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Validity of SAT® for Predicting First-Semester, Domain-Specific Grades

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Abstract

In May 2019, College Board published the first national operational SAT® validity study on the new SAT introduced in 2016. Based on data from more than 221,000 students across 169 four-year colleges and universities, the study showed that the SAT was essentially as effective as high school grades in predicting students' college performance and that these two measures, when combined, offer a more accurate understanding of student performance than either measure used alone.

The current study extends the College Board's validity research on the new SAT. Using data from 221,300 students enrolled at 169 four-year colleges and universities, we examined relationships between SAT section scores, test scores, cross-test scores, and subscores with domain-specific course grades earned in college. Results of this study show a strong, positive relationship between SAT scores and grades in matching college course domains, suggesting that the SAT is sensitive to instruction in English language arts, math, science, and history/social studies. On their own and combined with high school GPA (HSGPA), SAT scores provide valuable information for colleges and universities as they make admission and course placement decisions. These scores also allow institutions to identify students who can benefit from additional academic support as they enter college and can inform important conversations with students about course selection and choice of major based on students' academic strengths and weaknesses.

Introduction

College Board designed the new SAT introduced in 2016 as an academic achievement measure to identify students' academic preparedness for postsecondary studies. Specifically, the new SAT reflects the work that students do in high school, focusing on the core knowledge and skills that research has shown to be critical for students to be ready for college and career.[1] Scholarly research and empirical data derived from secondary and postsecondary curriculum surveys conducted by College Board and other organizations, as well as research indicating what is most essential for college readiness and success formed the evidentiary foundation for specifying the test content and domains of interest (College Board, 2017). The SAT includes the Evidence-based Reading and Writing section, the Math section, and an optional Essay section.[2]

The current study focuses on the SAT section scores, test scores, cross-test scores, and subscores. The SAT reports two section (domain) scores: (1) Evidence-Based Reading and Writing (ERW), which is the sum of the Reading Test score and the Writing and Language Test score multiplied by 10, and (2) Math, which is the Math Test score multiplied by 20. Each of the two section scores is reported on a scale ranging from 200 to 800. The SAT reports three test scores in the range of 10–40; (1) Reading, (2) Writing and Language, and (3) Math. The SAT reports two cross-test scores in the range of 10–40: (1) Analysis in History/ Social Studies and (2) Analysis in Science, which are based on selected questions in the SAT Reading, Writing and Language, and Math Tests. The SAT also reports seven subscores for curricular purposes, to help identify students' strengths and weaknesses and pinpoint areas of development. These subscores, reported in the range of 1-15, include Command of Evidence and Words in Context (both based on the Reading Test as well as the Writing and Language Test), Expression of Ideas and Standard English Conventions (both based on the Writing and Language Test), and Heart of Algebra, Problem Solving and Data Analysis, and Passport to Advanced Math (all based on the Math Test).

As noted above, College Board aimed to make the new SAT an assessment that reflects the work that students need to do to be ready for and successful in college and the workplace. The purpose of this study is to seek evidence that the SAT does reflect this work by examining the predictive validity of the SAT scores in domain-specific courses. The analyses that follow examine the relationships between SAT section, test, cross-test scores, and subscores with nine corresponding first semester outcomes: English GPA, Reading GPA, Writing and Language GPA, Math GPA, History/Social Studies GPA, Science GPA, Heart of Algebra GPA, Problem Solving and Data Analysis GPA, and Passport to Advanced Math GPA.

[1] More information on the development of the SAT can be found in *Test Specifications for the Redesigned SAT®* (College Board, 2015) and *SAT® Suite of Assessments Technical Manual: Characteristics of the SAT* (College Board, 2017).

[2] Validity evidence for the SAT Essay section can be found in *Validity of SAT® Essay Scores for Predicting First-Year Grades* (Marini et al., 2019).

SAT Score Relationships with First Semester, Domain-Specific Grades

Methodology

Sample

College Board broadly recruited four-year institutions with at least 250 first-year students (at least 75 of whom had to have SAT scores) to participate in this study. These institutions provided data through College Board's secure online Admitted Class Evaluation Service (ACES™) system. Ultimately, 169 institutions provided the complete student-level information needed for the analyses that follow in this section of the report.

Table 1 includes the characteristics of the institutions in the sample and shows that the sample is quite diverse regarding region of the United States, control (public/private), selectivity, and size. Compared to the population[3] of four-year institutions for this study, the institutional study sample included more public institutions, more "selective" institutions, and more "large" and "very large" institutions than the reference population. This is to be expected, as there was a sample size minimum to participate in the study, and more-selective institutions rather than less-selective institutions would be more apt to use the SAT and therefore to be interested in examining the relationship between the SAT and college outcomes.

[3] The population included four-year public or private nonprofit institutions that accepted 90% or fewer applicants for admission.

Table 1: Institutional Characteristics of the 2017 SAT Validity Study Sample and Population of Four-Year Institutions

	Variable	**Sample (*k*=169)**	**Reference Population of Institutions (*k*=1,230)**
U.S. Region	Midwest	35 (21%)	343 (28%)
	Mid-Atlantic	31 (18%)	246 (20%)
	New England	22 (13%)	119 (10%)
	South	28 (17%)	277 (23%)
	Southwest	19 (11%)	90 (7%)
	West	34 (20%)	155 (13%)
Control	Public	81 (48%)	417 (34%)
	Private	88 (52%)	813 (66%)
Admittance Rate	Under 25%	20 (12%)	57 (5%)
	25% to 50%	30 (18%)	211 (17%)
	51% to 75%	71 (42%)	651 (53%)
	Over 75%	48 (28%)	311 (25%)
Undergraduate Enrollment	Small	67 (40%)	761 (62%)
	Medium	29 (17%)	202 (16%)
	Large	30 (18%)	136 (11%)
	Very Large	43 (25%)	131 (11%)

Note. *k* = number of institutions. Percentages may not sum to 100 due to rounding. Undergraduate enrollment was categorized as follows: small: 4,999 or less; medium: 5,000 to 9,999; large: 10,000 to 19,999; and very large: 20,000 or more.

Inclusion in the study sample required students to have new SAT scores, a valid self-reported high school GPA (HSGPA), and a valid domain-specific course grade (or grades) supplied by the institution. This resulted in a sample size of 221,300 students. See Table 2 for more information about the characteristics of the student sample and the population of 2017 graduating seniors who took the new SAT. Compared to the population, the study sample, which included students who were enrolled in college, has slightly more female students, slightly more white students and fewer black or African American students, and more students whose highest parental education level was a bachelor's degree or higher than was the case in the overall SAT-taking population.

Table 2: Student Characteristics of the 2017 SAT Validity Study Sample and 2017 Graduating Seniors with SAT Scores

	Variable	Sample (*n*=221,300)	2017 Graduating Seniors who took the SAT (*N*=1,715,481)
Gender	Male	95,798 (43%)	809,462 (47%)
	Female	125,502 (57%)	906,019 (53%)
Race/Ethnicity	American Indian or Alaska Native	656 (<1%)	7,782 (<1%)
	Asian	24,645 (11%)	158,031 (9%)
	Black or African American	15,719 (7%)	225,860 (13%)
	Hispanic or Latino	46,397 (21%)	408,067 (24%)
	Native Hawaiian or Other Pacific Islander	317 (<1%)	4,131 (<1%)
	White	121,961 (55%)	760,362 (44%)
	Two or More Races	8,446 (4%)	57,049 (3%)
	Not Stated	3,159 (1%)	94,199 (5%)
Highest Parental Education Level	No High School Diploma	12,653 (6%)	137,437 (8%)
	High School Diploma	47,514 (21%)	482,194 (28%)
	Associate Degree	15,493 (7%)	134,451 (8%)
	Bachelor's Degree	79,534 (36%)	473,103 (28%)
	Graduate Degree	62,910 (28%)	339,743 (20%)
	Not Stated	3,196 (1%)	148,553 (9%)

Measures

High School GPA (HSGPA). Students' self-reported HSGPA was obtained from the SAT Questionnaire when they registered for the SAT and is reported on a 12-point interval scale ranging from 0.00 (F) to 4.33 (A+). Institution-provided HSGPA could not be used in this national study because it is reported on so many different scales across institutions. Note that the inclusion of self-reported HSGPA is consistent with previous admission test validity studies (e.g. Mattern & Patterson, 2014; Sawyer, 2013), and studies have found self-reported HSGPA to be highly correlated with actual HSGPA (Kuncel, Credé, & Thomas, 2005; Shaw & Mattern, 2009). In the class of 2017, 93% of the SAT-taking population reported their HSGPA. The HSGPA measure in this study had a sample mean of 3.67 (SD=0.48).

SAT Scores. SAT scores were obtained from College Board's database and matched to each student provided in the institution files. The SAT scores included in this study are:

> **SAT Evidence-Based Reading and Writing (ERW) Section Score (200 to 800 scale)**—increments of 10, sample mean of 596 (SD=83). The ERW section consists of 96 items, 52 from the Reading Test and 44 from the Writing and Language Test.

SAT Math Section Score (200 to 800 scale)—increments of 10, sample mean of 591 (SD=93). The Math section consists of 58 items. Additional details are provided below under SAT Math Test Score.

SAT Reading Test Score (10 to 40)—increments of 1, sample mean of 30 (SD=4). The Reading Test focuses on the assessment of students' comprehension and reasoning skills in relation to appropriately challenging prose passages (sometimes paired or associated with one or more informational graphics) across a range of content areas.

SAT Writing and Language Test Score (10 to 40)—increments of 1, sample mean of 30 (SD=4). The Writing and Language Test focuses on the assessment of students' revising and editing skills in the context of extended prose passages (sometimes associated with one or more informational graphics) across a range of content areas.

SAT Math Test Score (10 to 40)—increments of 0.5, sample mean of 30 (SD=4). The overall aim of the SAT Math Test is to assess students' fluency with, understanding of, and ability to apply the mathematical concepts, skills, and practices that are most strongly prerequisite for and useful across a range of college majors and careers. The Math Test (MTS) scale scores are derived from the rounded Math section scale scores (MSS).

SAT Analysis in History/Social Studies Cross-Test Score (10 to 40)—increments of 1, sample mean of 30 (SD=4). SAT Analysis in History/Social Studies cross-test scores are intended to be used to report on students' achievement in applying the core skills within Reading, Writing and Language, and Math to specific history and social studies contexts.

SAT Analysis in Science Cross-Test Score (10 to 40)—increments of 1, sample mean of 30 (SD=4). SAT Analysis in Science cross-test scores are intended to be used to report on students' achievement in applying the core skills within Reading, Writing and Language, and Math to specific science contexts.

SAT Command of Evidence Subscore (1 to 15)—increments of 1, sample mean of 10 (SD=2). Scores are derived from questions on the Reading Test and the Writing and Language Test.

SAT Words in Context Subscore (1 to 15)—increments of 1, sample mean of 11 (SD=2). Scores are derived from questions on the Reading Test and the Writing and Language Test.

SAT Expression of Ideas Subscore (1 to 15)—increments of 1, sample mean of 11 (SD=2). Scores are derived from questions on the Writing and Language Test.

SAT Standard English Conventions Subscore (1 to 15)—increments of 1, sample mean of 10 (SD=3). Scores are derived from questions on the Writing and Language Test.

SAT Heart of Algebra Subscore (1 to 15)—increments of 1, sample mean of 10 (SD=2). Scores are derived from questions on the Math Test.

SAT Passport to Advanced Math Subscore (1 to 15)—increments of 1, sample mean of 10 (SD=3). Scores are derived from questions on the Math Test.

SAT Problem Solving and Data Analysis Subscore (1 to 15)—increments of 1, sample mean of 10 (SD=3). Scores are derived from questions on the Math Test.

Domain-Specific First Semester College Grades. Each institution provided domain-specific first semester course grade values for their 2017 first-time, first-year students. The domain-specific grades across the 169 institutions in this sample ranged from 0.00 to 4.33. Not all students received domain-specific grades because student course selection varies. For example, students may choose not to take a math course, so they do not have a Math GPA. In most instances, students had one grade for one domain. However, when students had more than one course grade in a domain, the grades were averaged. GPAs associated with the three SAT Math subscores (Heart of Algebra, Problem Solving and Data Analysis, and Passport to Advanced Math) were the narrowest domain-specific outcomes and were almost always associated with one course grade. Domain-specific grades and information regarding how courses were selected and assigned to the outcome measures included in the study follow and were arrived at in collaboration with subject matter experts on College Board's Assessment Design and Development team.

English and Writing GPA (EWGPA)—This outcome measure was constructed using course grades that were aligned with both the SAT Reading and SAT Writing and Language Tests. Any course that met the inclusion criteria for Reading GPA or Writing and Language GPA was included in EWGPA.

Reading GPA (RGPA)—This outcome measure was constructed using course grades that were aligned with the SAT Reading Test. General content areas included English, humanities, history, and the social sciences.

Writing and Language GPA (WLGPA)—This outcome measure was constructed using English and writing course grades that were aligned with the SAT Writing and Language Test. However, foreign and classic language courses were excluded, as were developmental English courses, English as a second language courses, and business, technical, and scientific writing courses.

Math GPA (MGPA)—This outcome measure was constructed using course grades that were aligned with the SAT Math Test. General content areas included mathematics and engineering.

History/Social Studies GPA (H/SSGPA)—This outcome measure was constructed using grades from history and social science courses and aligned with relevant content from the SAT Reading Test, SAT Writing and Language Test, and the SAT Math Test.

Science GPA (SGPA)—This outcome measure was constructed using science coursework drawn from science courses relevant to natural sciences, health sciences, and engineering majors, and aligned with relevant content from the SAT Reading Test, SAT Writing and Language Test, and the SAT Math Test.

Heart of Algebra GPA (HOAGPA)—This outcome measure was constructed using course grades in Algebra.

Problem Solving and Data Analysis GPA (PSDGPA)—This outcome measure was constructed using course grades that were aligned with the SAT Problem Solving and Data Analysis subscore (e.g. Quantitative Analysis/Reasoning courses, Statistics, Probability).

Passport to Advanced Math GPA (PAMGPA)—This outcome measure was constructed using course grades that were aligned with the SAT Passport to Advanced Math subscore (e.g. Trigonometry, Algebra, Pre-Calculus).

Dichotomous Measures of Success within a Domain. As noted above, each institution provided college course work information, including grades, for their 2017 first-time, first-year students. Within each institution, when there were data for at least 15 students for an outcome of interest, students were categorized as successful (1) or unsuccessful (0) based on their domain-specific grades. Two outcomes were used: earning a GPA of 2.50 or higher and earning a GPA of 3.00 or higher. The 2.50 GPA criterion was selected as a reasonable threshold for indicating that a student is managing to navigate college-level work and can remain enrolled and progress through college. The 3.00 GPA criterion was selected as the second threshold because the average first-year GPA (FYGPA) of students in the national SAT validity study was 3.03. While average GPA varies across institutions and domains of study, achieving a GPA of 3.00 or higher serves as a general benchmark to ascertain whether students are performing well rather than just getting by in their studies. This higher criterion measure is particularly relevant for students considering graduate school, as researchers have noted that students pursuing master's degrees and doctoral degrees had mean undergraduate GPAs (UGPAs) of 3.00 and 3.40, respectively, and that few students admitted to graduate schools had UGPAs below 2.50 (Burton & Wang, 2005).

Descriptive Statistics

Table 3 includes descriptive statistics for all measures of interest in the sample and for the 2017 SAT-tested graduating seniors. As the sample includes students enrolled in college, it is not surprising that these students are academically stronger than the total SAT test-taking population across all measures. Descriptive statistics are reported for all SAT scores utilized in the study analyses: SAT ERW section, SAT Math section, SAT Reading Test, SAT Writing and Language Test, SAT Math Test, SAT Analysis in History/Social Studies cross-test score, Analysis in Science cross-test score, HSGPA, and domain-specific first semester GPAs. Note that not every student completed courses associated with the domain-specific GPAs in this study, so the number of students varies across the outcome measures.

Table 3: Descriptive Statistics for Measures of Interest

	Study Sample					2017 Graduating Seniors Who Took the SAT				
Measure	*n*	*Mean*	*SD*	*Min*	*Max*	*N*	*Mean*	*SD*	*Min*	*Max*
SAT ERW Section Score	221,300	596	83	200	800	1,715,481	533	100	200	800
SAT Math Section Score	221,300	591	93	200	800	1,715,481	527	107	200	800
SAT Reading Test Score	221,300	30	4	10	40	1,715,481	27	5	10	40
SAT Writing and Language Test Score	221,300	30	4	10	40	1,715,481	26	5	10	40
SAT Math Test Score	221,300	30	5	10	40	1,715,481	26	5	10	40
SAT Analysis in History/ Social Studies Cross-Test Score	221,300	30	4	10	40	1,715,481	27	5	10	40
SAT Analysis in Science Cross-Test Score	221,300	30	4	10	40	1,715,481	27	5	10	40
SAT Command of Evidence Subscore	221,300	10	2	1	15	1,715,481	9	3	1	15
SAT Words in Context Subscore	221,300	11	2	1	15	1,715,481	9	3	1	15
SAT Expression of Ideas Subscore	221,300	11	2	1	15	1,715,481	9	3	1	15
SAT Standard English Conventions Subscore	221,300	10	3	1	15	1,715,481	8	3	1	15
SAT Heart of Algebra Subscore	221,300	10	2	1	15	1,715,481	9	3	1	15
SAT Problem Solving and Data Analysis Subscore	221,300	10	3	1	15	1,715,481	9	3	1	15
SAT Passport to Advanced Math Subscore	221,300	10	3	1	15	1,715,481	9	3	1	15
HSGPA	221,300	3.67	0.48	0.00	4.33	1,594,136	3.33	0.65	0.00	4.33
English and Writing GPA (EWGPA)	189,674	3.05	0.95	0.00	4.33					
Reading GPA (RGPA)	189,458	3.05	0.95	0.00	4.33					
Writing and Language GPA (WLGPA)	132,609	3.13	0.97	0.00	4.33					
Math GPA (MGPA)	138,625	2.73	1.16	0.00	4.33					
History/Social Studies Cross-Test GPA (H/SSGPA)	183,151	2.89	1.00	0.00	4.33					
Science Cross-Test GPA (SGPA)	111,554	2.80	1.03	0.00	4.33					
Heart of Algebra GPA (HOA GPA)	10,362	2.49	1.23	0.00	4.33					
Problem Solving and Data Analysis GPA (PSD GPA)	32,257	2.98	1.07	0.00	4.33					
Passport to Advanced Math GPA (PAM GPA)	20,491	2.47	1.21	0.00	4.33					

Note. Not all 2017 graduating seniors who took the SAT reported their HSGPA. Sample sizes varied for the outcome analyses, but the means and standard deviations for the predictor variables were quite similar across the outcome samples. Additional descriptive statistics for the outcome samples are presented in Appendix A, Table A 1.

