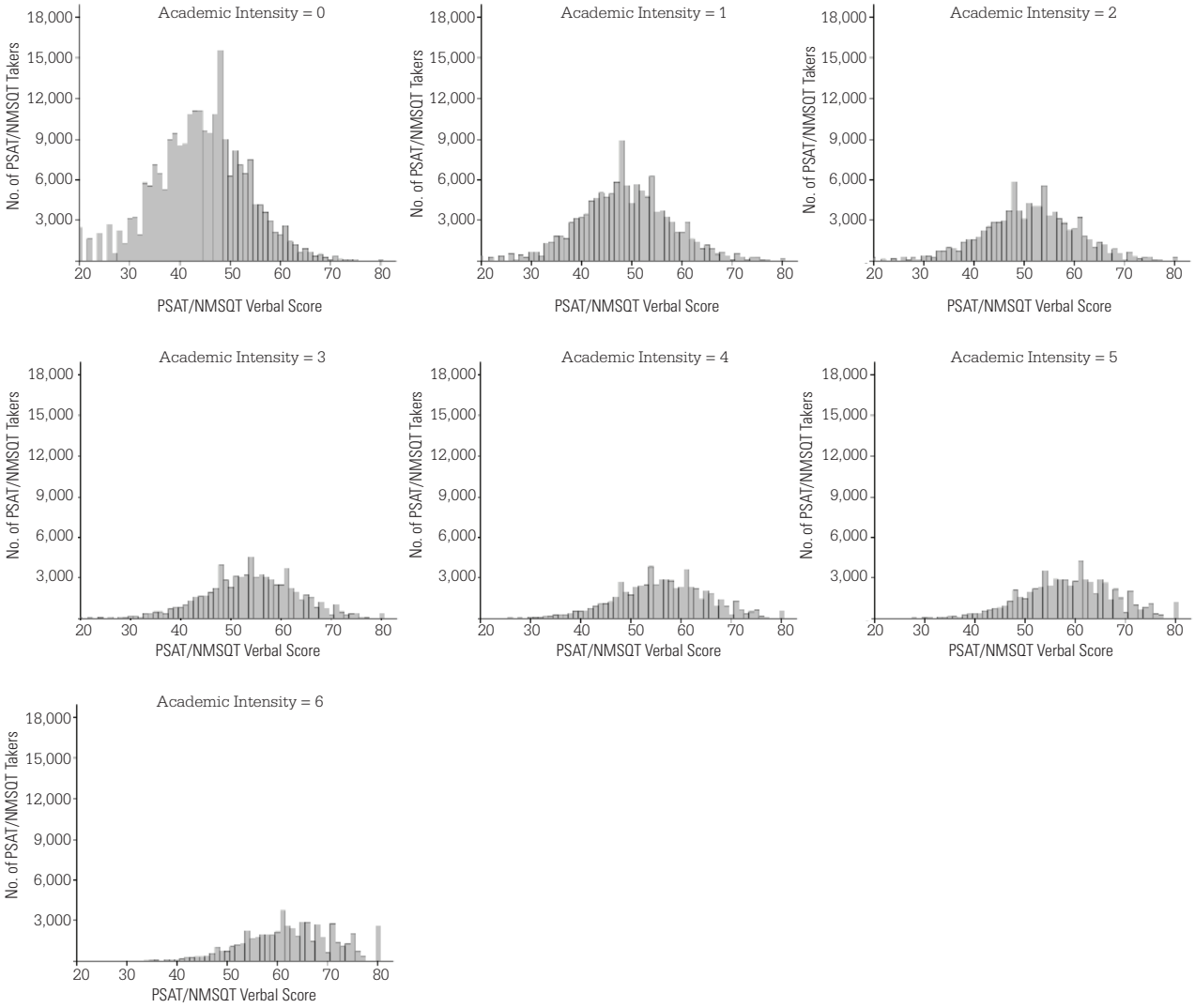

Figure 4. PSAT/NMSQT verbal histograms by level of overall academic intensity.

