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Answers in the Tool Box: Academic Intensity, Attendance Patterns, and Bachelor's Degree Attainment — June 1999

Executive Summary

Answers in the Tool Box is a study about what contributes most to long-term bachelor's degree completion of students who attend 4-year colleges (even if they also attend other types of institutions).

Degree completion is the true bottom line for college administrators, state legislators, parents, and most importantly, students—not retention to the second year, not persistence without a degree, but completion.

This study tells a story built from the high school and college transcript records, test scores, and surveys of a national cohort from the time they were in the 10th grade in 1980 until roughly age 30 in 1993. The story gives them 11 years to enter higher education, attend a 4-year college, and complete a bachelor's degree. In these respects—based in transcripts and using a long-term bachelor's degree attainment marker—this story is, surprisingly, new.

This study was motivated by four developments in higher education during the 1990s:

1. The growing public use of institutional graduation rates as a measure of accountability, and the tendency in public policy and opinion to blame colleges for students' failure to complete degrees and/or for failure to complete degrees in a timely manner.

2. An ever expanding proportion of high school graduating classes entering postsecondary education, and new federal policies encouraging even more students to enter or return to higher education. Our system is being challenged simply to maintain, let alone improve, college graduation rates.

3. The increasing tendency, overlooked in both policy and research, for students to attend two, three, or more colleges (sometimes in alternating patterns, sometimes simultaneously) in the course of their undergraduate careers.

4. The rising heat of disputes involving admissions formulas at selective colleges where affirmative action policies have been challenged. These disputes, carried into the media and hence dominating public understanding, involve two indicators of precollege attainment—grades/class rank *versus* test scores—without any reference to high school curriculum and its role in the degree completion rates of the mass of minority students.

The story of what contributes most to bachelor's degree attainment works toward six ordinary least squares regression equations that progressively add blocks of key variables following the progress of students from high school into higher education and through the first true year of attendance. The penultimate model (the fifth in the series) accounts for about 43 percent of the variance in bachelor's degree completion. The sixth equation simply indicates that one hits a plateau of explanation at this point. For a story-line such as this, 43 percent is a very high number. A five-step logistic regression then provides both a dramatic underscoring of the principal findings and some enlightening variations.

There are 11 variables in the penultimate linear regression model. The two most important variables, accounting for the bulk of the model's explanatory power are:

- "Academic Resources," a composite measure of the academic content and performance the student brings forward from secondary school into higher education. This measure is dominated by *the intensity and quality of secondary school curriculum* [Part I and Appendix C].

- Continuous enrollment once a true start has been made in higher education.

In the logistic version of the penultimate model, the same 11 variables (out of 24) are statistically significant, but those displaying the strongest relationships to degree completion (the highest "odds ratios") are all post-matriculation phenomena: continuous enrollment, community college to 4-year college transfer, and the trend in one's college grades.

Among the 11 variables, the following are not usually found in similar analyses:

- Proportion of undergraduate grades indicating courses the student dropped, withdrew, left incomplete, or repeated.

- A final undergraduate grade point average that is higher than that of the first "true" year of attendance.

- Parenthood prior to age 22.

- Whether the student attended more than one institution and did *not* return to the first institution of attendance, a situation that includes, but transcends, the classical community college to 4-year college transfer pattern.

The only demographic variable that remains in the equation at its penultimate iteration is socioeconomic status, and by the time students have passed through their first year of college, SES provides but a very modest contribution to eventual degree completion. No matter now many times (and in different formulations) we try to introduce race as a variable, it does not meet the most generous of threshold criteria for statistical significance.

Selected Findings

High School Background

- High school curriculum reflects 41 percent of the academic resources students bring to higher education; test scores, 30 percent; and class rank/academic GPA, 29 percent. No matter how one divides the universe of students, the curriculum measure produces a higher percent earning bachelor's degrees than either of the other measures. The correlation of curriculum with bachelor's degree attainment is also higher (.54) than test scores (.48) or class rank/GPA (.44).

- The impact of a high school curriculum of high academic intensity and quality on degree completion is far more pronounced and positively-for African-American and Latino students than any other pre-college indicator of academic resources. The impact for African-American and Latino students is also much greater than it is for white students.

- Of all pre-college curricula, the highest level of mathematics one studies in secondary school has the strongest continuing influence on bachelor's degree completion. Finishing a course beyond the level of Algebra 2 (for example, trigonometry or pre-calculus) more than doubles the odds that a student who enters postsecondary education will complete a bachelor's degree.

- Academic Resources (the composite of high school curriculum, test scores, and class rank) produces a much steeper curve toward bachelor's degree completion than does socioeconomic status. Students from the *lowest* two SES quintiles who are also in the *highest* Academic Resources quintile earn bachelor's degrees at a higher rate than a majority of students from the top SES quintile.

- Advanced Placement course taking is more strongly correlated with bachelor's degree completion than it is with college access.

- Graduating from high school "late" does not influence bachelor's degree completion provided that one enrolls in higher education directly following receipt of the diploma and attends a 4-year college at some time.

College Attendance Patterns

- The proportion of undergraduate students attending more than one institution swelled from 40 percent to 54 percent (and among bachelor's degree recipients, from 49 to 58 percent) during the 1970s and 1980s, with even more dramatic increases in the proportion of students attending more than two institutions. Early data from the 1990s suggest that we will easily surpass a 60 percent multi-institutional attendance rate by the year 2000.

- Students beginning in highly selective 4-year colleges and those starting out in open door institutions have the highest rates of multi-institutional attendance, though for very different reasons.

- The number of institutions attended by students has no effect on degree completion.

- The fewer schools attended, the more likely the student was enrolled continuously, and the less likely a 4-year college was part of the attendance pattern. Students who move from one sector (2-year, 4-year, other) to another are the least likely to be continuously enrolled.

- Sixteen (16) percent of postsecondary students (and 18 percent of bachelor's degree completers) engaged in alternating or simultaneous enrollment patterns. Some 70 percent of this group attended three or more institutions.

- Some 40 percent of students who attended more than one institution crossed state lines in the process, and their bachelor's degree completion rate was higher than that for multi-institutional students who remained within state borders.

- Students who expected to earn a bachelor's degree, started in a 2-year institution, but never attended a 4-year college have a lower SES profile and a considerably lower academic resources profile than students with the same expectations and starting point but who did attend a 4-year school. Family income, however, plays no role in the different attendance patterns of these students.

Degree Completion

- For students who attend 4-year colleges at some time, the only form of financial aid that bears a positive relationship to degree completion after a student's first year of college attendance is employment (principally College Work-Study and campus-related) undertaken (a) while the student is enrolled and (b) for purposes of covering the costs of education.

- The long-term national *system* bachelor's degree completion rate by age 30 for all *students* who attend 4-year colleges is 63 percent; for all those who earn more than 30 credits, the rate exceeds 70 percent. For those who start in highly selective colleges, the rate exceeds 90 percent.

- While only 26 percent of students who began their undergraduate careers in community colleges formally transferred to 4-year institutions, their bachelor's degree completion rate was over 70 percent. The classic form of transfer, in which the student earns at least a semester's worth of credits before moving to the 4-year college, produces a very high likelihood of bachelor's degree completion.

- The mean elapsed time to complete a bachelor's degree for this cohort was 4.72 *calendar* years, or 5 full academic years. For students in the highest quintile of pre-college academic resources, the mean time was 4.45 calendar years. For students who were continuously enrolled, it was 4.33 calendar years. [Appendix D]

- Thirty-nine percent of 4-year college students who were assigned to remedial reading courses completed bachelor's degrees, compared with 60 percent of students who took only one or two *other* types of remedial courses, and 69 percent of those who were not subject to remediation at all.

- Students who attend 4-year colleges and who earn fewer than 20 credits in their first calendar year of postsecondary experience severely damage their chances of completing a bachelor's degree.

Conclusions That Follow from These Findings

- When nearly 60 percent of undergraduates attend more than one institution and 40 percent of this group do not complete degrees, institutional graduation rates are not very meaningful. It is not wise to blame a college with superficially low graduation rates for the behavior of students who swirl through the system.