Table 4 provides the percentages of students who earned GPAs of 2.50 or higher and 3.00 or higher for the outcome measures aligned with SAT section, test, and cross-test scores. Inclusion in the probability of success analyses required institutions to have at least 15 students with the outcome measure of interest. Consequently, the number of students (*n*) included in the analyses differs somewhat from the number of students reported in Table 3. Also note that the number of institutions (*k*) also varies depending on the analyses. The number of institutions for the WLGPA analyses differs from those for the English GPA and Reading GPA analyses not only because some institutions did not report course grades aligned with WLGPA, but for reasons related to grades awarded. Specifically, at some institutions every student earned a WLGPA of 2.50 or higher, and at some institutions all but one student achieved the measure of success, which led to the statistical model not converging. These institutions were excluded from the analyses.

Table 4: Rates of Success for Dichotomized Outcome Measures

	GPA ≥ 2.50			GPA ≥ 3.00		
First Semester Outcome Measure	*k*	*n*	% Successful	*k*	*n*	% Successful
EWGPA	168	189,663	78%	168	189,663	67%
RGPA	168	189,447	78%	168	189,447	67%
WLGPA	157	132,284	81%	163	132,495	73%
MGPA	167	138,608	64%	167	138,608	57%
H/SSGPA	168	183,141	80%	168	183,141	59%
SGPA	167	111,539	67%	167	111,539	56%

From Table 4, it is also worth noting that the percentage of students meeting the standard of success varies considerably across domains. For example, 73% of students at the institutions included in the Writing and Language analyses earned a GPA of 3.00 or higher but only 64% of students in the Math analyses met the lower threshold of earning a GPA of 2.50 or higher

Methods

We conducted three types of analyses in this study. First, we calculated the average outcome GPA within the corresponding SAT score bands. We used 100-point score bands for section scores and 5-point score bands for test and cross-test scores. We then calculated the average GPA for SAT score bands within HSGPA bands. The average GPAs were calculated across all institutions that had at least 15 students with outcome data. For the subscores, this was the only type of analysis we conducted.[4]

[4] We made this decision for two reasons. First, SAT subscores were introduced for curricular purposes, to help identify students' strengths and weaknesses and pinpoint areas of development (an especially low score on one subscore relative to the other subscores may indicate that a student has a weakness in that area and may need

For the second type of analyses, we conducted logistic regression to predict students' probability of earning a GPA of 2.50 or higher and a GPA of 3.00 or higher. Logistic regression analyses were conducted at each institution with at least 15 students with corresponding outcome data. The institution-level coefficients were weighted by the number of students in the institutional study, and then mean coefficients from the aggregated weights were calculated. These analyses were conducted for SAT section, test, and cross-test scores.

Our third type of analyses were correlational analyses between predictors and the outcomes of interest. Analyses consisted of correlations between the predictors—SAT scores and HSGPA—with the domain-specific GPAs. Raw and adjusted correlations (predictive strength) were calculated between predictors and each domain-specific GPA at the institution level and weighted by the number of students in each institutional analysis. The weighted correlations were summed and then divided by the total number of students across institutions. Correlations were adjusted to account for the selectivity of the student sample.[5] These analyses were conducted for SAT section, test, and cross-test scores. Full correlational results are presented in Appendix B.

Results

As the focus of the study is on domain-specific college outcomes, results will be presented by outcome measure (e.g., EWGPA) rather than by type of analysis (e.g., logistic regression results). For each of the outcomes studied, we present mean GPAs within SAT score bands, followed by mean GPAs by SAT score bands within HSGPA bands. Next, we present graphs showing students' probability of success given their SAT scores and HSGPA, first for achieving a GPA of 2.50 or higher and then for achieving a GPA of 3.00 or

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support.) Furthermore, the College Board has consistently called for the use of multiple measures to predict student outcomes, such as using both SAT scores and high school GPA to predict first-year GPA. As the subscores are but a portion of the SAT tests, colleges and universities would most likely use SAT sections scores and SAT test scores to predict students' academic performances because more information is better than less information. However, we included the subscores in this report to provide evidence that the subscores are valid measures of knowledge that predicts future academic performance. The second reason was the sake of brevity. Though analyses conducted using the subscores were positive—students with higher subscores earn higher grades—the results were largely redundant with the results found using the SAT section and test scores. For example, multiple regression analyses indicated that the joint use of the three math subscores predicted first-semester math GPA as well as the Math Test alone. Including all the results for the subscore analyses would have lengthened the report considerably without adding substantive information.

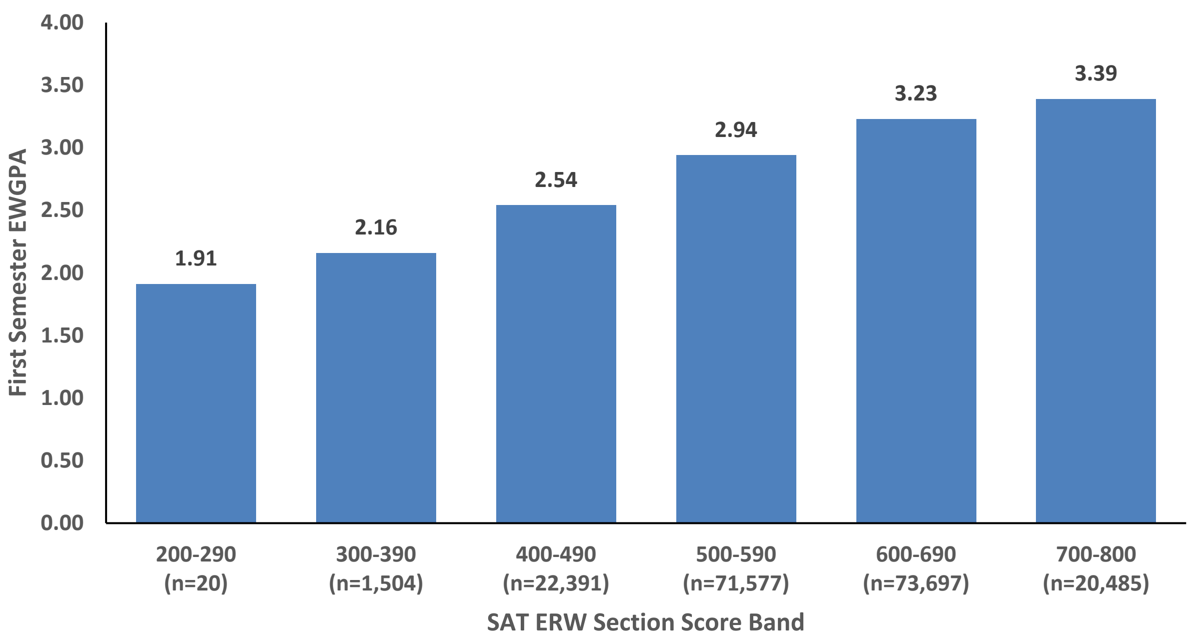
[5] It is a widely accepted practice to statistically correct correlation coefficients in admission validity research for restriction of range because the raw correlation tends to underestimate the true relationship between test scores and college outcome (American Educational Research Association, American Psychological Association, and National Council on Measurement in Education, 2014). Without information on how students who were not admitted or those who did not enroll would have performed at an institution, we gain only a glimpse into how the tests work for selection. This restricts the variability, or range, in test scores available for analysis since the test scores available tend to be the higher scores of students who were admitted, minimizing the test score–criterion relationship. Correlations in this study were corrected for multivariate range restriction (Lawley, 1943) using the 2017 graduating seniors who took the SAT as the reference population.

higher. We then conclude each section by presenting correlational results, including evidence of incremental validity of SAT scores beyond the predictive value of HSGPA.

English and Writing GPA

Figure 1 depicts the mean English and Writing GPA (EWGPA) by SAT ERW section score bands. As SAT ERW scores increase, so do the average EWGPAs. For example, students with SAT ERW section scores between 400 and 490 had a mean EWGPA of 2.54. In contrast, students with SAT ERW scores between 700 and 800 had a mean EWGPA of 3.39, nearly a full letter grade higher than that for the students previously mentioned.

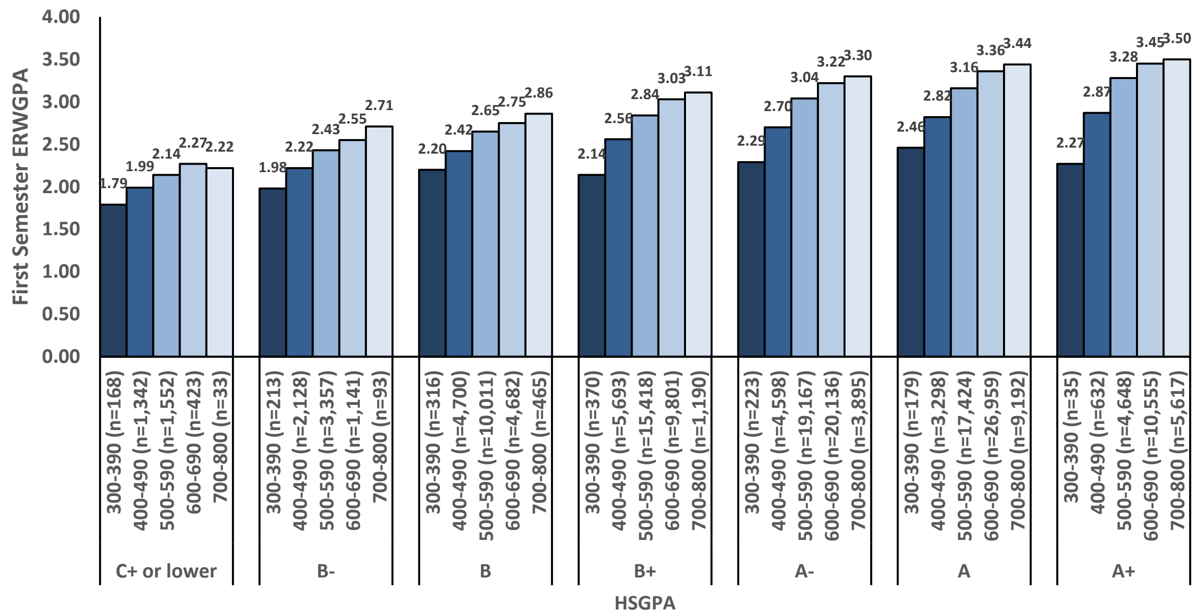
Figure 1: Mean First Semester English and Writing GPA by SAT ERW Section Score Bands



Results are reported for categories with at least 15 students.

Figure 2 communicates the validity of the SAT for predicting EWGPA after controlling for HSGPA. Based on SAT ERW section score bands within each HSGPA category, the relationship between SAT ERW section scores and EWGPA remains positive and increases by SAT ERW section score. Note that as HSGPA increases from C+ or lower to an A+, EWGPA gaps increase between students in the same HSGPA category but in different SAT ERW section score bands. This is especially true for students in the A-, A, and A+ HSGPA categories, which contain approximately two-thirds of the students in the sample. For example, among students with an “A” HSGPA, students with SAT ERW section scores between 400 and 490 had a mean EWGPA of 2.82, but students with SAT ERW section scores between 600 and 690 had a mean EWGPA of 3.36, more than half a letter grade higher than the students with scores between 400 and 490 but in the same HSGPA band. At the ERW score-band extremes for “A” students, those with SAT ERW section scores between 300 and 390 had a mean EWGPA of 2.46, but students with SAT ERW section scores between 700 and 800 had a mean EWGPA of 3.44, nearly a full letter grade difference.

Figure 2: Mean First Semester English and Writing GPA by HSGPA and SAT ERW Section Score Bands



Note. Results are reported for categories with at least 15 students.

As seen in Figure 2 above, combining HSGPA and SAT information reveals additional insights beyond those possible from HSGPA alone regarding student performance and allows institutions to more accurately predict differences in the future academic performances of students with similar HSGPAs. Figure 3 further demonstrates the value of using SAT ERW section scores with HSGPA to estimate students' probabilities of earning an EWGPA of 2.50 or higher in college given their HSGPA and select SAT ERW scores. If SAT ERW section scores added no information to HSGPA information, there would only be one curve on the graph, but that is clearly not the case. For example, a student with a HSGPA of 3.00 and an SAT ERW section score of 500 has approximately a 63% chance of earning an EWGPA of 2.50 or higher, while a student with the same HSGPA (3.00) and an SAT ERW section score of 700 has approximately an 80% chance of earning an EWGPA of 2.50 or higher. Even among students with higher HSGPAs, we see the added value of the SAT in predicting student success in college. The SAT ERW section scores provide meaningful information in predicting a student's probability of earning a 2.50 or higher EWGPA in college at every point on the HSGPA scale.

Figure 3: Probability of a 2.50 or Higher English and Writing GPA Given HSGPA and SAT ERW Section Score

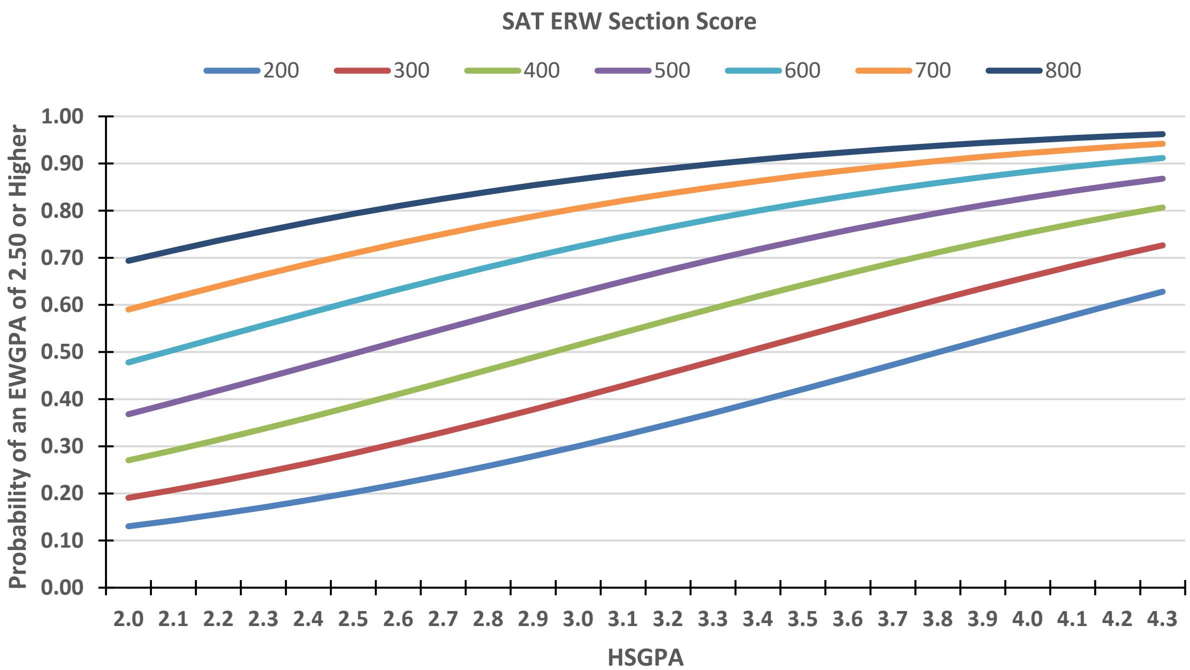
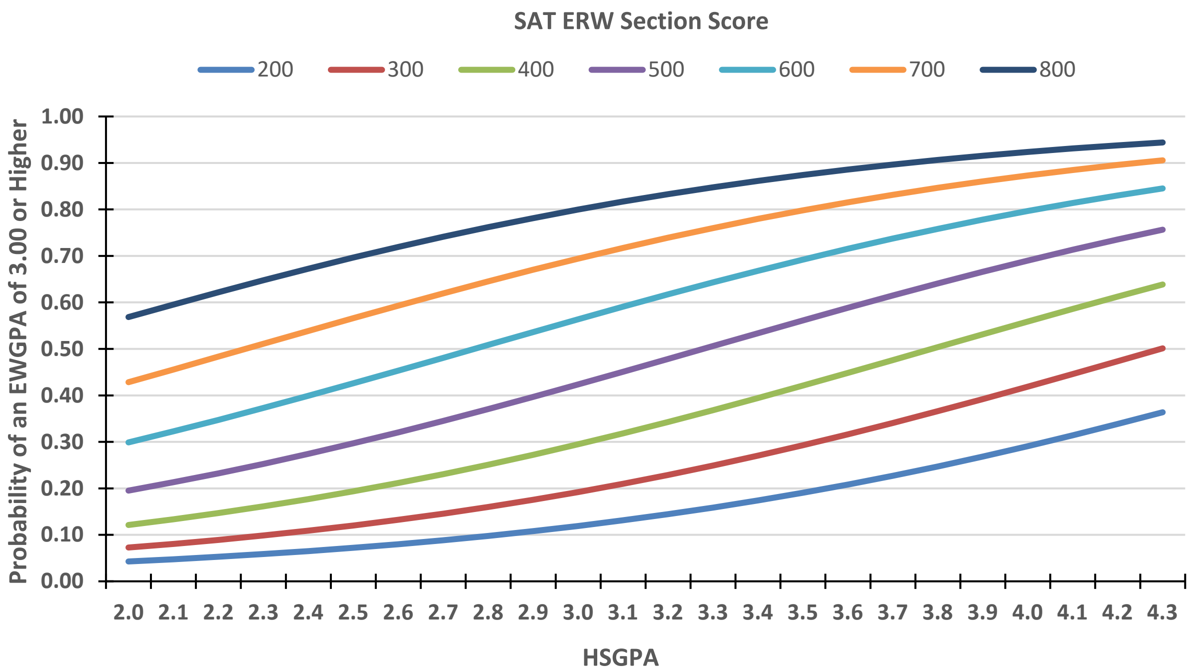