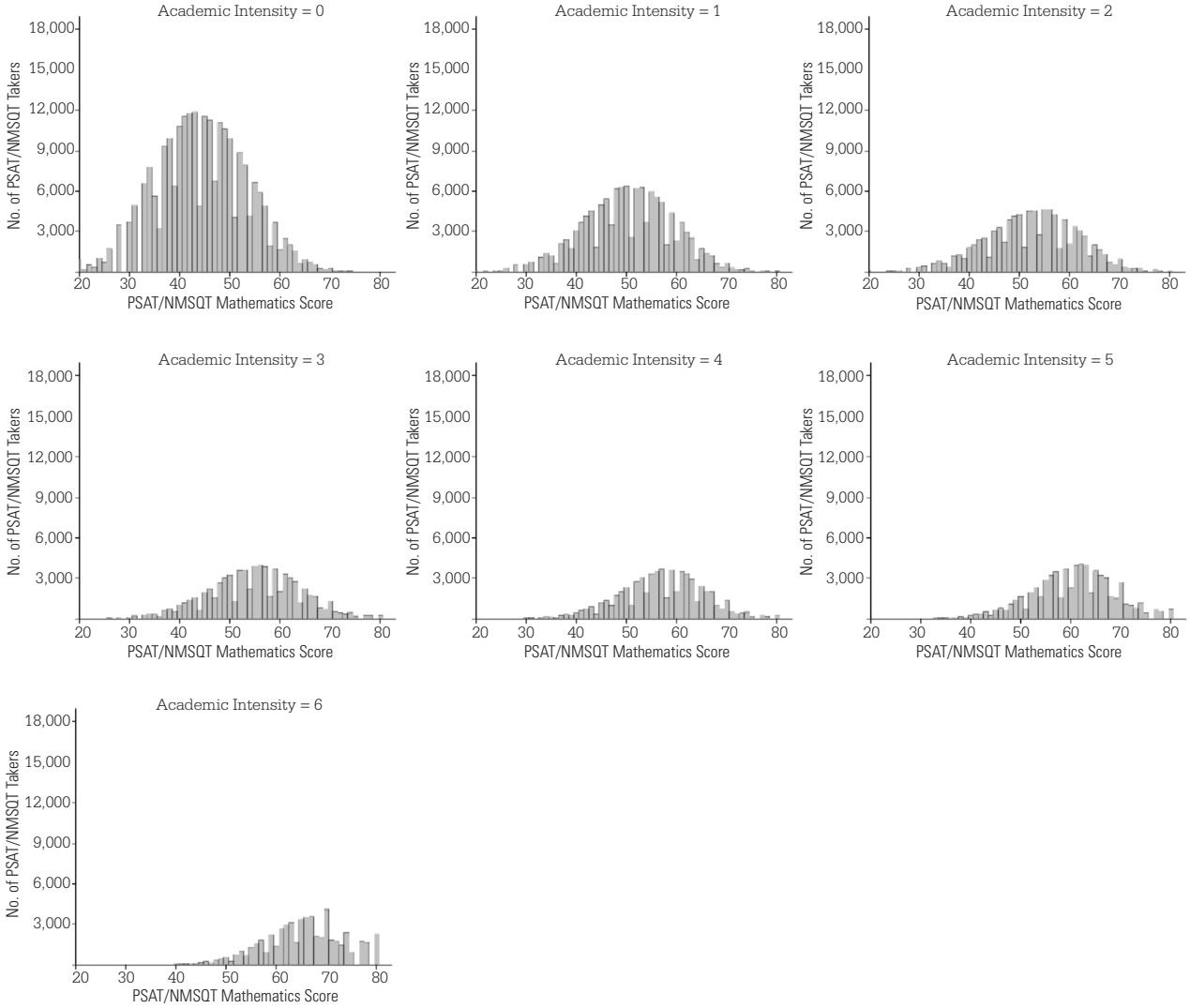

Figure 5. PSAT/NMSQT mathematics histograms by level of overall academic intensity.