- Analysis of institutional effects on degree completion is compromised when students attend two or more institutions. One wastes precious research time trying to figure out which type of experience in institution X had an impact if the student also attends institutions Y and Z. There are some exceptions to these principles, e.g. when the second institution involves a study abroad semester.

- When the academic intensity and quality of one's high school curriculum is such a dominant determinant of degree completion, and both test scores and (especially) high school grade point average or class rank are so much weaker contributors to attainment, college admissions formulas that emphasize test scores and (especially) high school grade point average or class rank are likely to result in lower degree completion rates.

- The type and amount of remediation matters in relation to degree completion. Increasingly, state and local policy seeks to constrictif not eliminatethe amount of remedial work that takes place in 4-year colleges. But there is a class of students whose deficiencies in preparation are minor and can be remediated quickly without excessive damage to degree completion rates.

What We Learned: Variables to Discard

Examples of stock building-block variables that are discarded because of weak architecture:

- Highest level of parents' education. As reported by students, these data are uneven and unreliable. In the most recent of the national longitudinal studies, the *highest* degree of agreement between students and parents on this score was 72 percent in the case of fathers with "some college." One out of six students would not even venture a guess as to their parents' education.

- "Persistence" defined in temporal terms, e.g. from the 1st to 2nd year of college. Transcripts reveal an enormous range in the *quality* of arrival at the putative 2nd year: some 30 percent of those who were "retained" or "persisted" arrived with either less than 20 credits or 3 or more remedial courses.

- "Academic track" (sometimes called "college preparatory") in secondary school curriculum, whether reported by students or by schools. When the transcripts for a third of the students on the "academic track" show 8 or fewer Carnegie units in core academic subjects, it is obvious that the transcripts—not the label—must be the source of judgment.

- "Part-time" enrollment in postsecondary education. Students change status from term to term. Part-year enrollment may be more important than light credit loads. Most importantly, students change status within a given term, by dropping, withdrawing from, or leaving incomplete large portions of their credit loads. The "DWI Index" (ratio of drops/withdrawals/incompletes to total courses attempted) derived from transcript records is far more important than what the student says in an interview about full-time/part-time status.

. . . and Variables Reconstructed

- Academic intensity and quality of high school curriculum. This is the most elaborate construction in the study. It includes Carnegie units in 6 academic areas, accounts for highest mathematics studied, remedial work in English and math, and advanced placement. The construction results in a criterion-referenced scale with 40 gradations.

- Educational aspirations. Traditionally defined on the basis of a single question asked in the senior year of high school. Reconstructed on the bases of 6 pairs of questions asked in both 10th and 12th grades, and on the principles of consistency and level. The result is a statement of "anticipations," not "aspirations."

- First institution/date of attendance in postsecondary education. Redefined from college transcript data to exclude false starts and incidental attendance in the summer following high school graduation.

- Transfer. The classic form of community college to 4-year college transfer is now a sub-set of a larger multi-institutional attendance pattern universe defined here in terms of 9 sets of institutional-type combinations. Transfer as we knew it has been replaced by what one might call "portfolio building." But the classic form of transfer is an extremely effective route to bachelor's degree completion.

What We Learned: Principles to Guide Research and Evaluation

- Institutions may "retain" students, but it's *students* who complete degrees, no matter how many institutions they attend. So follow the student, not the institution.

- Common sense can tell us what's likely to be important at every step toward the degree. A fierce empiricism will validate common sense.

- Before one accepts a variable simply because it has been used for decades or because a federal agency paid for it, one must examine the bricks and mortar of that variable very carefully. Where the architecture is faulty, the data must be fixed or the variable discarded—or one will never tell a true story.

- We should not compute bachelor's degree attainment rates for people who never set foot in a bachelor's degree-granting institution.

- The most useful data lie in the details, not the generalities.

The monograph concludes with "tool box" recommendations to those who execute policy regarding both pre-college opportunity-to-learn and post-matriculation advisement. The tool box metaphor is a logical consequence of the analysis. It says that if we are disappointed with uneven or inequitable outcomes of postsecondary education, we must focus our efforts on aspects of student experience that are realistically subject to intervention and change. We do not have tools to change intentions or perceptions, or to orchestrate affective influences on students' decisions. The events of students' life course histories through their 20s lie largely beyond the micromanagement of collegiate institutions. But we do have the tools to provide increased academic intensity and quality of pre-college curricula, to assure continuous enrollment, to advise for productive first-year college performance, and to keep community college transfer students from jumping ship to the 4-year institution too early.

The recommendations thus address dual enrollment, direct provision of secondary school curriculum by college instructors, an 11-month rolling admissions cycle for all 4-year colleges, using Internet situated courses to keep college students continuously enrolled (even for one course), implementation of institutional policies restricting the extent of course withdrawals/ incompletes/repeats, realistic credit loads, and advisement that is both sensitive and sensible.

The story and its analyses are derived from and apply to a cohort whose history covers the period 1980-1993. There is another and more contemporary cohort whose history, beginning in 1988, is still in progress. Will the story-line change? Will the analyses be validated? Will we have attained greater equity in degree-completion rates for minority students? Have attendance patterns become even more complex, and more or oriented toward competences and certifications as opposed to degrees? Only a full data-gathering for this cohort in the year 2000 and the collection of its college transcripts in 2001 will tell.

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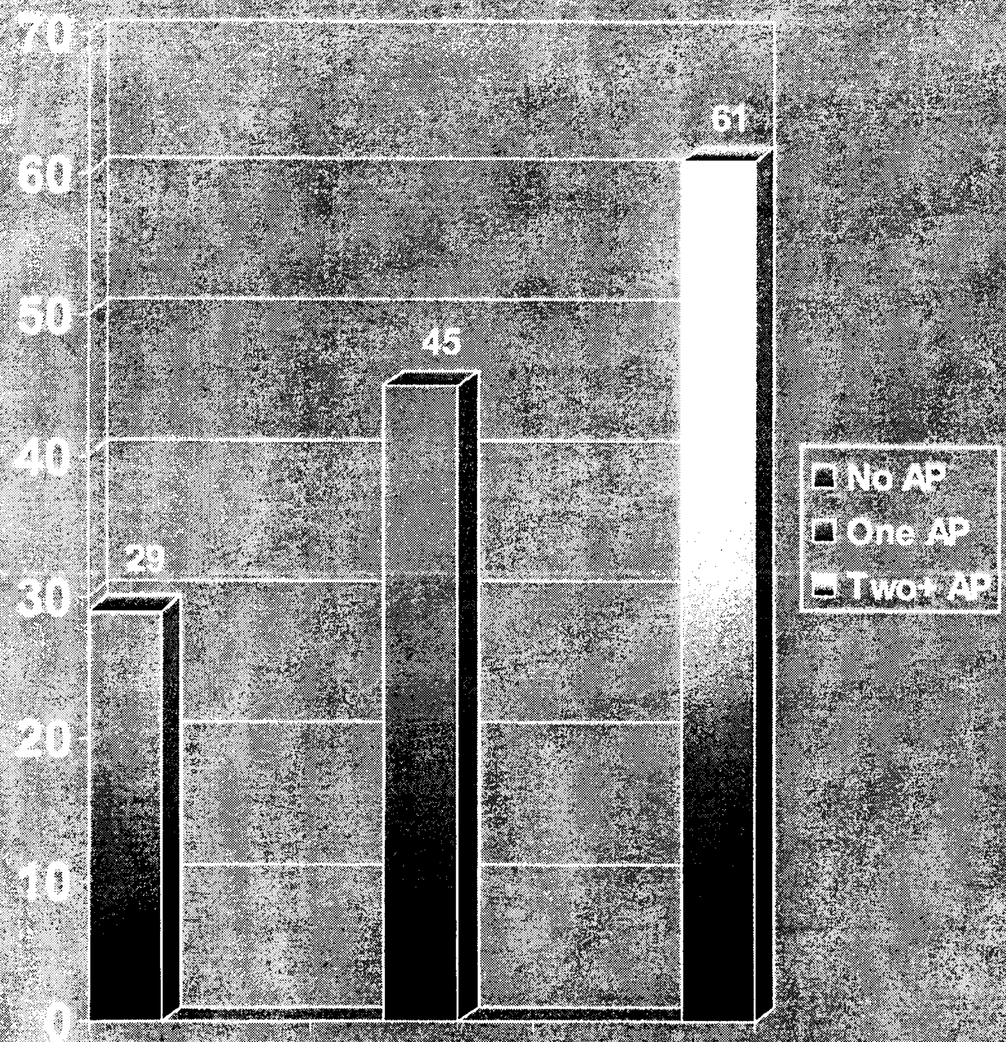
Acknowledgments PREV UP NEXT On Reading Tables In This Study

AP And College Success™



Students who take AP courses and exams are much more likely than their peers to complete a bachelor's degree in four years or less.