Figure 4 shows students' probabilities of earning an EWGPA of 3.00 or higher in college given their HSGPA and select SAT ERW section scores. What stands out in Figure 4 is that, compared to Figure 3, the probability curves are shifted to the right, and the probabilities of success are lower at every SAT ERW–HSGPA combination than they are when the criterion is achieving an EWGPA of 2.50 or higher. While the probabilities of success are slightly lower at every HSGPA point for students with high SAT ERW section scores, the probabilities are much lower for students with low SAT ERW section scores. For example, a student with a HSGPA of 3.50 and an SAT ERW section score of 700 has an 87% chance of earning an EWGPA of 2.50 or higher; that same student has an 80% chance of earning an EWGPA of 3.00 or higher, a decrease of seven percentage points. In contrast, a student with a HSGPA of 3.50 and an SAT ERW section score of 400 has a 64% chance of earning an EWGPA of 2.50 or higher but only a 42% chance of earning an EWGPA of 3.00 or higher, a decrease of 22percentage points. Even among students with near-perfect HSGPAs of 4.30, we see sizable differences between students' probabilities of earning an EWGPA of 3.00 or higher, ranging from a 94% chance of success for students with SAT ERW section scores of 800 to only a 36% chance of success for students with SAT ERW section scores of 200.

Figure 4: Probability of a 3.00 or Higher English and Writing GPA Given HSGPA and SAT ERW Section Score

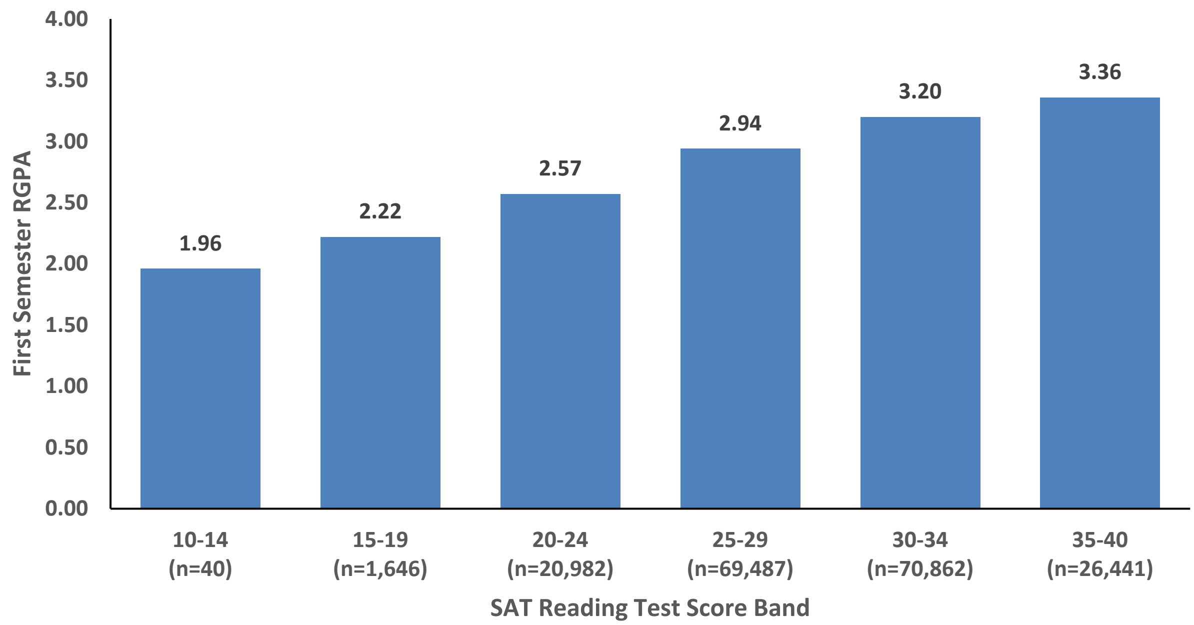


Correlations (see Table C 1) between the predictors (SAT ERW section scores and HSGPA) and EWGPA were positive, meaning that as students' SAT ERW section scores and HSGPAs increase, so did the students' EWGPAs. The correlations between SAT ERW section scores and HSGPA with EWGPA were .38 and .44, respectively. When used together to predict EWGPA, the multiple correlation for SAT ERW section scores plus HSGPA was .50, a 14% increase in predictive utility over the use of HSGPA alone. **This indicates that in order to have the most informed understanding of how a student will perform in first semester English and writing course work, institutions would benefit from using both HSGPA and SAT ERW section scores.**

Reading GPA

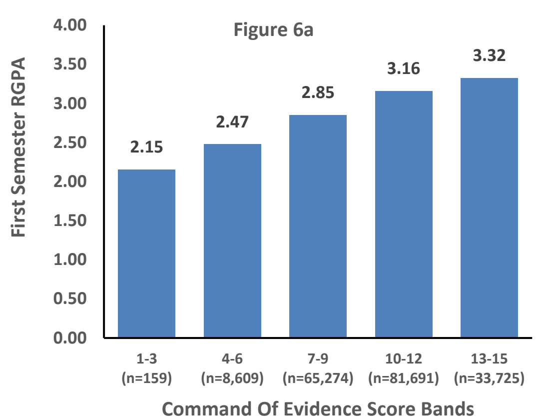
Results for the Reading GPA (RGPA) analyses closely parallel those for the English and Writing (EWGPA). In Figure 5, students with SAT Reading Test scores between 30 and 34 earned an average RGPA of 3.20, nearly a full letter grade higher than the average RGPA of students with SAT Reading Test scores between 15 and 19, which was only 2.22. Figures 6a and 6b show that the two subscores associated with the Reading Test as well as the Writing and Language Test (Words in Context and Command of Evidence) are also positively related to first semester RGPA. This shows the instructional sensitivity of the subscores in that performance on the subscores accurately reflects academic performance in an aligned domain. When combined with HSGPA data in Figure 7, we again see differences between mean GPAs for students in different SAT score bands within the same HSGPA category and that these gaps increase as HSGPA increases. Among the students with HSGPAs of C+ or lower, the difference between students in SAT Reading Test score band 15-19 (mean RGPA = 1.78) and students in the SAT Reading Test score band of 35-40 (mean RGPA = 2.26) is about a half a letter grade. However, among students in the A+ HSGPA category, the RGPA difference between students with SAT Reading Test scores between 15 and 19 (mean RGPA = 2.42) and students with SAT Reading Test scores between 35 and 40 (mean RGPA = 3.49) is a full letter grade.

Figure 5: Mean First Semester Reading GPA by SAT Reading Test Score Bands



Note. Results are reported for categories with at least 15 students.

Figures 6a and 6b: Mean First Semester Reading GPA by SAT Command of Evidence (COE) and Relevant Words in Context (WIC) Subscore Bands



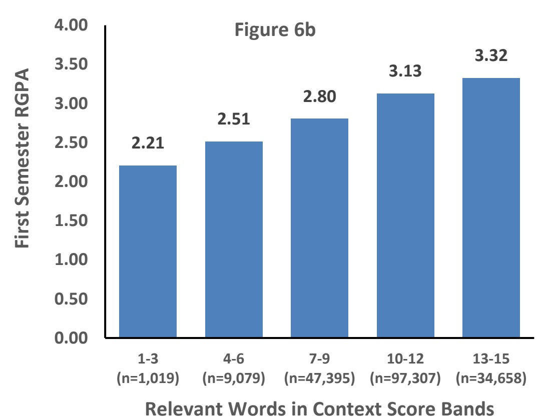
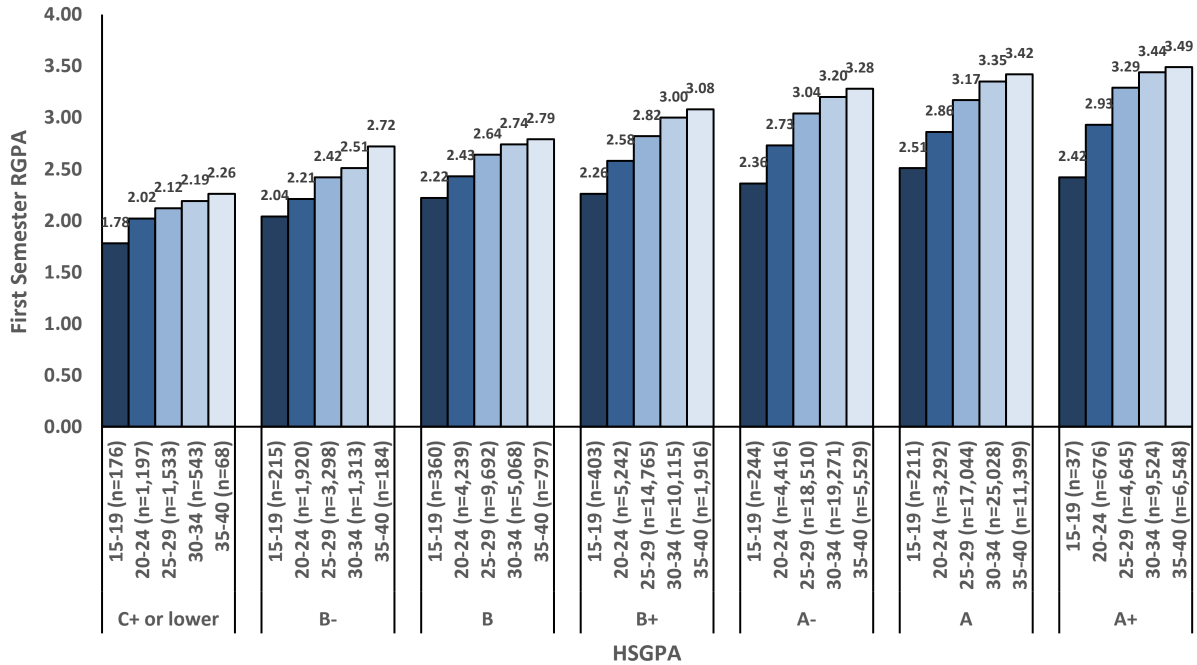


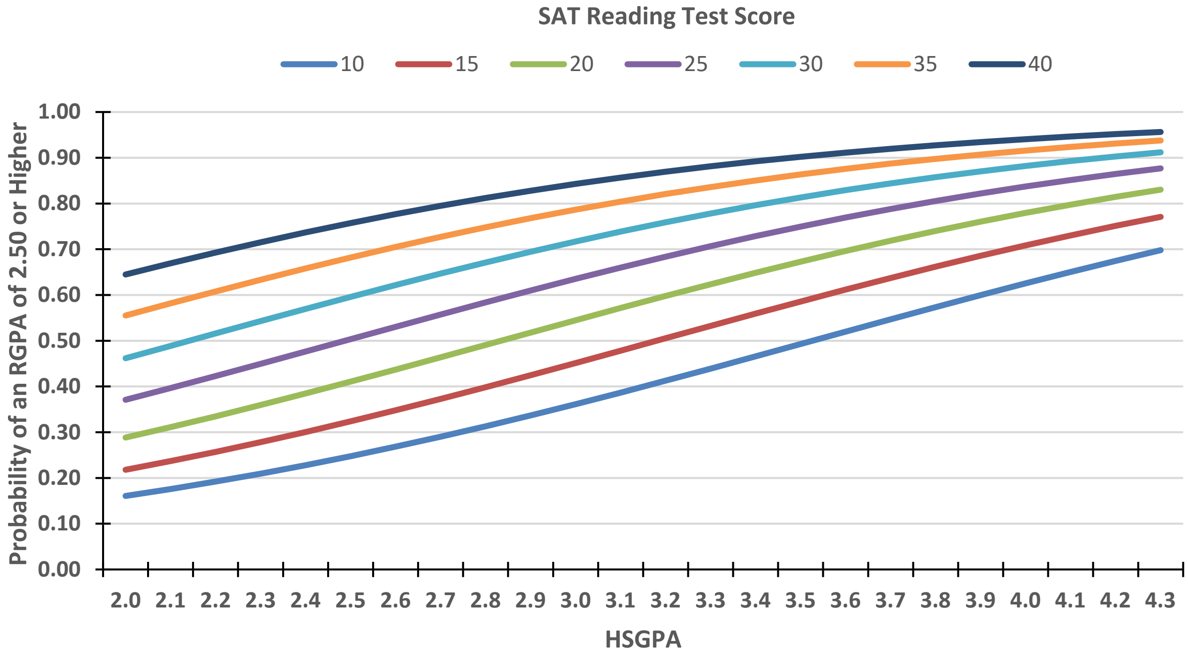
Figure 7: Mean First Semester Reading GPA by HSGPA and SAT Reading Test Score Bands



Note. Results are reported for categories with at least 15 students.

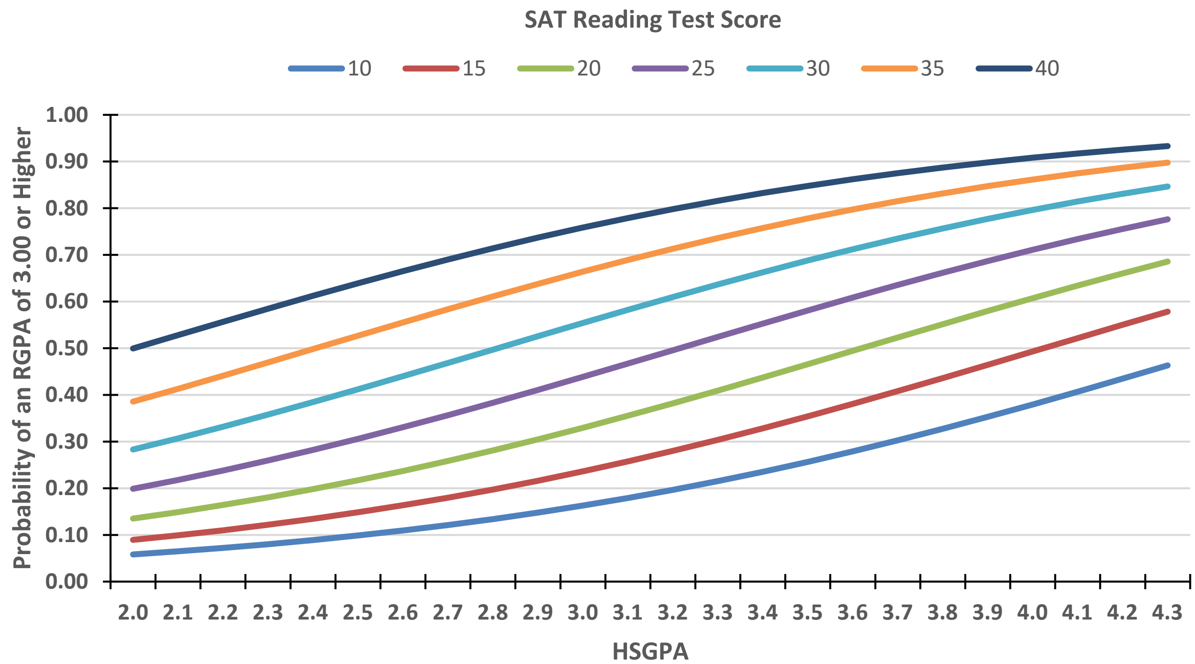
Results in the probability of RGPA success analyses are similar to the results for EWGPA. In Figure 8, we can see that SAT Reading Test scores contribute to students' probabilities of earning an RGPA of 2.50 or higher at every HSGPA point. The largest contributions of SAT Reading Test scores are at the lower end of the HSGPA scale. For students with HSGPAs of 2.00, the difference in the students' chances of earning an RGPA of 2.50 or higher range from 16% for students with SAT Reading Test scores of 10 to 64% for students with SAT Reading Test scores of 40. As HSGPA increases, students' chances of success increase, and differences in probabilities of success between students with different SAT Reading Test scores decrease. For example, among students with a HSGPA of 4.30, the chances of earning an RGPA of 2.50 or higher ranges from 70% to 96% for students with SAT Reading Test scores of 10 and 40, respectively.