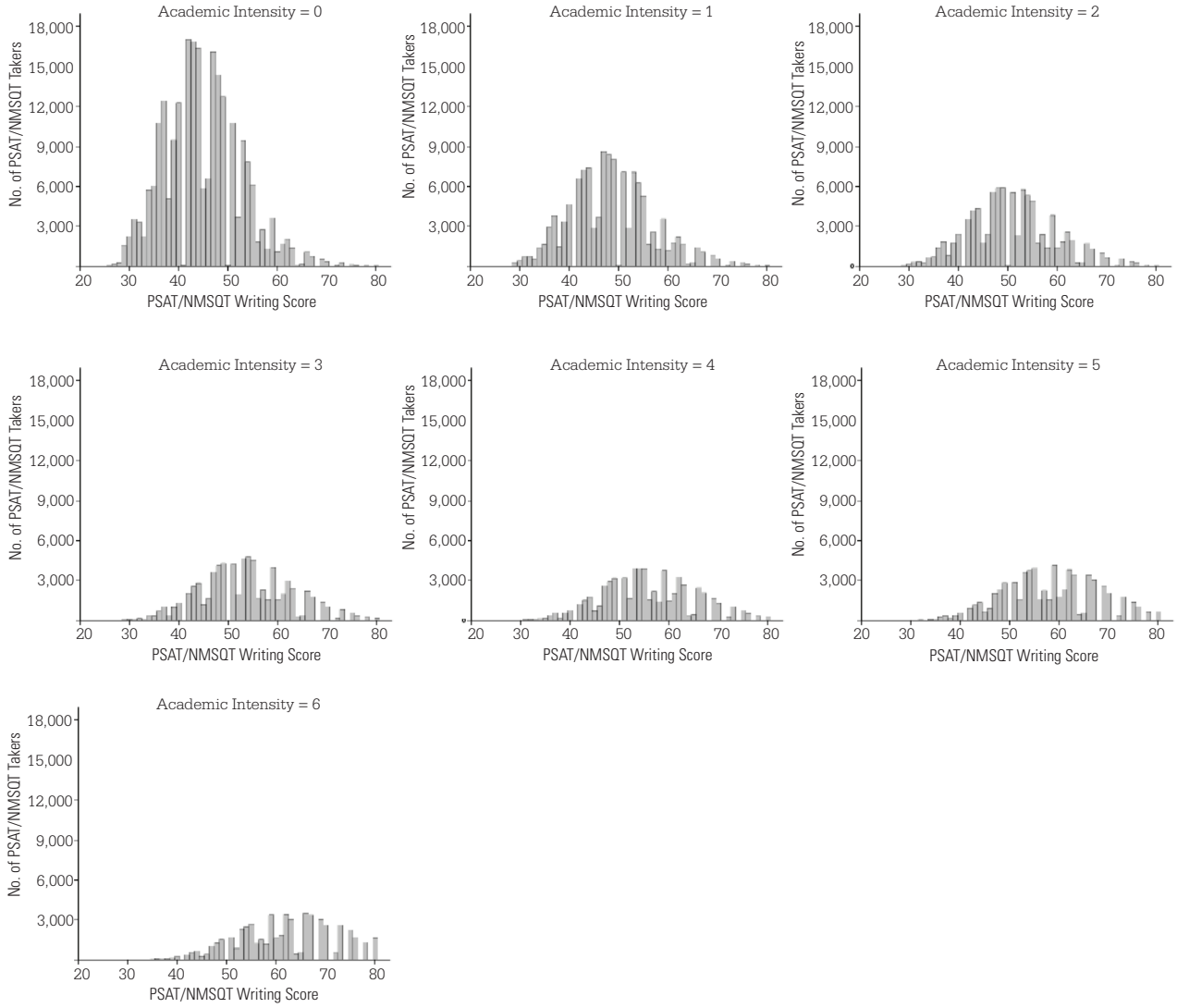

Figure 6. PSAT/NMSQT writing histograms by level of overall academic intensity.

took the PSAT/NMSQT as juniors and the SAT as seniors. These students represent approximately 65 percent of the 2002 College-Bound Seniors. A comparison revealed that the current sample has slightly higher PSAT/NMSQT scores than the 2000 College-Bound Juniors, and it is possible that the current sample is also different from the population in other meaningful ways. These potential differences may have affected the results of this study.