Source: Camara, Wayne. (2003). College Persistence, Graduation, and Remediation. *College Board Research Notes (RN-19).* New York, NY: College Board.

The College Board
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Research Notes
RN-19, March 2003

College Persistence, Graduation, and Remediation

Wayne J. Camara

I. PERSISTENCE AND EDUCATIONAL ATTAINMENT

Understanding the Data

Data on college persistence and graduation often appear inconsistent and overly complex because different groups of students are often defined in different reports, and a variety of metrics are used to evaluate these outcomes. For example, colleges generally define graduation rates in terms of first-time freshmen who complete a bachelor's degree at that institution within a specific period of time. When students leave an institution, they may either be leaving postsecondary education permanently or transfering to another institution. From that institution's perspective, all students who leave prior to degree completion are considered dropouts. However, students who transfer to another institution and graduate are not considered dropouts within the broader higher education system from any perspective (DOE, NCES, 2003). Therefore, it is helpful to distinguish between institutional completion rates (bachelor's degree attainment of students at the first institution they attended) and student completion rates (bachelor's degree attainment anywhere).

College completion rates not only differ by institutional or student perspectives, but also by subcategory of students being considered. The completion rates can be quite different among first-time college students (students who first enter college at any time), high school graduates or "traditional students" who enter college as full-time students immediately after high school with no delay, and several categories of nontraditional students (these include students who delay entry into college by a couple of years, to those who enter college decades after high school). In addition, part-time and full-time students are yet another distinction made in describing college completion.

Enrollment in Postsecondary Education by Institutional Type: Students Who Entered Higher Education in 1995-96

Public two-year institutions or community colleges	46%
Public four-year institutions	26%
Private four-year institutions	15%
Private for-profit institutions or vocational programs of less than four years	10%
Other institutions	3%

Bachelor's Degree Attainment

Traditional college students (high school graduates who enroll in college full-time immediately after high school) comprised 83 percent of freshmen at four-year institutions in 1995-96. Sixty-four percent of these students attained a bachelor's degree in six years or less from a four-year institution versus 55 percent of all freshmen (DOE, NCES, 2003).

Persistence Track

When student persistence is tracked by following students who transfer from one institution to another institution, degree completion improves from 55 percent to 63 percent for the same students, as shown in Table 1. An additional 5 percent received an associate degree or certificate, 12 percent were still enrolled, 2 percent were enrolled at a two-year institution, and 18 percent left postsecondary education. Among all students who began postsecondary education (two- or four-year institutions) in 1995-96, 32 percent transferred to another postsecondary institution. Transfer rates were higher at two-year public institutions than four-year institutions, 42 percent versus 25 percent.

What happens to students who enter college as freshmen and don't graduate? Institutional graduation rates are lower than student graduation

TABLE 1
PERCENT OF STUDENTS BEGINNING FOUR-YEAR COLLEGES WHO COMPLETED A BACHELOR'S DEGREE AT ANY INSTITUTION IN SIX YEARS BY SUBCATEGORIES

		% of total	Institutional completion rate at first four-year institution	Student completion rate at any four-year institution
1	All beginners at four-year institutions	100	50.7	58.2
	Subcategories			
2	Enrolled full-time (first year)	90.4	54.1	62
3	Had a B.A. goal	90.3	55.3	62.7
4	Had a B.A. goal and enrolled FT	82.9	58	65.6
5	Recent HS graduate (no delay)	83.2	55.1	63.7
6	Recent HS graduate, with B.A. goal	76.5	59.2	67.4
7	Recent HS graduate, with B.A. goal and enrolled FT (first year)	73	60.6	68.6

Reprinted from DOE, NCES, 2003-151, pg.V, table A.

rates. From an institutional perspective, 86 percent of students who entered four-year postsecondary institutions in 1995-96 with a B.A. goal were still enrolled at that institution after one year, while 10 percent transferred and 3 percent left higher education. After two years, 73 percent persisted at the same institution, while 18 percent transferred and 6 percent left postsecondary education. After three years, 65 percent persisted at the same institution, 22 percent transferred, 9 percent left postsecondary education, 2 percent had a B.A., and 2 percent had attained an associate degree or certificate. At the end of six years, 55 percent had a B.A., 2 percent an associate degree or certificate, 7 percent were still enrolled, 23 percent had transferred, and 13 percent had left postsecondary education.

First-Generation Students

First-generation students are less likely to enroll in a four-year college than students with at least one parent who has a bachelor's degree (60 versus 70 percent); and if they do enroll, they are less likely to persist toward a degree three years later (13 versus 33 percent) (DOE, NCES, 2002).

Academic Preparation and College Completion

Rigorous academic courses in high school greatly improve college-going rates, but as importantly, dramatically increase students' success in college.[1] Three years after entering college, 87 percent of students who had taken rigorous course work in high school remained on track for a bachelor's degree compared to 62 percent of students who had not completed even a core curriculum.

The gap between first-generation and other students decreases for students who take more rigorous curriculum in high school. For example, among students completing a core curriculum, 55 percent of first-generation students persist beyond three years compared to 69 percent of students with a parent who has a four-year college degree. This 14-percent gap decreases to 10 percent when students take more than a core curriculum. However, among students who completed a rigorous curriculum, 81 percent of first-generation students are persisting at three years, as well as 89 percent of students with parents who have a four-year degree. Among these students the gap in college persistence is reduced to only 7 percent.

1. Core curriculum includes four years of English, two years of math, science, and social studies. Rigorous curriculum includes at least four years of English and mathematics (including precalculus), three years of science (including biology, chemistry and physics) and social studies, three years of foreign language, and at least one honors course or AP® Examination score.

TABLE 2 AP EXAMS AND DEGREE ATTAINMENT	At first four-year institution			At any four-year institution		
	4 years or less	More than 4 years	6 years	4 years or less	More than 4 years	6 years
None	26.9	22.1	49.0	28.9	27.4	56.3
One	42.5	22.3	64.8	44.9	27.2	72.1
Two or more	57.3	17.5	74.8	60.9	21.4	82.3

"Students who entered college with good academic preparation—those who received mostly A's in high school, took two or more AP® tests and had high SAT® scores (1030+)—also had higher completion rates than others. About 80 percent completed a bachelor's degree within six years, and more than one-half (55–61 percent) graduated within four years." (DOE, NCES, 2003-151, p.vii). In fact AP Exams are a strong indicator of bachelor's degree attainment, as shown in Table 2.

Risks to College Completion

There are a number of risk factors that reduce college completion rates. As noted earlier, first-generation students have lower completion rates, but these are mitigated by rigorous course work in high school. Students who complete less than rigorous courses have lower completion rates than students who complete a core curriculum, and students who complete less than a core curriculum are at greatest risk for not receiving a degree. Transferring colleges, attending part-time, and non-continuous enrollments are associated with lower persistence and graduation rates. Parental income was much less of a influence on degree attainment than these student behaviors. For example, 22 percent of students from families with incomes below $25,000 received a degree in more than four years compared to 30.8 percent of students from families with incomes above $70,000.

Ethnicity/Race

There remain significant differences in educational attainment by ethnicity and race, although gaps have decreased significantly in the past 30 years. Table 3 illustrates the percent of 25- to 29-year-olds at different levels of educational attainment between 1971 and 2001 (DOE, NCES *Condition of Education, 2002*).