Figure 8: Probability of a 2.50 or Higher Reading GPA Given HSGPA and SAT Reading Test Score



When the criterion is earning an RGPA of 3.00 or higher, the story changes somewhat. In Figure 9, at every HSGPA point, students' probabilities of success increase in tandem with increases in their SAT Reading Test scores. However, the contributions of SAT Reading Test scores are more stable across the HSGPA score scale than there are when predicting an RGPA of 2.50 or higher. For students with a HSGPA of 2.00, the chances of earning an RGPA of 3.00 or higher range from 6% to 50% for students with SAT Reading Test scores of 10 and 40, respectively, a difference of 44 percentage points. For students with a HSGPA of 4.30, the chances of earning an RGPA of 3.00 or higher range from 46% to 93% for students with an SAT Reading Test scores of 10 and 40, respectively. This represents a difference of 47 percentage points, which is much larger than the 26 percentage points difference for the same students when estimating their probability of earning an RGPA of 2.50 or higher (Figure 8).

Figure 9: Probability of a 3.00 or Higher Reading GPA Given HSGPA and SAT Reading Test Score



Correlations (see Table B 1) between the predictors (SAT Reading Test scores and HSGPA) and RGPA were positive, meaning that as students' SAT Reading Test scores and HSGPAs increased, so did the students' RGPAs. The correlations between SAT Reading Test scores and HSGPA with RGPA were .36 and .44, respectively. When both measures are used together to predict RGPA, the multiple correlation for SAT Reading Test scores plus HSGPA was .49, an 11% increase over the correlation between HSGPA alone and RGPA. Whether considered alone or with the results from the other analyses in this section, **this information supports the utility of SAT Reading Test scores in placement decisions for reading-intensive coursework**.

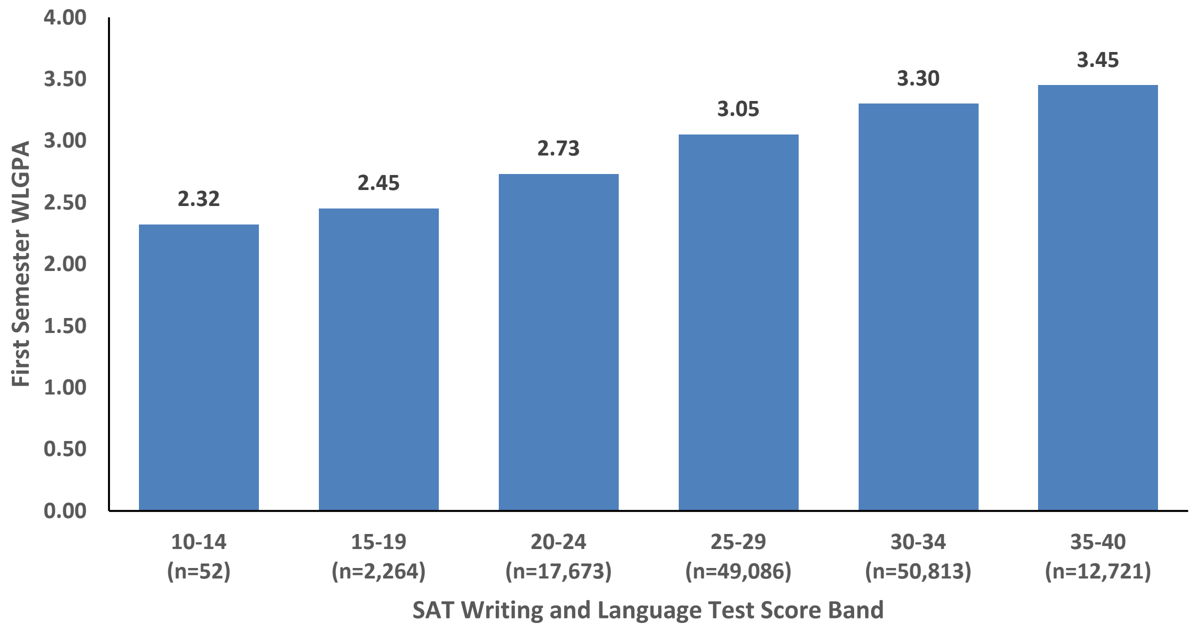
Writing and Language GPA

Results for the Writing and Language GPA (WLGPA) analyses show a positive relationship between SAT Writing and Language Test scores and WLGPA. In Figure 10, the mean WLGPA increases as SAT Writing and Language Test scores increase. Students with SAT Writing and Language Test scores between 35 and 40 earned an average WLGPA of 3.45, a full letter grade higher than the mean WLGPA for students with SAT Writing and Language Test scores between 15 and 19. Figures 11a, 11b, 11c, and 11d show that the four subscores associated with the Writing and Language Test are also positively related to first semester WLGPA, indicating that performance on the subscores accurately reflects academic performance in an aligned domain.[6] In Figure 12, this positive relationship between SAT Writing and Language Test scores and mean WLGPA can be seen within HSGPA categories as well. This means that the scores provide information beyond that provided by HSGPA. If SAT Writing and Language Test scores

[6] All four subscores draw upon items from the Writing and Language Test.

added no additional information, the mean GPAs within each HSGPA category would be the same. What we see, in all but one instance, is that within each HSGPA category the students in the higher SAT Writing and Language Test score bands earned higher mean WLGPAs than did the students in the lower SAT Writing and Language Test score bands.

Figure 10: Mean First Semester Writing and Language GPA by SAT Writing and Language Test Score Bands



Note. Results are reported for categories with at least 15 students.

Figures 11a, 11b, 11c, and 11d: Mean First Semester Writing and Language GPA by SAT Command of Evidence, Relevant Words in Context, Expression of Ideas, and Standard English Conventions Subscore Bands

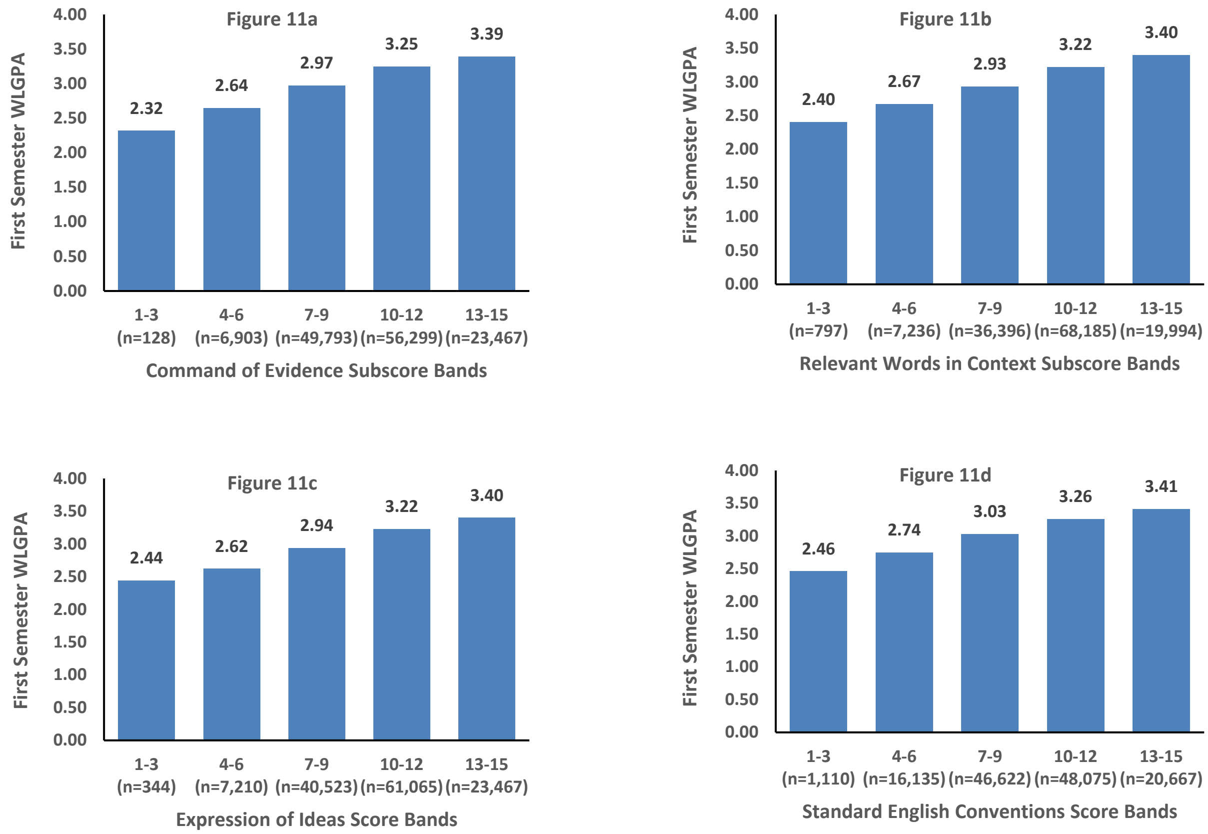
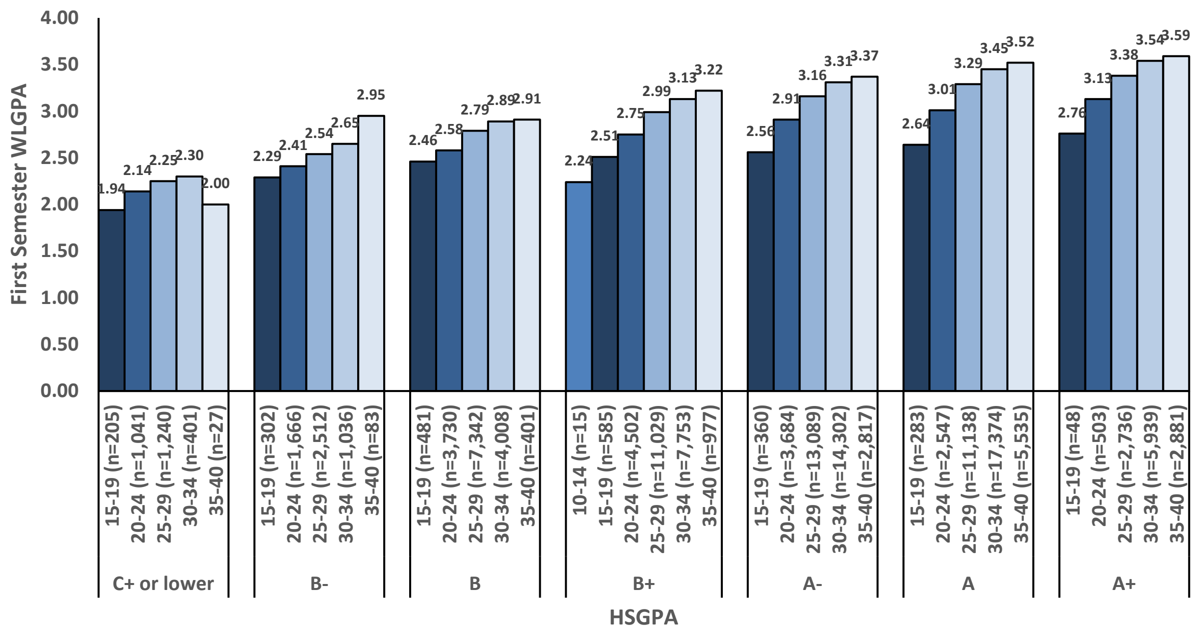


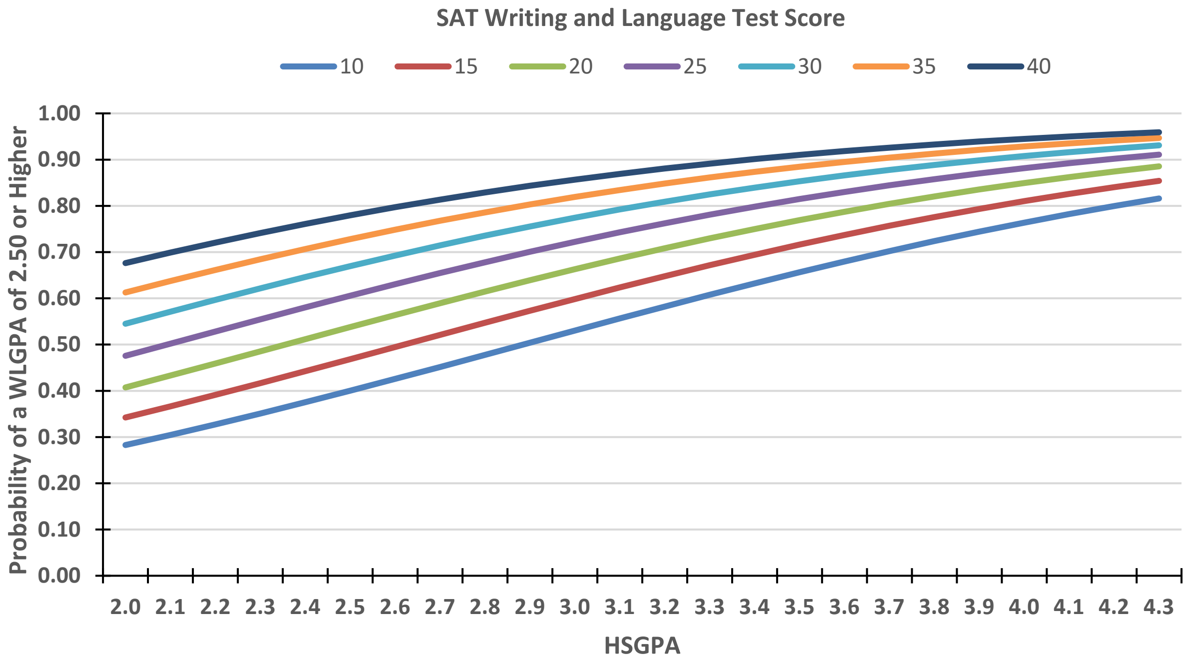
Figure 12: Mean First Semester Writing and Language GPA by HSGPA and SAT Writing and Language Test Score Bands



Note. Results are reported for categories with at least 15 students.

Turning to the probability of success analyses, SAT Writing and Language Test scores add information at every HSGPA score point whether estimating students' likelihood of earning a WLGPA of 2.50 or higher or earning a WLGPA of 3.00 or higher. In Figure 13, we can see that SAT Writing and Language Test scores add the most information at the low end of the HSGPA scale. For students with HSGPAs of 2.0, the chances of earning a WLGPA of 2.50 or higher for students with SAT Writing and Language Test scores of 10, 20, 30, and 40, are 28%, 41%, 55%, and 68%, respectively. At the higher end of the HSGPA scale, we see that the probabilities of success are more similar for students with different SAT Writing and Language Test scores, but the scores still add information above that provided by HSGPA. If SAT Writing and Language Test scores added no information beyond that of HSGPA, there would be one probability curve, but that is clearly not the case.

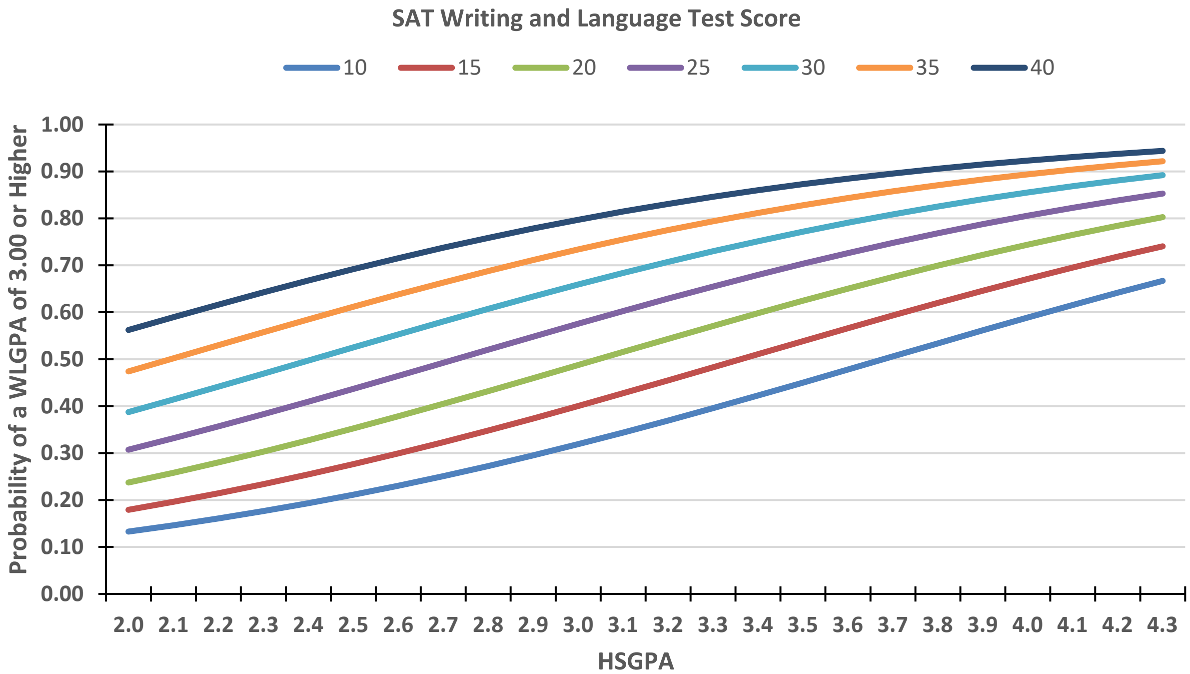
Figure 13: Probability of a 2.50 or Higher Writing and Language GPA Given HSGPA and SAT Writing and Language Test Score



In Figure 14, we can see that earning a WLGPA of 3.00 or higher is more difficult than earning a WLGPA of 2.50 or higher and that the amount of information delivered by SAT Writing and Language Test scores is greater at every HSGPA point than seen in Figure 13. As in Figure 13, the SAT Writing and Language Test scores add more information at the low end of the HSGPA scale than at the high end, but there are clear differences in the probabilities of success, even for students with HSGPAs of 4.30, depending on their SAT Writing and Language Test scores.