Seventh, the relationships reported in the current study do not necessarily imply that greater academic achievement in high school causes students to earn higher PSAT/NMSQT scores. Instead, the current study simply shows that moderate to strong relationships between indicators of academic achievement and PSAT/NMSQT scores can be demonstrated empirically. It is possible that greater high school achievement causes higher PSAT/NMSQT scores, and it is also possible that both high school achievement and PSAT/NMSQT scores are caused by a third variable such as general cognitive ability. To sort out the cause of the effects observed in this study, one could examine whether the relationship between high school achievement and PSAT/NMSQT scores changed markedly after the variance accounted for by a good measure of cognitive ability (administered, say, in the eighth grade) was partialed out. Alas, such data were not available at the time of this study so the cause of the observed effects is not clear.

Conclusions

The current study showed that moderate to strong relationships exist between PSAT/NMSQT scores and several indicators of academic achievement in high school including: high school grade point average, years of study within an academic area, rigorous course participation, academic intensity, and participation/performance in AP courses. The strongest relationships were observed between PSAT/NMSQT composite scores and academic intensity in math/science and humanities/social science (multiple correlation of .62), self-reported HSGPA (correlation of .53), and taking more than four years of study in an academic area or participating in an honors course (differences in PSAT/NMSQT composite scores between students who took these courses and those who did not were as high as 15 points on the 20-to-80 PSAT/NMSQT score scale). The current study supports the hypothesis that PSAT/NMSQT scores are reflective of academic achievement in high school, which provides important validity evidence for the NMSC's use of the PSAT/NMSQT.

References

Adelman, C. (1999). *Answers in the tool box: Academic intensity, attendance patterns, and bachelor's degree attainment*. Washington, DC: U.S. Department of Education.

Bridgeman, B., Pollack, J., & Burton, N. (2004). *Understanding what SAT Reasoning Test scores add to high school grades: A straightforward approach.* (College Board Research Report No. 2004-4). New York: The College Board.

Camara, W., Kimmel, E., Scheuneman, J., & Sawtell, E. A. (2003). *Whose grades are inflated?* (College Board Research Report No. 2003-4). New York: The College Board.

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd edition). Hillsdale, NJ: Lawrence Erlbaum Associates.

The College Board (2005). *2005 College-Bound Seniors: Total group profile report.* New York: The College Board.

The College Board. (2003a). *PSAT/NMSQT: Understanding 2003 scores.* New York: The College Board.

The College Board. (2003b). *Register for the SAT.* New York: The College Board.

Freeberg, N. E. (1988). *Analysis of the revised Student Descriptive Questionnaire, phase I: Accuracy of student-reported information.* (College Board Research Report No. 88-5). New York: The College Board.

Freeberg, N. E., Rock, D. A., & Pollack, J. (1989). *Analysis of the revised Student Descriptive Questionnaire, phase II: Predictive validity of academic self-report.* (College Board Research Report No. 89-8). New York: The College Board.

PSAT/NMSQT 2000 State Summary Reports: College-Bound Juniors. Retrieved May 17, 2004, from http://www.collegeboard.com/researchdocs/2000_psat_pdf.html.

Appendix A: Mean Verbal, Mathematics, Writing, and Composite PSAT/NMSQT® Scores by Intended College Major