There are substantial differences among males and females within these groups. In 1971, females consistently had lower levels of educational achievement among all groups, except for blacks where a slightly higher proportion of females completed high school and some college. Today, females had higher levels of all categories of educational attainment and among all of these groups. The gender gap favoring males appeared to change and advantage females in terms of high school graduation in 1981-83, in terms of some college in 1985-86, and in terms of college graduation in 1990-93. The largest gender gap for high school graduation is among Hispanic students (59 percent male versus 67 percent females) and is more consistent across all groups in terms of college attendance and completion. Today 54.4 percent of males attend some college and 26.2 percent have attained a B.A. or higher, compared to 62.5 percent and 31.1 percent of females, respectively.

TABLE 3 EDUCATIONAL ATTAINMENT	All		White		Black		Hispanic	
	1971	**2001**	**1971**	**2001**	**1971**	**2001**	**1971**	**2001**
HS completion	77.7	87.7	81.7	93.3	58.8	87	48.3	63.2
Some college	33.9	58.4	36.7	64.8	18.2	50.5	14.8	32.2
B.A. or higher	17.1	28.7	18.9	33.0	6.7	17.9	5.1	11.1

II. REMEDIATION

Student Rates

A report by the Southern Regional Education Board (SREB, 2000) notes that remedial education is now needed by about one-third of students who enter higher education where college placement tests are used. The report goes further to state that there is no typical remedial student; often students with high grades and college-preparatory courses are in need of remediation in college.

A 1995 survey of colleges reported 29 percent of all first-time freshmen enrolled in at least one remedial course and about 75 percent of these students eventually pass or complete those courses successfully (DOE, NCES, 1996). Fifty-six percent of those in remediation were freshmen, and 24 percent were sophomores, with juniors and seniors comprising an additional 18 percent. In one of the only national studies of students who received remediation, a cohort of students who graduated from high school in 1982 were followed until they were 29–30 years of age. The data were clear—students assigned to remedial reading in college are much more likely to take additional remediation courses and have a substantially lower rate of graduation.

Students who take remedial courses in math or reading, especially remedial reading, have a substantially smaller probability of graduation from college. Sixty-three percent of students attending a two-year college took one or more remedial course compared to 40 percent of students attending a four-year college. Math remediation rates were nearly twice the rate of reading remediation courses.

Tennessee and Oklahoma report that remediation rates are higher among less-traditional students who graduated more than one year prior to enrolling as freshmen in higher education. Academic rigor is also related to remediation. In Georgia, 80 percent of students who did not complete a core curriculum took at least one remedial course while only 20 percent of students who did complete such a curriculum required remediation. Similar results have been reported in Maryland where students not taking a core curriculum were 50 percent more likely to be placed in remedial writing, math, and reading courses (SREB, 2000).

Remedial Courses

A 1995 survey of remediation in colleges (DOE, NCES, 1996) indicated that 78 percent of institutions offered a least one remedial course, with 100 percent of two-year colleges offering remedial courses. The average number of remedial courses at an institution was: 2.1 reading, 2.0 writing, and 2.5 math. About 47 percent of institutions surveyed indicated students enrolled in remedial courses has remained the same over the past five years, while 39 percent and 14 percent, respectively, said remediation rates increased or decreased. Placement testing was the most common method for selecting students for remediation (60 percent) and 1.3 of institutions offering remediation reported there were state policies or laws affecting offerings at their institutions (DOE, NCES, 1996).

Among first-time freshmen in 1995 across all institutions:

- 17 percent were in remedial writing courses—up 1 percent from 1989.
- 13 percent were in remedial reading courses—the same as in 1989.
- 24 percent were in remedial math courses—up from 21 percent in 1989.

At four-year institutions in 1995:

- 12 percent of students at public institutions and 8 percent at private institutions were in remedial writing courses.
- 8 percent of students at public institutions and 7 percent at private institutions were in remedial reading courses.
- 18 percent of students in public institutions and 9 percent at private intuitions were in remedial math courses.

Figure 1 shows the percent of students receiving an associate or bachelor's degree from 1980 to 1993 by extent and type of remedial courses in college.

The Institute for Higher Education Policy (1998) estimated that remediation costs $2 billion annually in public higher education. Costs vary greatly by state and institutional type. Firm estimates of the extent and cost of remediation may often be understated for a variety of reasons, ranging from different definitions on what constitutes a remedial course and a student enrolled in remedial courses, to how direct and indirect costs associated with remediation are classified and the

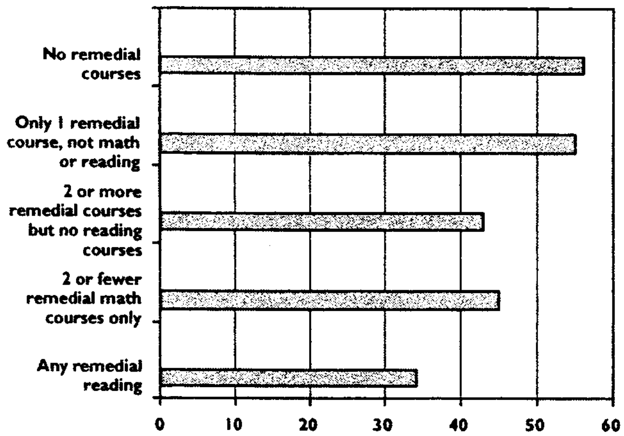

Figure 1. Percent of students receiving an associate or bachelor's degree 1980-93 by extent and type of remedial courses in college. Reprinted from *The Condition of Education, 2001*, pg. 40, Indicator 29, DOE, NCES, 2001.

extent they can be separated from other institutional costs. Finally, the stigmatizing factor for the student and the negative incentives for institutions may also result in underreporting of remediation rates (The Institute for Higher Education Policy, 1998).

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Impact of AP on 5-Year College Graduation Rates

Student Group	AP Exam Grade of 3, 4, 5	AP Exam Grade of 1, 2	Took AP course, but not exam
African-American	28% higher	22% higher	16% higher
Hispanic	28% higher	12% higher	10% higher
White	33% higher	22% higher	20% higher
Low-Income	26% higher	17% higher	12% higher
Not Low-Income	34% higher	23% higher	19% higher

Source: Chrys Dougherty, Lynn Mellor, and Shuling Jian, *The Relationship Between Advanced Placement and College Graduation* (National Center for Educational Accountability, 2005)

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The Relationship between Advanced Placement and College Graduation

2005 NCEA Study Series, Report 1 – October 2005

Chrys Dougherty, Lynn Mellor, and Shuling Jian, National Center for Educational Accountability

The Relationship Between Advanced Placement and College Graduation

Chrys Dougherty, Lynn Mellor, and Shuling Jian, National Center for Educational Accountability

Abstract

This study explores the relationship between college graduation rates and student participation and success in Advanced Placement (AP) courses and exams. We reviewed three approaches to examining this relationship: 1) comparing the college graduation rates of AP and non-AP students; 2) comparing the college graduation rate of AP and non-AP students after controlling for students' demographics and prior achievement and the demographics of their high schools; and 3) examining the relationship between percent of students from a given high school graduating from college, and the school's percent of students in Advanced Placement. We conclude that the percent of a school's students who take and pass AP exams is the best AP-related indicator of whether the school is preparing increasing percentages of its students to graduate from college. The importance of AP exam results indicates the need for schools and districts to pay close attention not only to the quality of teaching in Advanced Placement courses but also to improving the academic preparation of students prior to their enrollment in those courses.

Introduction

Education policymakers are interested in recruiting more low-income and minority students into college. For example, Texas has set a goal of attracting 500,000 additional low-income and minority students into Texas public higher education institutions by the year 2015 (Texas Higher Education Coordinating Board, 2004). Yet labor market data tell us that these students are best served if they are also able to graduate from college. Students' academic readiness for college when they leave high school has long been recognized as an important predictor of college completion rates (Adelman, 1999).