Figure 14 also highlights the compensatory nature of using multiple measures. At every SAT Writing and Language Test score point, there is an HSGPA point where students have approximately a 60% probability of earning a WLGPA of 3.00 or higher. Students with an SAT Writing and Language Test score of 40 and a HSGPA of 2.1 have a 59% probability of success, as do students with an SAT Writing and Language Test score of 10 and a HSGPA of 4.0. Similarly, students with an SAT Writing and Language Test score of 20 and a HSGPA of 3.4 and students with an SAT Writing and Language Test score of 25 and a HSGPA of 3.1 have a 60% probability of success, and students with an SAT Writing and Language Test score of 30 and a HSGPA of 2.8 and students with an SAT Writing and Language Test score of 35 and a HSGPA of 2.50 have a 61% probability of success.

Figure 14: Probability of a 3.00 or Higher Writing and Language GPA Given HSGPA and SAT Writing and Language Test Score



Correlations (see Table B 1) between the predictors (SAT Writing and Language Test scores and HSGPA) and WLGPA were positive, meaning that as students' SAT Writing and Language Test scores and HSGPAs increased, so did the students' WLGPAs. The correlations between SAT Writing and Language Test scores and HSGPA with WLGPA were .31 and .39, respectively. When both measures are used together to predict WLGPA, the multiple correlation for SAT Writing and Language Test scores plus HSGPA was .43, a 10% increase over the correlation between HSGPA alone and WLGPA. Similar to the other analyses, **this information supports the utility of SAT Writing and Language Test scores in placement decisions for writing-intensive course work and indicates that using multiple measures to predict student performance in writing courses is better than using a single measure.**

Math GPA

The relationships between SAT Math scores and math GPAs were positive and among the strongest in this study. The mean Math GPA (MGPA) analyses by SAT Math section and SAT Math Test score bands, summarized in Figures 15 and 16, show that as SAT Math section and SAT Math Test scores increase, so do students' mean first semester MGPAs. In Figure 15, mean MGPAs ranged from 1.63 in the 200 to 290 section score band to 3.21 in the 700 to 800 section score band. Even among students in the 400 to 490 SAT Math section score band, their average MGPA of 2.12 was more than a full letter grade lower than the students in the 700 to 800 SAT Math section score band (Mean MGPA = 3.21). The same means are found in Figure 16 for SAT Math Test score bands 20 to 24 and 35 to 40, respectively.

Figure 15: Mean First Semester Math GPA by SAT Math Section Score Bands

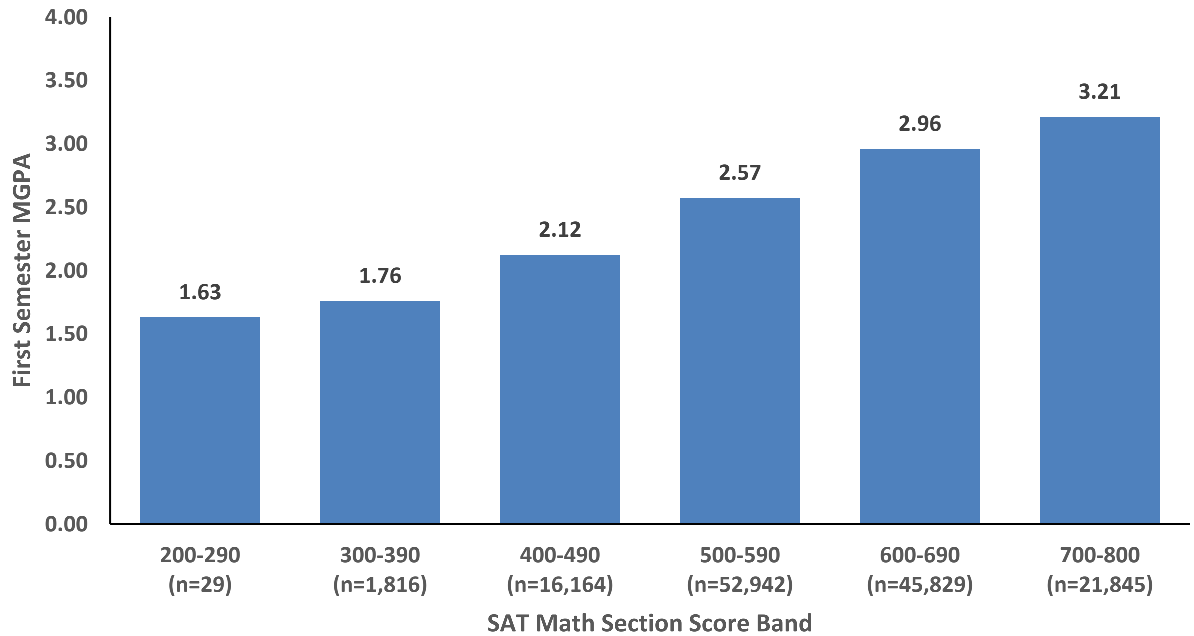
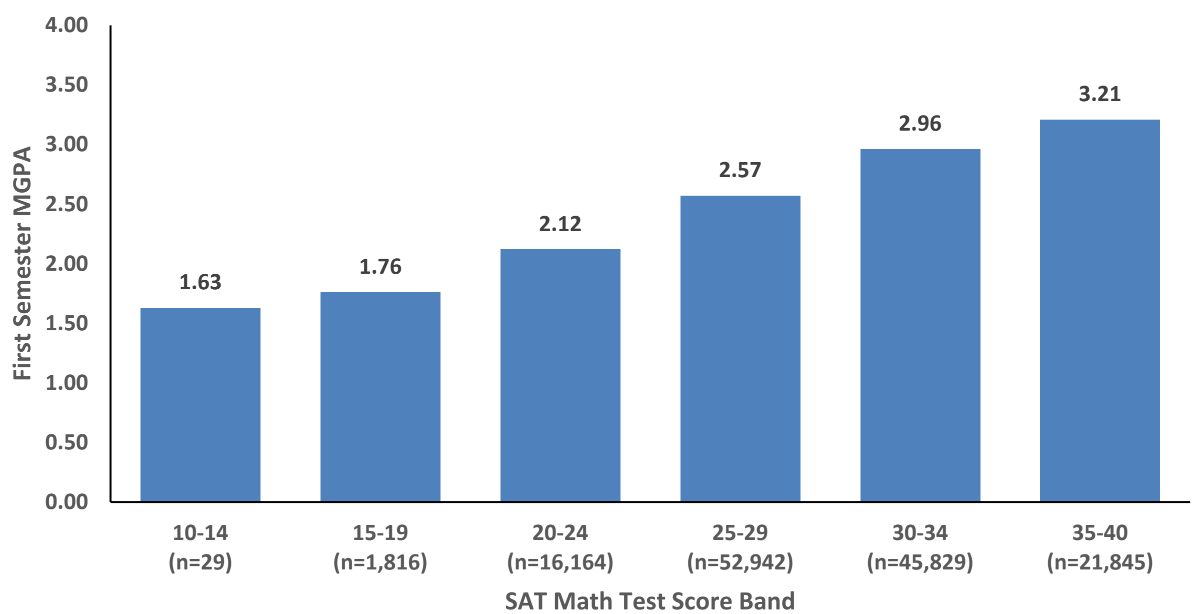


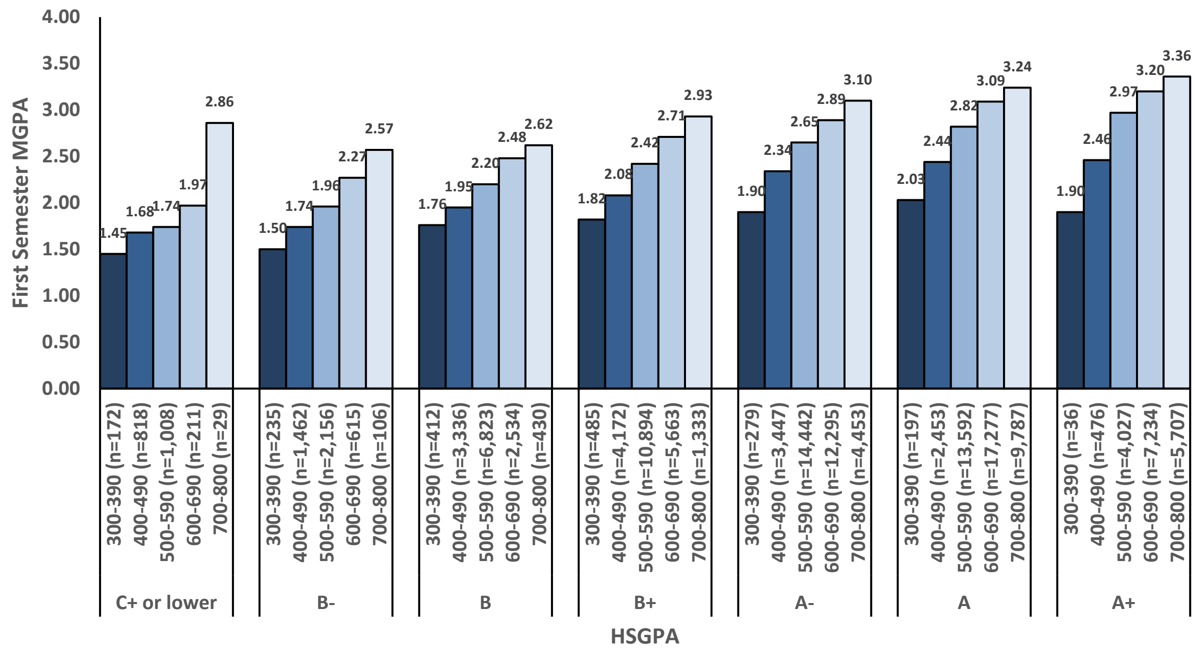
Figure 16: Mean First Semester Math GPA by SAT Math Test Score Bands



Note. Results are reported for categories with at least 15 students. SAT Math Test scores are reported in 0.5 increments. Scores were rounded down in this figure. For example, the 10-14 score band includes scores between 10.0 and 14.5.

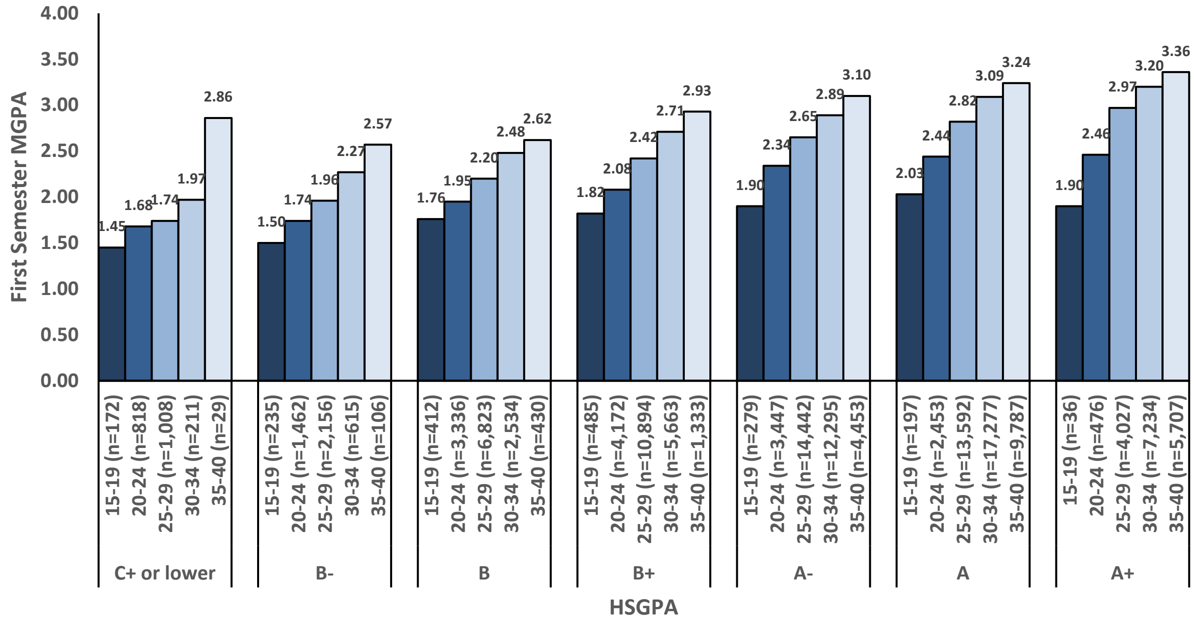
Figures 17 and 18 show that SAT Math section scores and SAT Math Test scores, respectively, predict MGPA after controlling for HSGPA. As shown in the correlational analyses (Table B 1), **the strength of the relationship between SAT Math section scores and Math Test scores and MGPA exceeded that of the relationship between HSGPA and MGPA**. Even for students with an A+ HSGPA, students in the 300 to 390 SAT Math section score band (Figure 17) had an average MGPA of 1.90. The same result is shown in Figure 18 for students with an A+ HSGPA and with scores in the 15 to 19 SAT Math Test score band.

Figure 17: Mean First Semester Math GPA by HSGPA and SAT Math Section Score Bands



Note. Results are reported for categories with at least 15 students.

Figure 18: Mean First Semester Math GPA by HSGPA and SAT Math Test Score Bands



Note. Results are reported for categories with at least 15 students.

Figures 19 and 20 show students' probabilities of earning an MGPA of 2.50 or higher given their HSGPAs and SAT Math section scores and Math Test scores, respectively. SAT Math scores clearly add information at all points across the HSGPA scale, but the **compensatory nature of the joint use of test scores and HSGPA is less for MGPA than it is for EWGPA, RGPA, and WLGPA, meaning that students with low SAT Math scores but high HSGPAs will likely not perform well in college math.** For example, among students with HSGPAs of 4.30, a student with an SAT Math section score of 700 (Figure 19) has an 88% chance of earning an MGPA of 2.50 or higher, but a student with the same HSGPA (4.30) and an SAT Math section score of 400 has only a 51% chance of earning an MGPA of 2.50 or higher, the same likelihood of success as a student with an SAT Math score of 700 and an HSGPA of 2.30.

Figure 19: Probability of a 2.50 or Higher Math GPA Given HSGPA and SAT Math Section Score

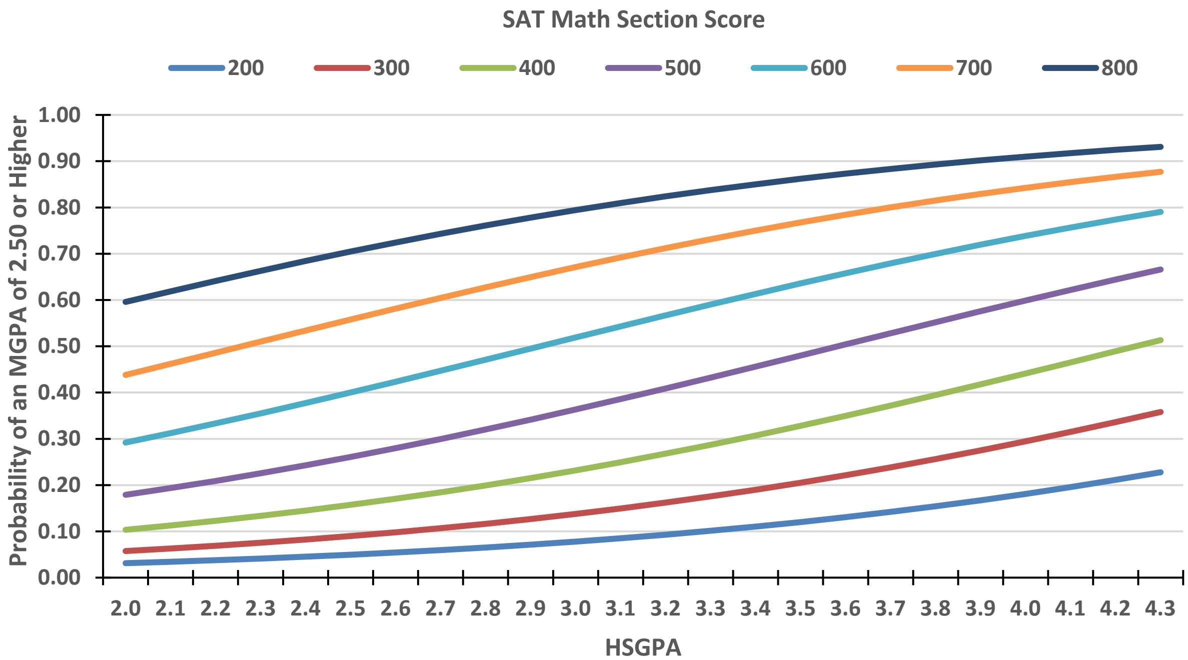
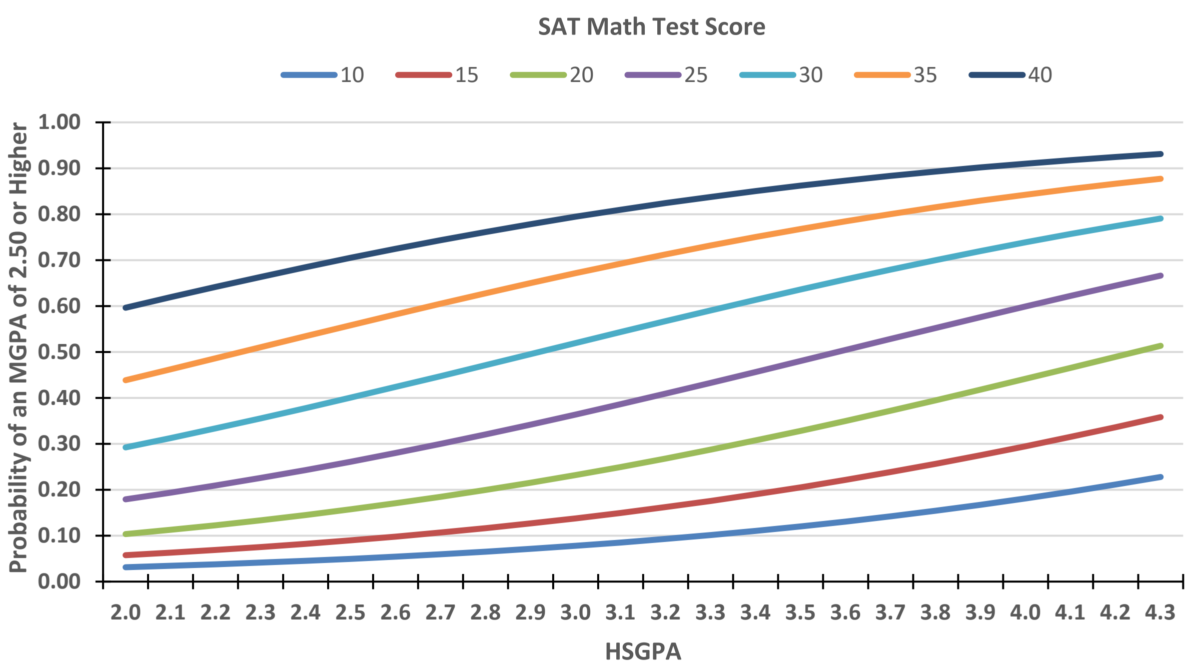