			Verbal		*Mathematics*		*Writing*		*Composite*	
Intended College Major	**n**	**%**	***M***	***SD***	***M***	***SD***	***M***	***SD***	***M***	***SD***
Agriculture and Natural Resources	6,795	0.8	48.3	9.7	48.4	9.5	48.0	9.1	144.8	24.8
Architecture and Environmental Design	12,480	1.5	48.1	10.1	51.1	10.1	48.5	9.4	147.8	26.3
Arts: Visual and Performing	51,684	6.0	51.0	10.6	50.0	10.2	51.1	10.0	152.1	27.5
Biological (Life) Science	37,499	4.4	53.7	10.6	54.4	10.6	53.1	10.2	161.2	28.3
Business and Commerce	87,751	10.2	48.3	10.0	50.8	10.3	48.5	9.2	147.7	26.2
Communications	31,388	3.7	51.5	9.8	50.1	9.7	51.7	9.6	153.2	25.9
Computer and Information Science and Technologies	41,421	4.8	50.1	11.4	53.5	11.6	49.4	10.2	153.0	30.1
Education	57,834	6.7	47.5	9.6	47.9	9.5	48.2	8.9	143.6	24.7
Engineering and Engineering Technologies	59,938	7.0	52.1	10.7	56.9	10.7	51.3	10.1	160.3	28.4
Foreign and Classic Languages	4,038	0.5	55.8	11.2	54.0	10.3	56.1	11.0	165.8	29.4
General and Interdisciplinary Studies	2,482	0.3	54.7	11.6	53.5	10.8	54.3	11.1	162.5	30.4
Health Professions and Allied Services	98,098	11.4	49.0	10.4	50.3	10.7	49.4	9.6	148.7	27.6
Home Economics	1,970	0.2	45.7	9.7	46.5	10.0	46.9	8.6	139.1	25.0
Language and Literature	9,917	1.2	59.8	10.4	54.5	10.0	59.3	10.6	173.5	27.9
Library and Archival Science	153	0.0	55.6	11.3	50.0	9.7	54.2	10.4	159.8	28.2
Mathematics	5,345	0.6	54.2	11.1	61.7	10.0	54.3	10.9	170.2	29.1
Military Science	2,969	0.3	50.7	10.0	51.4	9.8	49.1	9.2	151.3	25.6
Philosophy, Religion, and Theology	4,207	0.5	55.3	10.8	54.3	10.4	54.4	10.5	163.9	28.4
Physical Science	10,069	1.2	55.8	11.0	57.9	10.9	54.8	10.7	168.5	29.6
Public Affairs and Services	14,540	1.7	46.1	10.4	46.2	10.0	46.7	9.2	139.0	26.5
Social Science and History, General	68,719	8.0	52.5	10.8	51.1	10.5	52.0	10.2	155.6	28.5
Technical and Vocational	4,729	0.6	44.1	9.6	45.9	9.6	44.6	8.4	134.6	24.0
Undecided	45,608	5.3	51.6	11.1	53.0	10.9	51.5	10.5	156.1	29.4
No Response	197,741	23.1	50.3	10.9	51.5	10.9	50.3	10.2	152.1	28.7

Appendix B: Number and Percent of Test-Takers by Years of Study Within an Academic Area

	Years of Study								
Academic Area	***None***	***1/2***	***1***	***2***	***3***	***4***	***More Than 4***	***Honors***	***No Response***
Arts and Music	79,028 (9.2)	41,230 (4.8)	181,412 (21.2)	117,223 (13.7)	79,347 (9.3)	114,932 (13.4)	55,055 (6.4)	64,081 (7.5)	189,148 (22.1)
English	452 (0.1)	252 (0.0)	1,229 (0.1)	9,657 (1.1)	108,853 (12.7)	514,131 (60.0)	52,535 (6.1)	294,047 (34.3)	170,266 (19.9)
Foreign and Classical Languages	12,039 (1.4)	3,743 (0.4)	23,667 (2.8)	196,928 (23.0)	234,132 (27.3)	159,650 (18.6)	60,219 (7.0)	168,033 (19.6)	166,997 (19.5)
Math	706 (0.1)	307 (0.0)	1,874 (0.2)	17,408 (2.0)	158,342 (18.5)	361,236 (42.1)	149,452 (17.4)	254,918 (29.7)	168,050 (19.6)
Natural Science	3,680 (0.4)	897 (0.1)	10,315 (1.2)	59,294 (6.9)	256,895 (30.0)	285,904 (33.3)	66,804 (7.8)	252,385 (29.4)	173,586 (20.2)
Social Science and History	1,982 (0.2)	935 (0.1)	7,627 (0.9)	49,664 (5.8)	221,406 (25.8)	314,129 (36.6)	90,820 (10.6)	260,289 (30.4)	170,812 (19.9)

Note: Percentages are presented in parentheses. The "Honors" column represents the total number (and total percent) of test-takers who participated in an honors course.


CollegeBoard
connect to college success™