One approach to strengthening high school students' college readiness has been to increase their participation in Advanced Placement courses and exams, as students who take and pass AP exams have demonstrated the ability to do college-level work prior to leaving high school. Traditionally Advanced Placement courses were confined to a small minority of highly prepared students, and some high schools excluded all but their top students from taking those courses.[1] More recently participation in Advanced Placement courses has expanded as selective colleges take students' AP course-taking into account in their admissions decisions and as incentive programs have been introduced to encourage a broader student population to take AP courses and exams.

Over the last ten years AP incentive programs have been funded in districts serving large concentrations of low-income and minority students. One such program, funded by the O'Donnell Foundation in Dallas, Texas, has been accompanied by large percentage increases in low-

[1] This practice is documented in Jay Mathews' book *Class Struggle: What's Wrong (and Right) about America's Best Public High Schools*, Times Books, 1998.

income students' AP course participation and exam success.[2] This raises the following question of interest to educators and policymakers:

> By increasing the participation of low-income and minority students in Advanced Placement, are schools and districts improving those students' likelihood of graduating from college?

Answering this question in a way that would isolate the "AP impact" on college graduation rates would require random assignment of students to AP and non-AP classes, an approach that is not feasible in education. However, three questions we *can* answer are:

1. Do students in Advanced Placement graduate from college at higher rates than non-AP students?

2. Do students in Advanced Placement graduate from college at higher rates than non-AP students, controlling for the students' observed characteristics and the characteristics of their schools?

3. Do high schools with a higher percentage of students in Advanced Placement have higher college graduation rates of their students who attend college, controlling for the measured characteristics of those schools?

The answers to these questions should be interpreted based on their ability to address competing explanations of the relationship between Advanced Placement and college graduation rates. These alternative explanations include:

- Self-selection within the school: Better prepared and more highly motivated students are more likely to choose to take AP courses and exams. Much of those students' later success in college may be due not to the AP classes themselves, but to the personal characteristics that led them to participate in the classes in the first place – better academic preparation, stronger motivation, better family advantages, and so on. These selection effects will affect any comparison of AP and non-AP students. Missing is a comparison of the college graduation rates of two *otherwise similar* groups of students, one of which enrolled in AP and pre-AP classes and the other of which did not.

- Select-selection between schools, and other between-school differences in student populations: AP students are likely to be enrolled in schools with more advantaged and academically-focused student bodies, as the largest Advanced Placement programs are likely to be found in such schools. These schools would have produced more college graduates than other schools even if their AP programs had not been present. Strong AP programs may also attract more academically focused students to attend the school and participate in the program.

- Differences in school programs and strategies not directly related to AP: High schools with strong AP programs may be more effectively organized in other ways, and thus produce more college graduates as a result of these other school attributes. Whereas

[2] Dallas is a district with a 76% low-income and 93% minority student population. Between 1996 and 2001 the percentage of students in non-magnet schools taking and passing AP exams increased by 194%; and in magnet schools the percentage increased by 137%.

the previous explanation focused on the *students* the school attracts, this explanation focuses on the capacity and practices of the *school*.[3]

The first question – whether students in Advanced Placement have higher college graduation rates than their counterparts not in AP – does not address alternative explanations for why those students graduate at higher rates. Instead, the answer describes the size of the difference between AP and non-AP students that needs to be explained.

In answering the second question, we were able to control for some but not all of the preexisting student and school characteristics that might cause AP students to graduate from college at higher rates. In particular, information was available on students' demographic characteristics, prior test scores and completion of advanced courses other than AP, and on the demographics and average prior test scores in the high schools those students attended. Controlling for these variables gives us a limited ability to model a comparison of "otherwise similar" students. However, this approach cannot control for unobserved differences between students, such as greater motivation.

The third question bypasses entirely the problem of self-selection within the school. If better students self-select into AP classes, that should affect all comparisons between AP and non-AP students. However, if those classes merely select the best students without affect their college graduation chances, then moving more students into those classes should simply sort the students, but should not affect the school's overall college graduation rate. Thus, the college graduation rate of the school as a whole should not be affected by selection effects within the school.[4]

We were able to partly address differences in populations between schools in our answers to both the second and third questions. We included as control variables each high school's percentage of economically disadvantaged students,[5] the school's ethnic composition, and the average prior test scores of students before they entered the school. We eliminated magnet schools from the analysis in order to reduce the impact of self-selection of students between schools. However, in doing so, we could not completely eliminate the possibility that non-magnet schools with larger AP programs attract better students. That scenario would generate a relationship between AP and college graduation rates due to self-selection of students into schools that emphasize AP.[6]

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[3] A fourth explanation might be college practices not directly related to AP, for example, if AP students end up in colleges with better strategies for helping students graduate.

[4] By analogy, putting the taller students on the school basketball team affects comparisons of average height between basketball players and students who are not basketball players, but does not affect the overall average height of students in the school.

[5] To improve the accuracy of the low-income counts when many high school students do not participate in the free and reduced price lunch program, we used individual students' participation in the program in middle school wherever that information was available.

[6] We do not think this type of self-selection had a large impact on our results, based on the following information: We would expect advantaged parents to be more likely than low-income parents to choose their residence based on the perceived academic quality of the school. If these between-school self-selection effects dominated our results, then we would expect to see a stronger relationship between schoolwide AP exam passing rates and college graduation rates for advantaged students. However, the data showed the opposite: the relationship between schoolwide AP exam passing rates and college graduation rates was stronger for disadvantaged students.

Answering the second and third questions does not address alternative explanations related to school and district practices. Those practices, not just the AP and pre-AP classes themselves, may help to explain higher college graduation rates of students from those schools. The study of those practices is an important topic for further research.[7] A major reason for promoting success in Advanced Placement as a target is the idea that that will encourage schools to develop a wide range of practices that promote academic success.

To summarize, our answer to the first question defines the magnitude of the differences in college graduation rates that must be explained; our answer to the second partially eliminates self-selection within the school and between-school population differences as competing explanations; our answer to the third completely eliminates self-selection within the school and addresses between-school population differences as well as does our answer to the second question. Based on its ability to do the best job of addressing alternative explanations, we believe that the third question comes closest to answering the original question about the benefits of expanding AP programs.

Data and Methodology

Student Cohort Identification

To answer the three questions, we followed a statewide cohort of 67,412 1994 Texas 8th graders who graduated from high school in 1998 and enrolled in a Texas public college or university within twelve months after high school graduation. By the spring of 2003, the most recent year for which data were available at the time of this writing, these students had had five years to graduate from college.[8] The analysis focused on the odds that a student would graduate from a Texas public college or university with a Bachelor's degree in five years, given that he or she enrolled in any Texas public college, including two-year institutions, within twelve months after high school graduation.[9]

Students were followed from 8th grade in order to control for students' academic preparation prior to entering high school. Texas data were used because of the ability to track students longitudinally over an extended number of years, and to match K-12 and higher education data using a common student identifier. We disaggregated students by ethnicity into African-American, Hispanic, White, and "Other" (Asian and Native American), and separately by income into low- and non-low-income student groups, to look at the relationship of AP to college graduation separately for each group.

In the schoolwide analysis for Question Three, we limited ourselves to schools with at least 500 students overall and at least 15 students in the student group in question (e.g., African-American students). This reduced the size of our overall student cohort to 56,519 students.

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[7] NCEA has developed a conceptual framework, the Best Practices Framework, based on the study of school practices in over 300 elementary, middle, and high schools. This framework can be used to provide structure to such a research agenda.

[8] Appendix A (in preparation) contains a more complete description of this cohort.

[9] Many students enroll in two-year institutions and later transfer to four-year degree-granting programs. The odds that a student will enroll in college is the subject of a separate analysis that requires the use of data from the National Student Clearinghouse to track college enrollment across the U.S. This is especially important in the case of Advanced Placement programs, as students passing AP exams were less likely to enroll in a Texas public college or university than were students failing AP exams, probably because the exam passers were more likely to enroll in private and/or out-of-state universities.