Figure 20: Probability of a 2.50 or Higher Math GPA Given HSGPA and SAT Math Test Score



When we look at students' probabilities of earning an MGPA of 3.00 or higher given their HSGPAs and SAT Math section scores and Math Test scores, respectively (Figures 21 and 22), we see that SAT Math scores add information about student math performance across the entire HSGPA scale. This is especially true at the high end of the HSGPA scale, where differences between chances of success for students with HSGPAs of 4.30 range from 16% for students with SAT Math section scores of 200 to 91% for students with SAT Math section scores of 800 (Figure 21). Among students with an HSGPA of 3.70 (the average HSGPA of students in this sample was 3.68; see Table B 1), students' chances of earning an MGPA of 3.00 or higher were 43%, 60%, and 74% for students with SAT Math section scores of 500, 600, and 700, respectively. While 57% of students earned an MGPA of 3.00 or higher (see Table 4), students with SAT Math section scores below 500 and HSGPAs below 4.00 have less than a 50% chance of achieving this measure of success.

Figure 21: Probability of a 3.00 or Higher Math GPA Given HSGPA and SAT Math Section Score

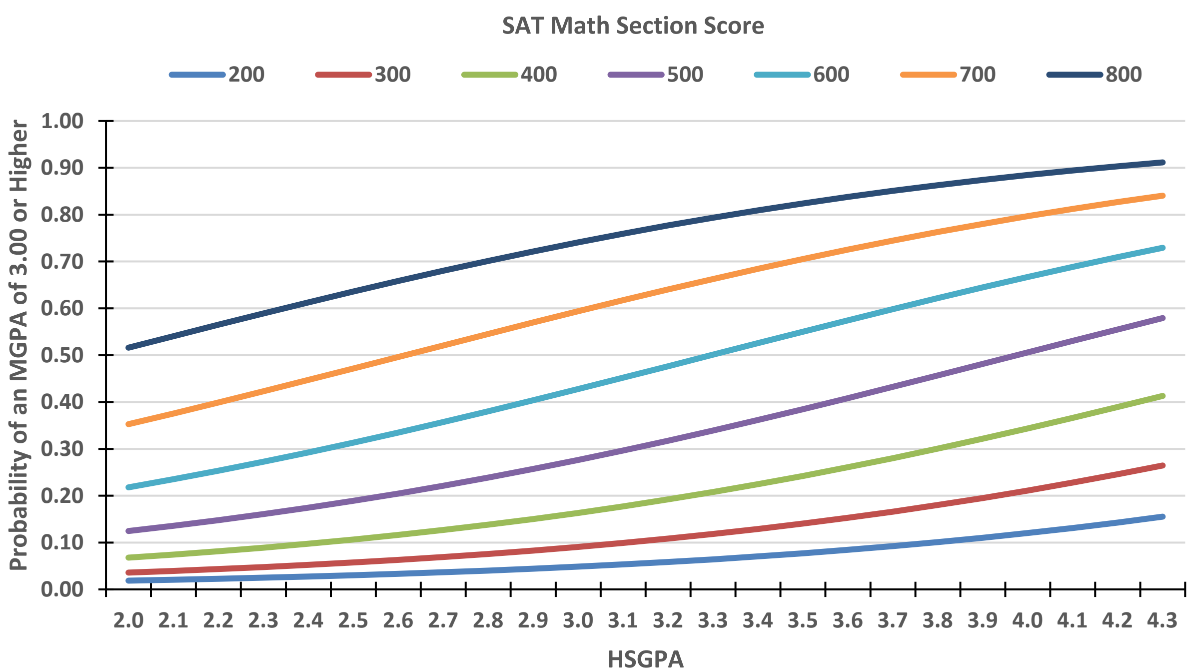
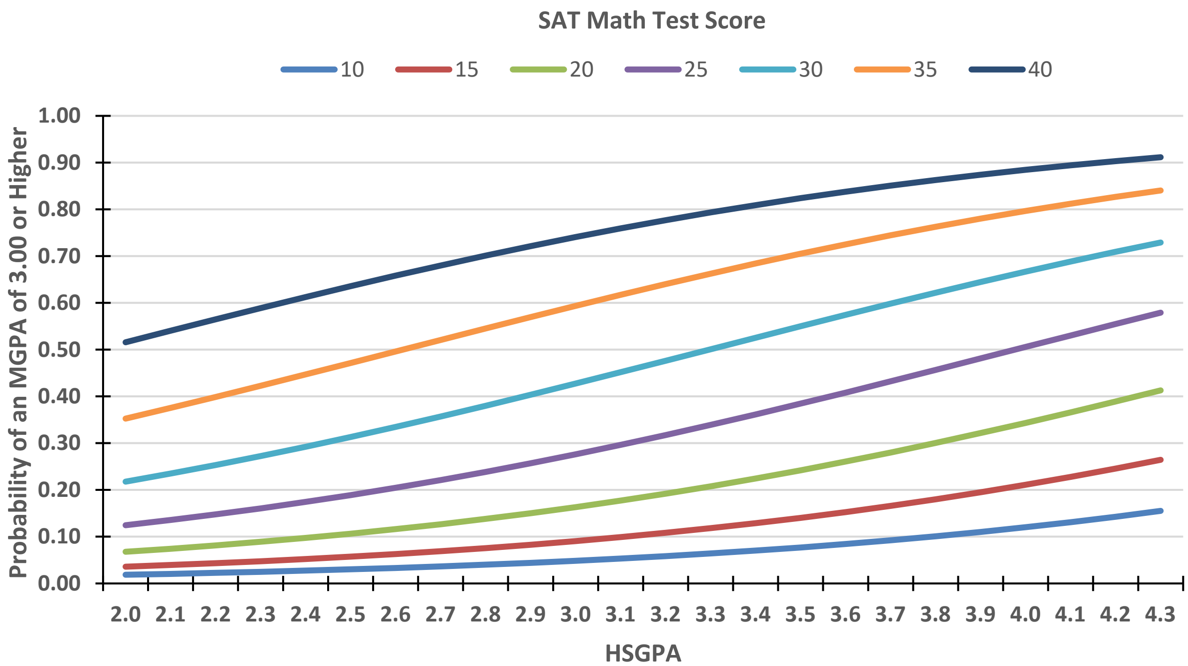


Figure 22: Probability of a 3.00 or Higher Math GPA Given HSGPA and SAT Math Test Score



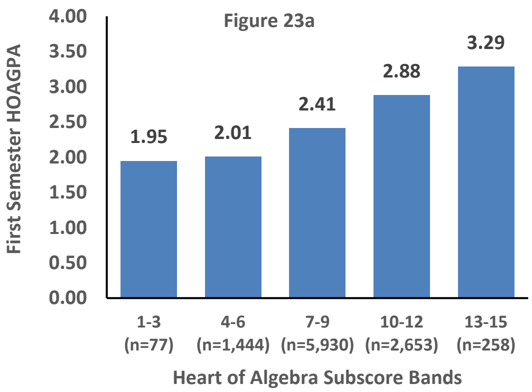
Correlations (see Table B 1) between the predictors (SAT Math section score or Math Test score and HSGPA) and MGPA were positive, meaning that as students' SAT Math section scores or Math Test scores and HSGPAs increased, so did the students' MGPAs. The correlations between SAT Math section scores, SAT Math Test scores, and HSGPA with MGPA were .46, .46, and .45, respectively. When used together to predict MGPA, the multiple correlation for SAT Math section scores plus HSGPA was .54, a 20% increase over the correlation between HSGPA alone and MGPA.

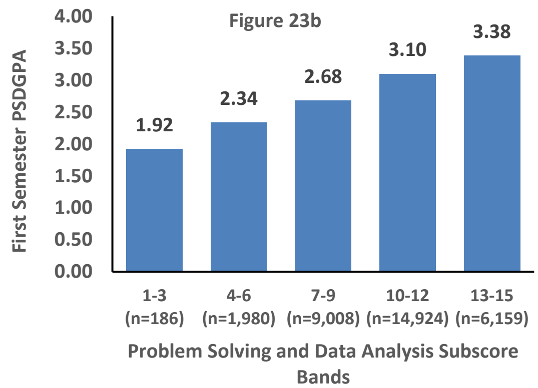
As mentioned earlier in this report, using multiple measures is better than using just one measure to predict student academic performance. That is also true when examining student outcomes in college math courses. However, we want to emphasize that in the case of MGPA, **students with low SAT Math scores but high HSGPAs will likely not perform well in college math. Broadly speaking, students with low SAT Math scores may need academic support to ensure their success in college math courses.**

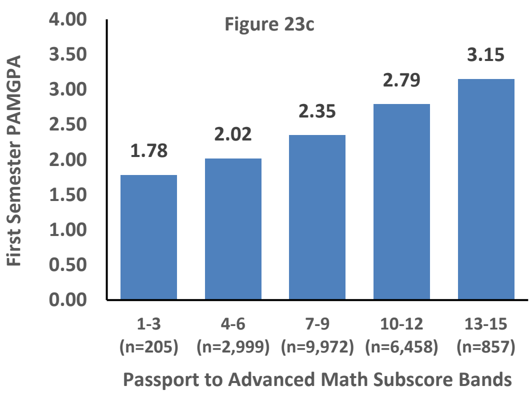
Heart of Algebra, Problem Solving and Data Analysis, and Passport to Advanced Math GPAs

In addition to the analyses for MGPA, analyses were conducted to examine the relationships between the three math subscores – Heart of Algebra, Problem Solving and Data Analysis, and Passport to Advanced Math – and the three domain-specific GPAs aligned with each of them. Though each subscore is but a portion of the SAT Math Test, Figures 23a, 23b, and 23c show that as students' subscores increase, so do the aligned, domain-specific GPAs.[7]

Figures 23a, 23b, and 23c: Mean First Semester Math Subscore GPAs by SAT Math Subscore Bands





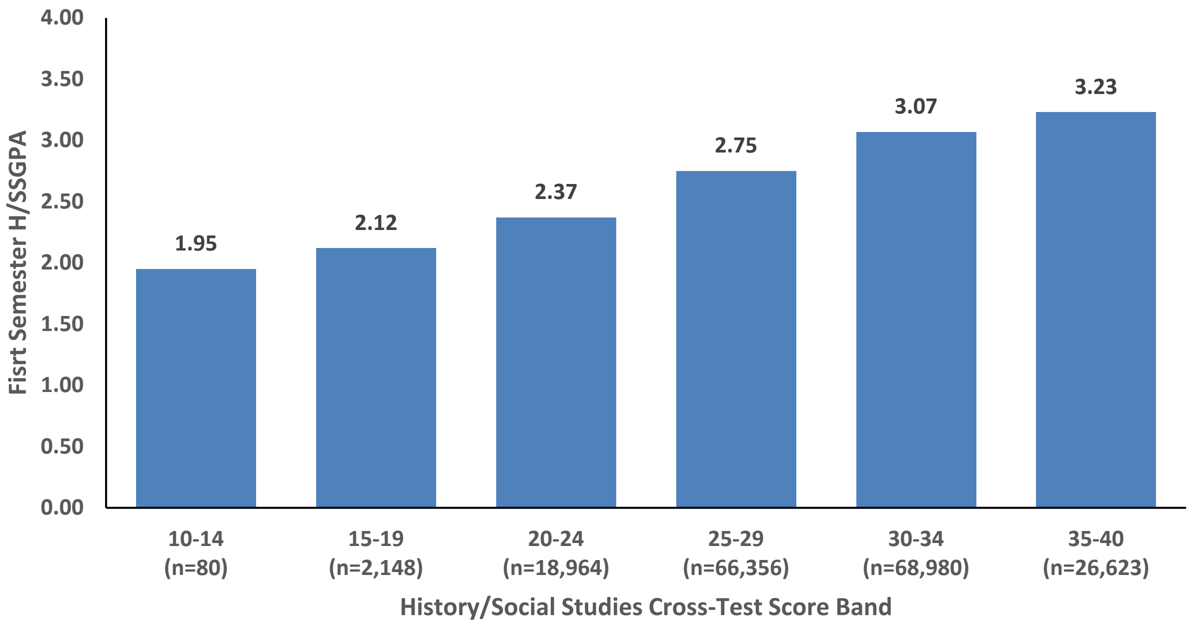


History/Social Studies GPA

Figure 24 shows the positive relationship between SAT Analysis in History/Social Studies cross-test scores and first semester History/Social Studies GPA (H/SSGPA), with mean H/SSGPA increasing in tandem with SAT Analysis in History/Social Studies cross-test score bands. Most students in the sample scored in the three upper score bands, but the difference between the mean H/SSGPA for students in the third- highest score band (25 to 29) and the highest score band (35 to 40) was nearly half a letter grade, 2.75 versus 3.23.

[7] An especially low score on one subscore relative to the other subscores may indicate that a student has a weakness in that area and may need support.

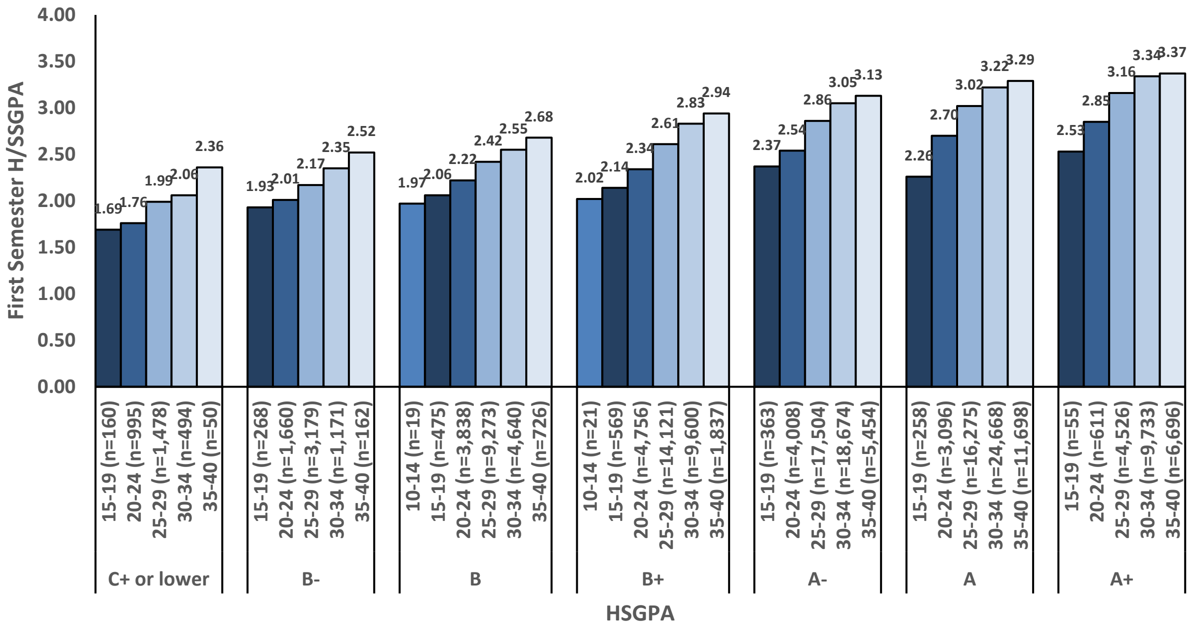
Figure 24: Mean First Semester History/Social Studies GPA by SAT Analysis in History/Social Studies Cross-Test Score Bands



Note. Results are reported for categories with at least 15 students.