Focus on Academic AP Courses and Exams

For each student, we recorded whether she or he took at least one academic AP course, took at least one academic AP exam, and what the student's highest score was on an academic AP exam. In this paper, "academic" AP courses and exams refer to those in English, mathematics, science, and social studies, on the premise that these areas were most likely to predict a student's college readiness.[10]

Based on this information, we divided students into four groups:

- Passed AP Exam: Students who took and passed at least one academic Advanced Placement exam with a score of 3 or above.
- Took, Did not Pass AP Exam: Students who took one or more academic AP exams, but did not pass any of them.
- Took AP Course, Not AP Exam: Students who took one or more academic AP courses, but did not take any academic AP exams.
- Took No AP Course or Exam: Students who took no academic AP courses or exams.

A student who took an AP exam without taking the corresponding AP course would be placed in the first or second group, depending on the student's score on the exam.

Use of Population AP Exam Passing Rates

For schoolwide analysis we used the *population* AP exam passing rate -- the percent of students in the cohort group in the school who pass at least one AP exam – as the definition of "AP exam passing rate." This rate should be distinguished from the AP *exam taker* passing rate, or the percent of AP exam takers who pass at least one exam. In the first statistic, the denominator is an entire student population, whereas in the second, the denominator is exam takers only. Schools can increase the exam taker passing rate by restricting the number of exam participants to a few top students. On the other hand, schools with broader student participation in AP courses and exams are likely to have higher population passing rates (NCEA research analyses).

Results

Question One: Do students in Advanced Placement graduate from college at higher rates than non-AP students?

A number of prior research analyses have established a predictive relationship at the individual level between Advanced Placement and college readiness and success measures.[11] The willingness of a student to enroll in an Advanced Placement course and take an AP exam

[10] Passing rates are higher in foreign languages because many native Spanish speakers can acquire easy college credit by taking and passing the Spanish Advanced Placement exam.
[11] Buck, Kostin and Morgan "Examining the Relationship of Content to Gender-Based Performance Differences in Advanced Placement Exams' College Board, 2002;
Division of Accountability Research, TEA: 'Advanced Placement and International Baccalaureate Examination Results in Texas 2002-03', August 2004.

conveys information about that student that predicts that the student is more likely to graduate from college. The student's success on AP exams conveys additional information (Table 1a).

Table 1a
Five-Year College Graduation Rates
In Texas Public Colleges and Universities

Student Group *(# Enrolled)*		**Passed AP Exam**	**Took, Did not Pass AP Exam**	**Took AP Course, Not AP Exam**	**Took No AP Course or Exam**
African American	% Graduating	53%	37%	30%	10%
(5831)	*# Enrolled*	*92*	*277*	*595*	*4867*
Hispanic	% Graduating	54%	29%	23%	8%
(15176)	*# Enrolled*	*459*	*1198*	*1704*	*11815*
White	% Graduating	65%	47%	41%	21%
(44048)	*# Enrolled*	*4413*	*3037*	*6214*	*30384*
Low Income	% Graduating	46%	27%	21%	7%
(17294)	*# Enrolled*	*492*	*1159*	*1870*	*13773*
Non Low-Income	% Graduating	66%	47%	41%	21%
(50118)	*# Enrolled*	*5057*	*3603*	*7114*	*34344*
Total	% Graduating	64%	42%	37%	17%
(67412)	*# Enrolled*	*5549*	*4762*	*8984*	*48117*

Appendix A contains a more detailed description of this student cohort. The four types of AP status are described in the methodology section above. The counts in this table show the denominator for each percentage: e.g., 92 African-American students in the cohort passed at least one academic AP exam and then enrolled in a Texas public college or university; of these, 53% (49 students) graduated from a Texas public college or university in the following five years.

Table 1b shows the differences indicated by Table 1a between the college graduation rates of the three student groups participating in AP – students passing exams, taking but not passing exams, and taking at least one course but no exam – and the students who took no AP course or exam. For example, this table shows that low-income students in the cohort who took and passed at least one academic Advanced Placement exam had a 39 percentage point higher college graduation rate (46% vs. 7%) than low-income students who did not take any AP course or exam.[12]

Table 1b
Differences in College Graduation Rates
Compared with Students Not Participating in Advanced Placement

Student Group	Passed AP Exam	Took, Did not Pass AP Exam	Took AP Course, No AP Exam
African-American	43%	26%	20%
Hispanic	45%	21%	15%
White	43%	26%	20%
Low-Income	39%	20%	14%
Non-Low-Income	45%	26%	20%

These differences are based on the percentages shown in Table 1. Apparent discrepancies are due to rounding of numbers, e.g., the college graduation rate for Hispanic AP exam passers was 45.4% higher (53.8% vs. 8.4%) than the graduation rate for Hispanic students who took no AP course or exam. This difference rounds to 45 not 46.

Because of self-selection, the statistics shown in Table 1b may not accurately predict what will happen to college graduation rates as additional students in a school enroll in Advanced Placement classes. The new students enrolling in the class are likely to be representative neither of the current students taking AP classes nor of the current students not in AP classes. Thus, the graduation rate they would have had had they stayed out of AP is not well predicted by that of the general population not in AP, and the rate they will likely have upon switching to AP may not be well predicted by that of the current students in AP.[13] If the newly enrolling students come from near the top of the group they switch from (current non-AP students) and are in the bottom half of the group they switch to (current AP students), then the predicted increase in their college graduation rate will be less than the differences shown in Table 1b.

[12] Students who transfer from Texas public colleges and universities to private or out-of-state colleges are lost from the data. If these students graduate at higher rates, the overall graduation rates shown here are an underestimate. One would expect that the underestimate would be more pronounced for academically better- prepared students.

[13] Monitoring how the college graduation rate of AP students changes as the group participating in AP becomes less selective over time provides a rough way to estimate the graduation rates of the "changing" students. This modeling will become possible in future years as additional cohorts of students are followed through college.

Question Two: Do students in Advanced Placement graduate from college at higher rates than non-AP students, controlling for the students' observed characteristics and the characteristics of their schools?

An alternative approach is to model the differences in college graduation rates of a hypothetical group of students who have the same measured student and school characteristics, but differ in whether they enrolled in an AP course, took an AP exam, and passed an AP exam. This is done using a hierarchical linear modeling (HLM) regression approach, as described in more detail in Appendix B.[14] This model answers the question, ""Do AP students do better than non-AP students with similar measured student and school characteristics?"

Table 2 shows the differences in predicted college graduation rates that emerged from this model. For example, the 39 percentage point advantage of low-income AP exam passers shown in Table 1b drops to 26 percentage points when differences in prior student academic achievement, school poverty rates, and other variables are taken into account.

Table 2
Increase in Probability of College Graduation
Compared with Students Not Participating in Advanced Placement

Student Group	Passed AP Exam	Took, Did not Pass AP Exam	Took AP Course, No AP Exam
African-American	28%	22%	16%
Hispanic	28%	12%	10%
White	33%	22%	20%
Low-Income	26%	17%	12%
Non-Low-Income	34%	23%	19%
Control variables in the model include the student's 8th grade mathematics test score and economically disadvantaged (free and reduced price lunch) status , and the average test scores and percent economically disadvantaged students in the student's school. College graduation probabilities were calculated at the average of each variable for the student group in question, e.g., African-American students.			

Question Three: Do high schools with a higher percentage of students in Advanced Placement have higher college graduation rates of their students who attend college, controlling for the measured characteristics of those schools?

Table 3 shows the increase in college graduation rates associated with differences in schools' percentages of students in the three AP categories. The table implies, for example, that a school

[14] Appendices A – D are currently in preparation.

with 100 additional students passing AP exams from the school's cohort of low-income students would expect to gain 32 additional college graduates from that same cohort. [15]

Table 3a
School-Level Regression Results for College Completion
(Five-Year Graduation Rates)

Student Group	Percent Taking and Passing AP Exams	Percent Taking but not Passing AP Exams	Percent Taking AP Course but No Exam
African-American	0.21	0.18 **	0.10
Hispanic	0.27 ***	0.01	0.00
White	0.19 ***	0.03	0.04
Low-Income	0.32 ***	0.05	0.06 *
Non-Low-Income	0.23 ***	0.00	0.05 *

***p<.01,**p<.05,*p<.10

Control variables in the model include the school's percentage of low-income students, the district dropout rate, the school's percentage of students in the same ethnic group (for the ethnic group regressions), the average 8th grade mathematics score of the students in the group in question, and the percent of the group in question taking at least four mathematics and four science courses. Schools are included that had at least 500 students and at least 15 students in the group enrolling in a Texas public college or university.