Even when controlling for HSGPA, SAT Analysis in History/Social Studies cross-test scores predict H/SSGPA. As seen in Figure 25, students with higher SAT Analysis in History/Social Studies cross-test scores earn higher mean H/SSGPAs within each HSGPA category. For example, among students with a HSGPA of “A,” students in the highest SAT Analysis in History/Social Studies cross-test score band (35-40) earned an average H/SSGPA of 3.29, a full letter grade higher than the average H/SSGPA for students in the lowest reported SAT Analysis in History/Social Studies cross-test score band (15-19).

Figure 25: Mean First Semester History/Social Studies GPA by HSGPA and SAT Analysis in History/Social Studies Cross-Test Score Bands



Note. Results are reported for categories with at least 15 students.

Figure 26 shows students' probabilities of earning an H/SSGPA of 2.50 or higher based on their SAT Analysis in History/Social Studies cross-test scores and HSGPAs. Comparable to what was seen in the analyses for other SAT measures, SAT Analysis in History/Social Studies cross-test scores add information at every point on the HSGPA scale. For example, among students with an HSGPA of 3.00, the chances of earning an H/SSGPA of 2.50 or higher with SAT Analysis in History/Social Studies cross-test scores of 15, 25, and 35 are 28%, 50%, and 72%, respectively. Toward the upper end of the HSGPA scale, these gaps decrease, but the differences remain considerable. Among students with an HSGPA of 3.70 (the average HSGPA of students in this sample was 3.66), the chances of earning an H/SSGPA of 2.50 or higher with SAT Analysis in History/Social Studies cross-test scores of 15, 25, and 35 are 47%, 69%, and 85%, respectively.

Figure 26: Probability of a 2.50 or Higher History/Social Studies GPA Given HSGPA and SAT Analysis in History/Social Studies Cross-Test Score

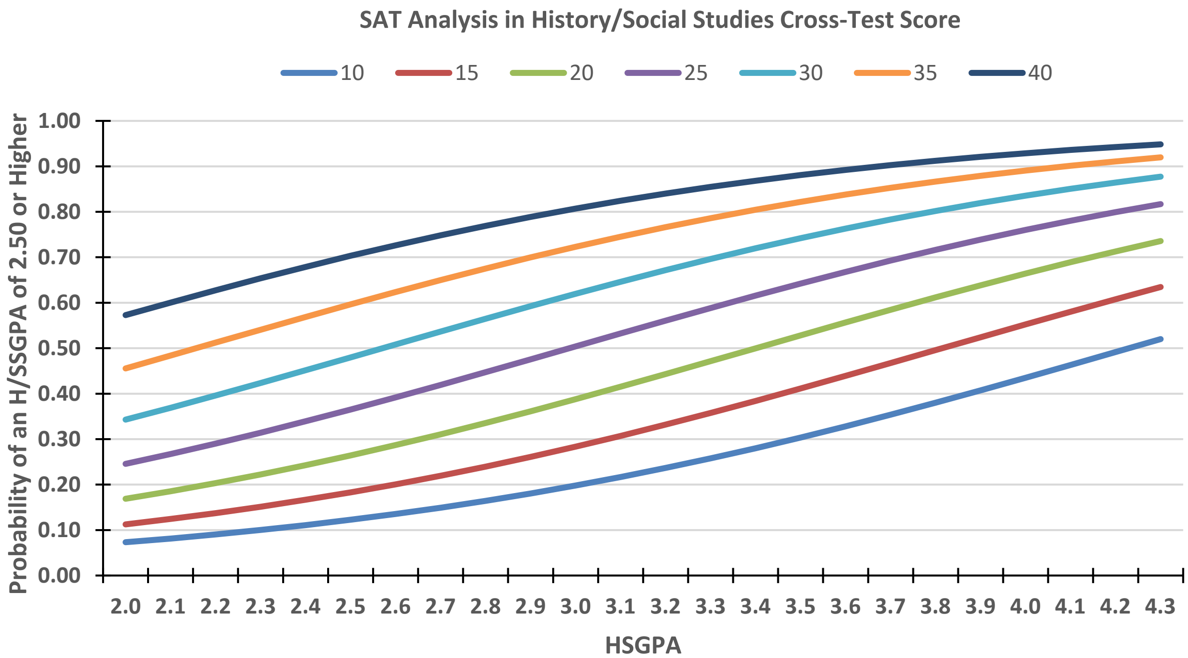
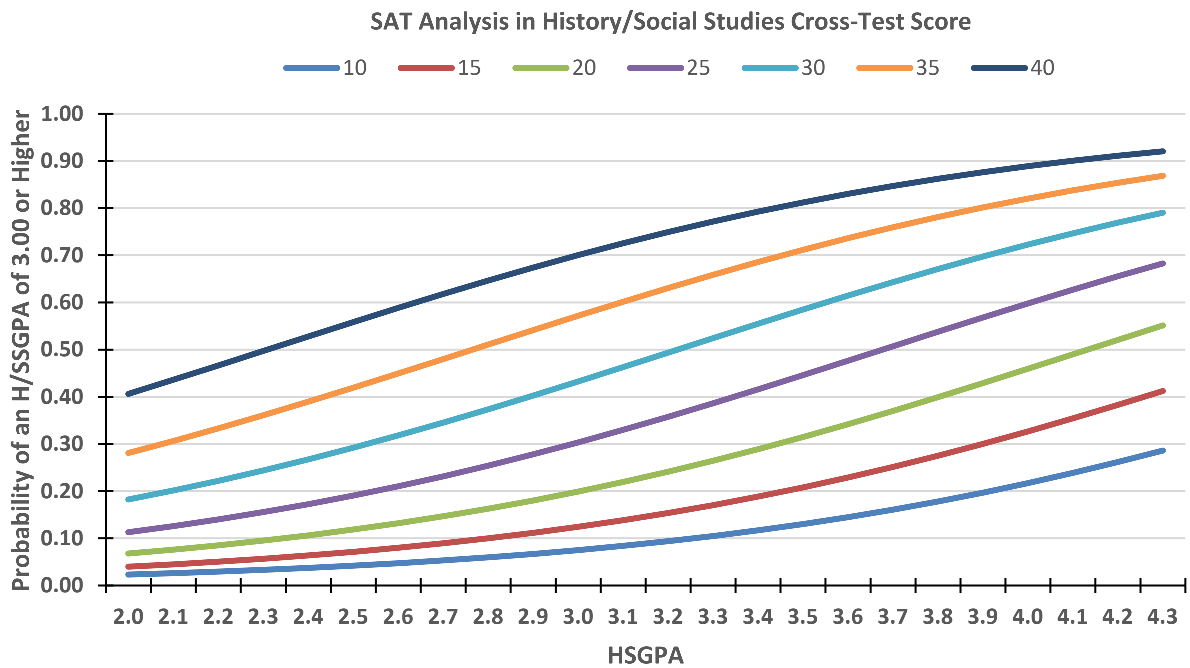


Figure 27 shows students' probabilities of earning an H/SSGPA of 3.00 or higher based on their SAT Analysis in History/Social Studies cross-test scores and HSGPAs. The cross-test scores add information at every point on the HSGPA scale, but relative to the probabilities seen in Figure 26, the curves are shifted to the right and downward. Among students with an HSGPA of 3.70, the chances of earning an H/SSGPA of 3.00 or higher with SAT Analysis in History/Social Studies cross-test scores of 15, 25, and 75, were 25%, 51%, and 76%, respectively. When compared to their chances of earning a H/SSGPA of 2.50 or higher (see Figure 26), these are decreases of 22 percentage points, 18 percentage points, and 9 percentage points, respectively. This suggests that students with lower SAT Analysis in History/Social Studies cross-test scores face a greater challenge when trying to make the leap from performing well enough to pass (i.e., earn up to a 2.50) to performing as well as (or better than) the majority of their classmates (i.e., earning a 3.00 or higher).

Figure 27: Probability of a 3.00 or Higher History/Social Studies GPA Given HSGPA and SAT Analysis in History/Social Studies Cross-Test Score



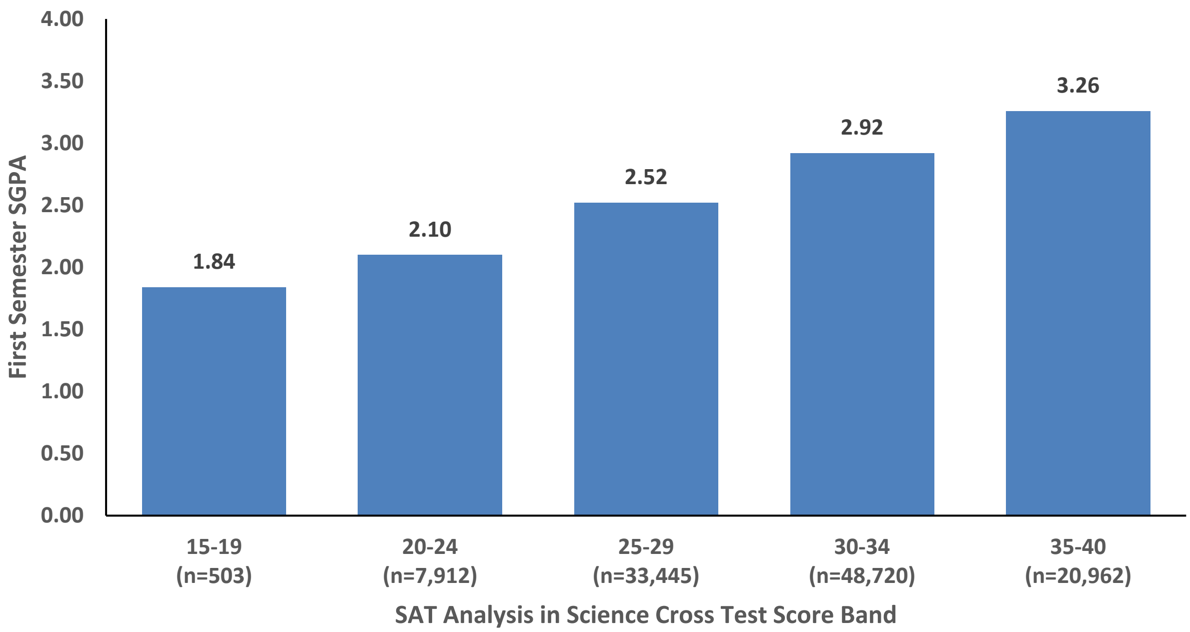
Correlations (see Table B 1) between the predictors (SAT Analysis in History/Social Studies cross-test score and HSGPA) and H/SSGPA were positive, meaning that as students' SAT Analysis in History/Social Studies cross-test scores and HSGPAs increased, so did the students' H/SSGPAs. The correlations between SAT Analysis in History/Social Studies cross-test scores and HSGPA with H/SSGPA were .40 and .46, respectively. When used together to predict H/SSGPA, the multiple correlation for SAT Analysis in History/Social Studies cross-test scores plus HSGPA was .54, a 17% increase over the correlation between HSGPA alone and H/SSGPA. **Taken together with the results from the probability of success analyses, this suggests that students with lower HSGPAs and/or lower Analysis in History/Social Studies cross-test scores may find it challenging to earn high grades in college history/social studies courses. This information should be useful in advising conversations about course work and selection of major.**

Science GPA

Figure 28 shows the positive relationship between SAT Analysis in Science cross-test scores and first semester Science GPA (SGPA), with mean SGPA increasing in tandem with SAT Analysis in Science cross-test score bands. Students with SAT Analysis in Science cross-test scores between 30 and 34 earned an average SGPA of 3.26, more than a full letter grade higher than the average SGPA of students with SAT Analysis in Science cross-test scores between 15 and 19, which was 2.10. When combined with the HSGPA data in Figure 29, differences in mean SGPA for students in different SAT score bands generally persist within the each HSGPA category. The largest differences in performance were within the "A"

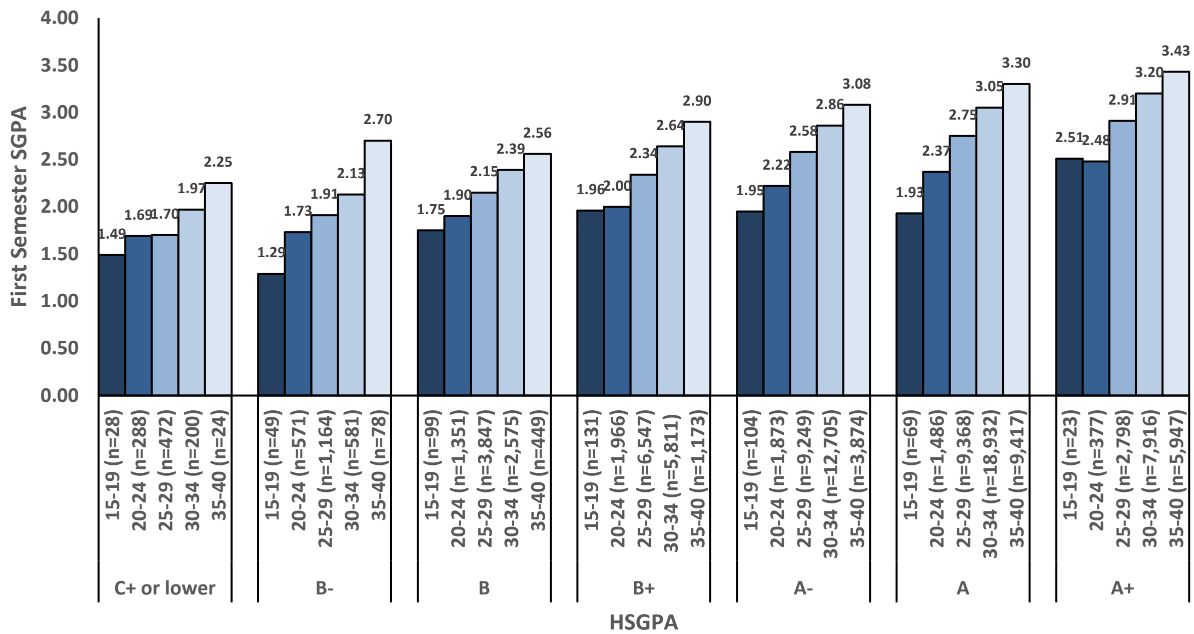
HSGPA category, with mean SGPAs ranging from 1.93 for students in the lowest reported SAT Analysis in Science cross-test score band (15-19) to 3.30 for students in the highest SAT Analysis in Science cross-test score band (35-40). These results indicate that SAT Analysis in Science cross-test scores add to the prediction of students' performance in first semester science courses even when the students have the same HSGPAs and even when those HSGPAs are quite high.

Figure 28: Mean First Semester Science GPA by SAT Analysis in Science Cross-Test Score Bands



Note. Results are reported for categories with at least 15 students.

Figure 29: Mean First Semester Science GPA by HSGPA and SAT Analysis in Science Cross-Test Score Bands



Note. Results are reported for categories with at least 15 students.

Figure 30 further illustrates the value of using SAT Analysis in Science cross-test scores in conjunction with HSGPA to predict students' likelihood of success in first semester science courses. Though 67% of the sample earned an SGPA of 2.50 or higher, students with an HSGPA of 4.30 and an SAT Analysis in Science cross-test score of 20 had just a 50% chance of earning an SGPA of 2.50 or higher, while students with the same HSGPA (4.30) and lower SAT Analysis in Science cross-test scores had even lower probabilities of success. By contrast, students with the same HSGPA (4.30) and an SAT Analysis in Science cross-test score of 30 had a 79% chance of meeting this standard of success. Closer to the average HSGPA of the students in this sample (3.75), students with an HSGPA of 3.70 and SAT Analysis in Science cross-test scores of 15, 25, and 35 have 21%, 51%, and 80% chances, respectively, of earning an SGPA of 2.50 or higher.