Table 3 shows a statistically significant relationship between AP exam passing and college graduation for all groups except African-Americans, despite the narrow range of AP exam pass rates across schools – few schools had more than 10% of low-income and minority students taking and passing AP exams. The lack of statistical significance of the result for African-American students is likely to have been affected by the fact that only 61 African-American students in the cohort passed at least one AP exam.

Enrolling more students in AP courses who do not also take and pass AP exams has a weaker and often not statistically significant relationship to college graduation rates. Schools enrolling large numbers of students in AP classes who do not pass the exams may have relatively weaker AP programs, or they may be enrolling many students in AP classes without a strategy to prepare students ahead of time to succeed in those classes.

[15] Recall that the cohort consists of low-income students who later enroll in Texas public colleges and universities.

Table 3b reproduces the regression results in Table 3a in a format similar to that of Tables 1b and 2.

Table 3b
Differences in College Graduation Rates
Associated with Differences in AP Participation and Exam Success

Student Group	Passed AP Exam	Took, Did not Pass AP Exam	Took AP Course, No AP Exam
African-American	21%	18%	10%
Hispanic	27%	1%	0%
White	19%	3%	4%
Low-Income	32%	5%	6%
Non-Low-Income	23%	0%	5%

This table should be interpreted as follows: A school where 10 percent more of its population of low-income students take and pass AP exams (vs. not participating in AP at all) should expect a college graduation rate 3.2 percentage points higher (32% of 10 percent) for that same population. The low-income population in question is the cohort of low-income students who enrolled in a Texas public college or university within twelve months of high school graduation.

Comparing the Answers to the Three Questions

Educators and policymakers would like to answer the question, "Are schools and districts improving their students' future college graduation success by enrolling more of those students in Advanced Placement courses?" As discussed earlier, Tables 1-3 do not directly answer this question. Because the approach based on Question 3 minimizes self-selection bias within the school, we believe that this approach comes closest to answering the questions policymakers have about the impact on college graduation rates of including more students in AP. However, Question 3 addresses the relationship between college graduation rates and everything high schools do that is associated with higher AP participation or exam success, so it is not an assessment of the impact of AP courses by themselves.[16]

[16] For example, if schools with higher AP exam passing rates also have stronger pre-AP programs or better extracurricular activities that boost college graduation rates, the model will associate these effects with the higher AP exam passing rates. This implies that it would be valuable to study the overall practices of these schools to see how they compare with those of schools with lower AP exam passing rates.

Figure 1
Increase in College Graduation Rates
Compared with Students Taking No Academic AP Course or Exam
Low-Income Students

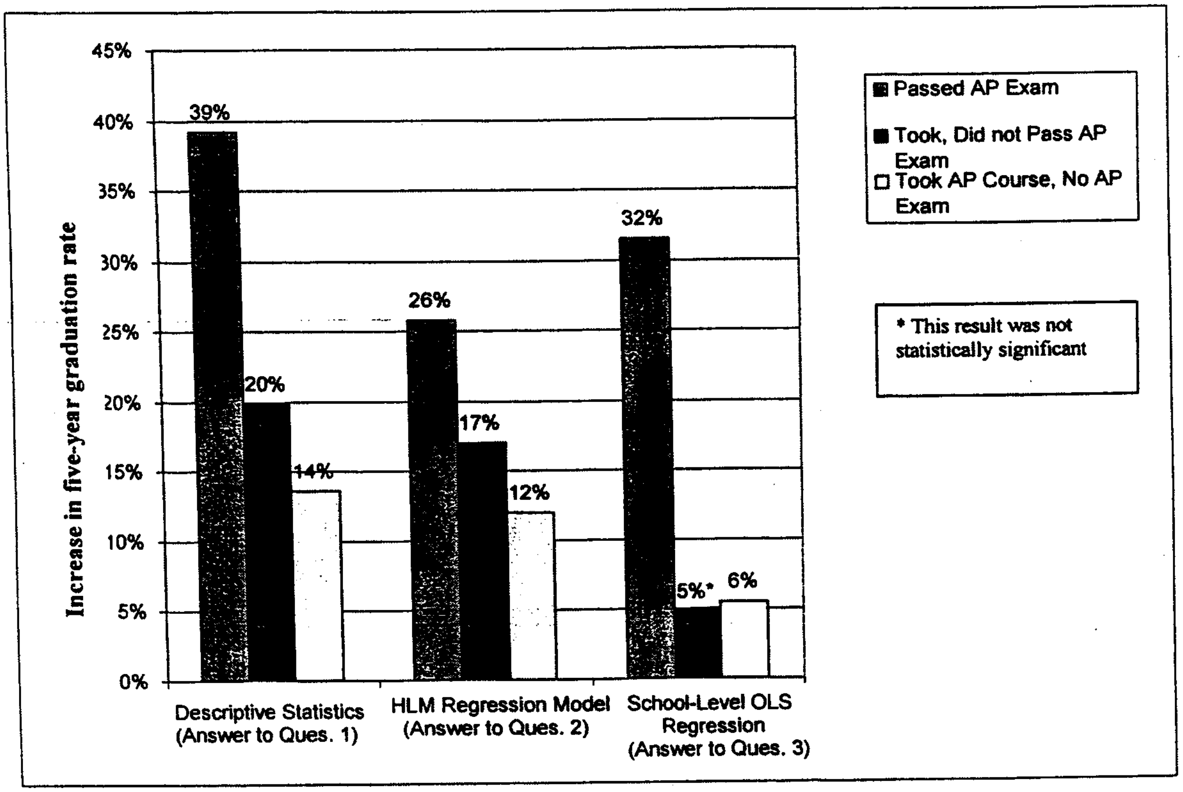

Figure 1 compares the answers to Questions 1-3 for low-income students. For example, the chart shows that low-income students who took but failed one or more academic AP exams had a 20 percentage point higher college graduation rate than did students who did not take any AP course or exams. This AP advantage declined to 17 percentage points when students with similar measured characteristics were compared. But schools only appeared to gain five additional college graduates for each 100 additional low-income students taking and failing AP exams, and this result is not statistically different from zero. [17] Similar charts for other student groups are shown in Appendix D.

[17] These results are based on comparisons across schools from a single student cohort. Estimates of the change in graduation rates associated with changes in AP participation and success in the same schools over time will be possible when data from multiple student cohorts are available.

Had we combined the three AP groups in Table 3 into a single "percent of students who are AP participants" variable, we would have found, as did Clifford Adelman (1999), a relationship between advanced course participation and college graduation.

Implications

We believe that the results in this paper have the following implications:

1. **The percent of a school's students who take and pass AP exams is the best AP-related indicator of whether the school is preparing increasing percentages of its students to graduate from college.**

The benefit to college graduation rates that schools obtain from enrolling more students in AP courses appears to be tied mainly to the resulting increase in the percent of the school's overall population who are able to take *and pass* AP exams, as the answer to Question 3 suggests. Most of the better results under Questions 1 and 2 for AP course-takers who do not pass exams could easily be driven by within-school self-selection effects. We have *not* shown that there is no advantage to taking AP ~~courses for students who struggle with the material.~~ However, having many such students may be a sign that a school is not preparing its students well. Based on the answer to Question 3, we would pose the commonsense hypothesis that preparing students to actually learn the material in an AP course is a good indicator that a school is preparing students well for college.