Figure 30: Probability of a 2.50 or Higher Science GPA Given HSGPA and SAT Analysis in Science Cross-Test Score

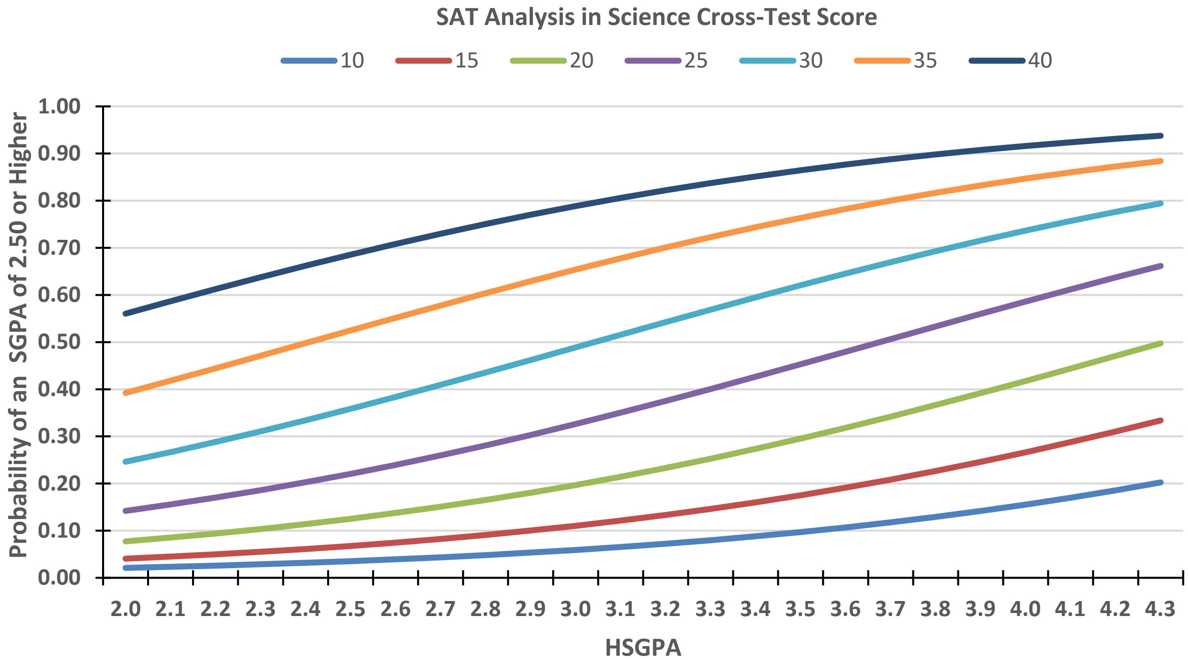
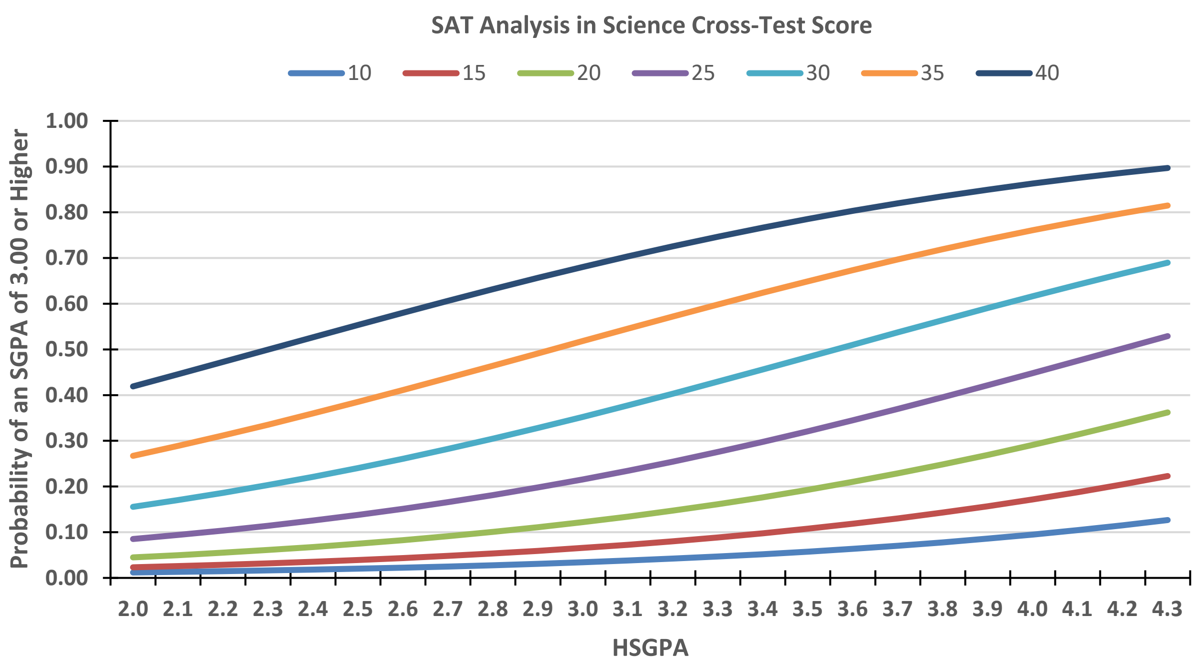


Figure 31 shows that when the standard of success is raised to earning an SGPA of 3.00 or higher, the value of SAT Analysis in Science cross-test scores increases as HSGPA increases. For students with an HSGPA of 3.30 and SAT Analysis in Science cross-test scores of 10, 20, 30, and 40, their chances of earning an SGPA of 3.00 or higher are 5%, 16%, 43%, and 75%, respectively. Moving up a full letter grade on the HSGPA scale, students with an HSGPA of 4.30 and SAT Analysis in Science cross-test scores of 10, 20, 30, and 40 have chances of 13%, 36%, 69%, and 90%, respectively, of earning an SGPA of 3.00 or higher. These results highlight the differences in probabilities of success for students with the same HSGPAs but different SAT Analysis in Science cross-test scores. While the figure shows that students' probabilities of success increase with higher HSGPAs, it also shows that high HSGPAs alone do not ensure high probabilities of success. Students with SAT Analysis in Science cross-test scores below 25 have less than a 50% chance of earning an SGPA of 3.00 or higher regardless of how high their HSGPAs are.

Figure 31: Probability of a 3.00 or Higher Science GPA Given HSGPA and SAT Analysis in Science Cross-Test Score



Correlations (see Table B 1) between the predictors (SAT Analysis in Science cross-test score and HSGPA) and SGPA were positive, meaning that as students' SAT Analysis in Science cross-test scores and HSGPAs increased, so did the students' SGPAs. The correlations between SAT Analysis in Science cross-test scores and HSGPA with SGPA were .48 and .49, respectively. When both measures are used together to predict SGPA, the multiple correlation for SAT Analysis in Science cross-test scores plus HSGPA was .57, a 16% increase over the correlation between HSGPA alone and SGPA. **These results reinforce the message that it is better to use multiple predictors than to use HSGPA or test scores alone. Taken together with results from the probability of success analyses, we find support for the utility of SAT Analysis in Science cross-test scores in college placement considerations and advising conversations around science course work and selection of major.**

Discussion

The redesigned SAT, introduced in 2016, was intended to provide insights into multiple areas of student academic achievement. It is not a single measure. Students who take the SAT receive two section scores, three test scores, seven subscores, and two cross-test scores. This large-scale national study explored the relationships between these SAT measures and student performance in multiple corresponding domains of academic study.

The results of this study show that SAT section, test, cross-test, and subscores are useful in predicting student performance in the matching academic domain—on their own and in conjunction with HSGPA.

Moreover, the positive relationships between the studied SAT section, test, subscore, and cross test scores and grades earned in corresponding college course domains indicate that the SAT is sensitive to instruction in English language arts, math, science, and history/social studies.

SAT Scores as Independent Measures

For all nine outcomes, as SAT score bands increased, so did the mean domain-specific GPAs in a stair-step fashion. Students with higher SAT scores earned higher GPAs on average across all nine domain-specific outcomes, including those aligned with single subscores. The correlational results for the section, test, and cross-test scores corroborated those graphs, again indicating that higher scores were associated with higher grades.[8]

SAT Scores Combined with HSGPA

Though SAT scores and HSGPA all had positive relationships with the domain-specific outcomes aligned with section, test, and cross-test scores, the joint use of SAT scores and HSGPA improved the prediction of student performance in that domain. The three types of analyses in this report provided evidence of the benefits of using multiple measures to predict student performance.

Mean GPA across SAT Score Bands. After controlling for HSGPA, we clearly observed that students' mean GPAs increased as SAT scores increased.[9] If SAT scores added nothing to the prediction of the examined domain-specific GPAs, within each level or category of HSGPA the mean GPA within each SAT score band would have been identical, and we would not see that stair-step increase in mean GPA with each increase in SAT score band.

Probabilities of Success. At every point across the HSGPA scale, students with higher SAT scores had higher probabilities of earning a GPA of 2.50 or higher and earning a GPA of 3.00 or higher. If SAT scores added nothing to HSGPA, there would have been a single curve in each figure associated with the probability analyses. Rather than a single curve, we saw clear differentiation between the probabilities of success for students with the same HSGPA but different SAT scores. Using SAT scores in conjunction with HSGPA in a compensatory model helps institutions predict a student's likelihood of succeeding in

[8] Results for analyses with subscores as predictors were limited in this report because they were largely redundant with the results found using the SAT section and test scores. That is, there were positive relationships between the subscores and the outcomes of interest, and when multiple subscores were used together as predictors the results were very similar to those using the test and section scores as predictors. Which SAT scores educators and researchers choose to employ should depend upon the particular use and/or decision to be made based on the score. Large differences between subscores associated with a test may indicate that a student has a weakness in that narrower domain and may need support.

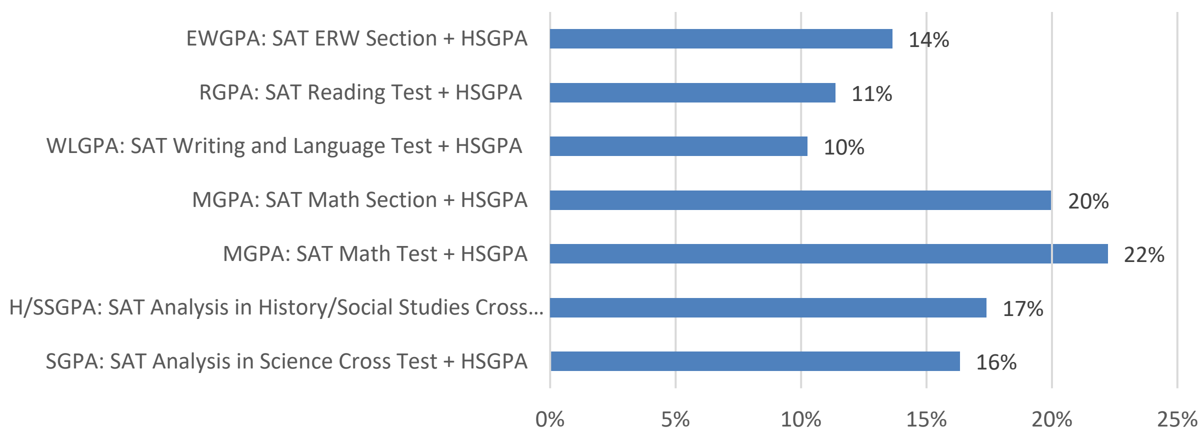
[9] There were two instances where – within a single HSGPA category – students in an SAT score band earned a lower mean GPA than did students in the lower SAT score band or students in a lower SAT score band earned a higher GPA than did students in the next higher score band. In both cases, the number of students within the score band with an aberrant mean GPA was less than 30, and these students had discrepant scores – either high SAT score and low HSGPA, or high HSGPA and low SAT score. These aberrant patterns were seen in Figure 12 (WLGPA for HSGPA category C+ or lower and SAT Writing and Language Test score band 35-40, n = 27) and in Figure 29 (SGPA, HSGPA category A+ and Analysis in Science score band 15-19, n = 23). This may happen when sample sizes are small and/or students come from different institutions with different grading standards.

college despite having a low level of performance on either of the two predictors. While this compensation generally worked both ways, we want to emphasize that for math and science grades, having a high HSGPA did not fully compensate for a low SAT Math scores.

Correlations. For all outcomes examined, the correlational analyses revealed that the multiple correlations for SAT scores and HSGPA with the domain-specific GPAs were higher than the correlations for single measures—SAT score or HSGPA—with the domain-specific GPAs. Multiple correlations for SAT scores and HSGPA with the domain-specific GPAs ranged from .43 (WLGPA) to .57 (SGPA). These are moderate to large effect sizes (Cohen, 1988).

Figure 32 further illustrates the advantage of using multiple measures rather than HSGPA or SAT scores alone. Using the correlations from this report (Table B 1), we can calculate the percentage increase in utility of using both SAT scores and HSGPA versus using HSGPA alone to predict the domain-specific GPAs. For example, the multiple correlation between SAT Math section scores and HSGPA with Math GPA was .54, a 20% increase beyond the correlation between HSGPA and Math GPA, .45. Regardless of which single predictor had the stronger relationship with the corresponding domain-specific GPA, the joint use of SAT scores and HSGPA provides more information.

Figure 32: Percentage Increase in Predictive Utility beyond Using HSGPA Alone



Note: Percentages calculated using the rounded correlations presented in Table B1.

The value of multiple measures is an outcome worth repeating. All three types of analyses show that a greater understanding of students' academic performance can be gained when using SAT scores and HSGPA together. Perhaps the most important takeaway from this study is that understanding student capabilities in particular academic areas can help higher education institutions target instructional support to ensure student success or accurate course placement. This is critical because academic performance is the best predictor of student retention (Pascarella & Terenzini, 2005) and a strong predictor of degree completion (Adelman, 2006).

Conclusion

Findings from the current study validate the alignment between SAT section, test, subscores, and cross-test scores with student performance in multiple domains of academic course work. The SAT measures studied had positive relationships with nine different domains of academic knowledge, demonstrating the value and effectiveness of SAT scores as tools for postsecondary institutions to use to inform decisions related to admission, course placement, and course/major field advising. Moreover, institutions may utilize this information to direct instructional supports and interventions to students who may need them to be successful in their academic endeavors. This study finds that

- SAT scores are strongly predictive of college performance: students with higher SAT scores are more likely to have higher college grades across multiple academic domains.
- SAT scores and HSGPA are both related to performance in the academic domains but tend to measure slightly different aspects of academic preparation. Using SAT scores in conjunction with HSGPA is the most powerful way to predict future academic performance.
    - On average, SAT scores add 15% more predictive power above using HSGPA alone to an understanding how students will perform in multiple academic domains.
    - SAT Math scores add about a 20% increase in predictive power above HSGPA alone, and we observe that high HSGPAs in the absence of strong SAT Math performance cannot compensate for the lower SAT performance in that domain with regard to first semester Math GPA.
    - SAT scores help further differentiate student performance in academic domains within narrow HSGPA ranges.
- Colleges can use SAT scores to identify students who may need academic support before they start college.
- Colleges can use SAT scores to inform advising conversations with students about course work and selection of major.

College Board will continue to maintain a robust and ongoing national SAT validity research agenda, which will include the study of SAT score relationships with performance, as well as with longer-term outcomes, including degree completion. College Board also provides a free online service for higher education institutions and systems (Admitted Class Evaluation Service, ACES) to conduct campus or system-specific validity studies (with outcomes such as FYGPA, course grades, retention, completion) that meet their specific institutional needs.

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Appendix A: Descriptive Statistics by Outcome Sample

Table A 1: Descriptive Statistics for Predictor Variables by Outcome Samples

	English GPA (*n*=189,674)		Reading GPA (*n*=189,458)		Writing and Language GPA (*n*=132,609)		Math GPA (*n*=138,625)		History/Social Studies GPA (*n*=183,151)		Science GPA (*n*=111,554)	
Measure	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*
SAT ERW Section Score	592	82	592	82	582	80	596	82	593	82	607	79
SAT Math Section Score	586	92	586	92	578	91	597	93	586	92	607	90
SAT Reading Test Score	30	4	30	4	29	4	30	4	30	4	30	4
SAT Writing and Language Test Score	30	4	30	4	29	4	30	4	30	4	30	4
SAT Math Test Score	29	5	29	5	29	5	30	5	29	5	30	4
SAT Analysis in History/ Social Studies Cross-Test Score	30	4	30	4	29	4	30	4	30	4	30	4
SAT Analysis in Science Cross-Test Score	30	4	30	4	29	4	30	4	30	4	31	4
HSGPA	3.65	0.48	3.65	0.48	3.60	0.48	3.68	0.47	3.66	0.47	3.75	0.44
Outcome GPA	3.05	0.95	3.05	0.95	3.13	0.97	2.73	1.16	2.89	1.00	2.80	1.03

Appendix B: Correlations between Predictors and Outcomes

Table B 1: Adjusted (Raw) Correlations between Predictors and First Semester Outcomes

First Semester Outcome (*k*, *n*)	Predictors	Adjusted (Raw) Correlations	Incremental Validity of SAT	% Increase beyond HSGPA
English and Writing GPA (*k*=168; *n*=189,663)	SAT ERW Section+ HSGPA	.50 (.34)	.06	14%
	HSGPA	.44 (.27)		
	SAT ERW Section	.38 (.23)		
Reading GPA (*k*=168; *n*=189,447)	SAT Reading Test + HSGPA	.49 (.33)	.05	11%
	HSGPA	.44 (.27)		
	SAT Reading Test	.36 (.20)		
Writing and Language GPA (*k*=165; *n*=132,571)	SAT Writing and Language Test + HSGPA	.43 (.29)	.04	10%
	HSGPA	.39 (.25)		
	SAT Writing and Language Test	.31 (.17)		
Math GPA (*k*=167; *n*=138,608)	SAT Math Section + HSGPA	.54 (.37)	.09	20%
	HSGPA	.45 (.26)		
	SAT Math Section	.46 (.29)		
Math GPA (*k*=167; *n*=138,608)	SAT Math Test + HSGPA	.55 (.37)	.10	22%
	HSGPA	.45 (.26)		
	SAT Math Test	.46 (.29)		
History and Social Studies GPA (*k*=168; *n*=183,141)	SAT Analysis in History/Social Studies Cross-Test + HSGPA	.54 (.37)	.08	17%
	HSGPA	.46 (.29)		
	SAT Analysis in History/Social Studies Cross-Test	.40 (.24)		
Science GPA (*k*=168; *n*=111,554)	SAT AIS Cross-Test + HSGPA	.57 (.38)	.08	16%
	HSGPA	.49 (.27)		
	SAT Analysis in Science Cross-Test	.48 (.29)		

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