This hypothesis is consistent with the conclusions of Geiser and Santelices (2004), who found that the combined number of AP and Honors courses on a student's transcript did not predict college success – measured by the student's first-year college grade point average and the odds the student would stay in college for at least two years – but that success on SAT II and AP exams did.[18]

Prior research has indicated that student course completion transcripts may be poor indicators of students' college readiness, especially for low-income and minority students. For example, an analysis by the Texas Higher Education Coordinating Board found that the majority of low-income and minority students who graduated from Texas public high schools in under the Recommended (college preparatory) High School Program needed remediation when they entered college.[19] This illustrates the important role that curriculum-based end-of-course exams, such as AP exams, can play in verifying whether credits on the student's transcript indicate that the student actually learned the material indicated by the course title.[20]

2. **The importance of AP exam results indicates the need for schools and districts to pay close attention not only to the quality of teaching in Advanced Placement courses but also to improving the academic preparation of students prior to their enrollment in those courses.**

We found in a separate NCEA analysis that although the percentage of low-income and minority students taking Advanced Placement courses and exams has risen encouragingly, the percent of those students passing AP exams is still disappointingly low. For example, the population AP

[18] Geiser and Santelices used individual-level data for University of California System students and controlled for high school grade point average and parents' education.
[19] Email communication from James Dilling, Texas Higher Education Coordinating Board, March 3rd, 2005, cited in Dougherty, Mellor, and Jian (2005).
[20] The need to look at exam results has implications for the many "State Scholars" programs that rely on course completion as their measure of students' mastery of a college preparatory curriculum. Most states with these programs do not have end-of-course exams to determine whether students learned the course content.

exam passing rate for low-income students in the 2002 high school graduating cohort was around 2%, compared with 13% for more advantaged students. Only around one low-income student in eight who took one or more academic Advanced Placement courses passed any of the corresponding exams. We also found only 1 non-magnet school with significant concentrations of low-income students in which 25% or more of those students were able to take and pass at least one academic AP exam.

We believe that these results are consistent with the other indicators showing a major college preparation gap for low-income students. To improve their college readiness outcomes for those students, school districts need to approach "Advanced Placement" not as a special set of courses for their already well-prepared students, but as a comprehensive program to prepare large numbers of students, starting in the early grades and including disadvantaged students, to be able to do college-level work before they leave high school.

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CRITICAL READING SKILLS - CR

CR1: Understanding main ideas in a reading passage
How to improve: Read the whole passage carefully and try to determine the author's overall message. Practice making distinctions between the main idea and supporting details.

Texas Standard(s) this skill complements:
Reading Literature: 110.42.b.7.F, 110.42.b.7.H, 110.43.b.7.F, 110.43.b.7.G, 110.44.b.7.F, 110.44.b.7.G

CR2: Understanding tone
How to improve: When reading, consider how an author's choice of words helps define his or her attitudes. Pay attention to the way in which tone conveys meaning in conversation and in the media.

Texas Standard(s) this skill complements:
Reading Literature: 110.42.b.6.F, 110.42.b.7.H, 110.43.b.6.F, 110.43.b.7.G, 110.44.b.7.G

CR3: Comparing and contrasting ideas presented in two passages
How to improve: Read editorials that take opposing views on an issue. Look for differences and similarities in tone, point of view, and main idea.

Texas Standard(s) this skill complements:
Reading Literature: 110.42.b.6.F, 110.42.b.7.H, 110.42.b.12.A, 110.43.b.7.F, 110.43.b.7.G, 110.43.b.12.A, 110.44.b.7.F, 110.44.b.7.G, 110.44.b.12.A

CR4: Understanding the use of examples
How to improve: Authors often include examples in their writing to communicate and support their ideas. Read different kinds of argumentative writing (editorials, criticism, personal essays) and pay attention to the way examples are used. State the point of the examples in your own words. Use examples in your own writing.

Texas Standard(s) this skill complements:
Reading Literature: 110.42.b.7.H, 110.43.b.7.G, 110.44.b.7.G

CR5: Recognizing the purpose of various writing strategies
How to improve: Writers use a variety of tools to achieve their effects. While you read, look for such things as specific examples, quotations, striking images, and emotionally loaded words. Think about the connotations of specific words and why the author might have decided to use them.

Texas Standard(s) this skill complements:
Reading Literature: 110.42.b.7.F, 110.42.b.7.H, 110.42.b.12.A, 110.43.b.7.F, 110.43.b.7.G, 110.43.b.12.A, 110.44.b.7.F, 110.44.b.7.G, 110.44.b.12.A

CR6: Applying ideas presented in a reading passage
How to improve: When you read, try to determine the author's ideas and assumptions and then think about how they might apply to new situations.

Texas Standard(s) this skill complements:
Reading Literature: 110.42.b.7.B, 110.42.b.7.F, 110.42.b.7.H, 7110.43.b.7.B, 110.43.b.7.F, 110.43.b.7.G, 110.44.b.7.B, 110.44.b.7.F, 110.44.b.7.G

CR7: Determining an author's purpose or perspective
How to improve: Authors write for a variety of purposes, such as to inform, to explain, or to convince. When you read, try to determine why the author wrote what he or she wrote.

Texas Standard(s) this skill complements:
Reading Literature: 110.42.b.7.H, 110.42.b.12.C, 110.43.b.7.G, 110.44.b.7.G

CR8: Making connections between information in different parts of a passage
How to improve: Work on figuring out the relationship between the material presented in one part of a reading passage and material presented in another part. Ask yourself, for example, how facts presented in the beginning of a magazine article relate to the conclusion.

Texas Standard(s) this skill complements:
Reading Literature: 110.42.b.7.H, 110.42.b.12.A, 110.42.b.7.H, 110.42.b.12.C, 110.43.b.7.G, 110.44.b.7.G,

CR9: Distinguishing conflicting viewpoints
How to improve: When reading, practice summarizing main ideas and noting sentences that mark transition points. Learn to understand methods of persuasion and argumentation. Expand your reading to include argumentative writing, such as political commentary, philosophy, and criticism.

Texas Standard(s) this skill complements:
Reading Literature: 110.42.b.6.F, 110.42.b.7.F, 110.42.b.7.H, 110.42.b.12.A, 110.43.b.6.F, 110.43.b.7.F, 110.43.b.7.G, 110.44.b.7.F, 110.44.b.7.G

CR10: Being thorough

How to improve: Don't just pick the first answer choice you see that looks tempting. Be sure to evaluate all the choices before you select your answer, just as you would read an entire paragraph rather than assume its meaning based only on the first sentence.

Texas Standard(s) this skill complements:
Reading Literature: 110.42.b.6.F, 110.42.b.7.F, 110.42.b.7.H, 110.43.b.7.F, 110.42.b.7.G, 110.44.b.7.F, 110.44.b.7.G

CR11: Understanding difficult vocabulary

How to improve: Broaden your reading to include newspapers and magazines, as well as fiction and nonfiction from before the 1900s. Include reading material that is a bit outside your comfort zone. Improve your knowledge of word roots to help determine the meaning of unfamiliar words.

Texas Standard(s) this skill complements:
Reading Literature: 110.42.b.6.F

CR12: Understanding how negative words, suffixes, and prefixes affect sentences

How to improve: When reading, pay attention to the ways in which authors use negation. Look at how negative words (like "not" and "never"), prefixes (like "un" and "im"), and suffixes (like "less") affect the meaning of words and sentences.

Texas Standard(s) this skill complements:
Reading Literature: 110.42.b.6.C, 110.42.b.6.F, 110.43.b.6.C, 110.44.b.6.C

CR13: Understanding complex sentences

How to improve: Ask your English teacher to recommend books that are a bit more challenging than those you're used to reading. Practice breaking down the sentences into their component parts to improve your comprehension. Learn how dependent clauses and verb phrases function in sentences.

Texas Standard(s) this skill complements:
No Identified Standards

CR14: Recognizing connections between ideas in a sentence

How to improve: Learn how connecting words (such as relative pronouns and conjunctions) establish the relationship between different parts of a sentence.

Texas Standard(s) this skill complements:
Reading Literature: 110.42.b.6.F

CR15: Recognizing words that signal contrasting ideas in a sentence

How to improve: Learn how certain words (such as "although," "but," "however," and "while") are used to signal a contrast between one part of a sentence and another.

Texas Standard(s) this skill complements:
Reading Literature: 110.42.b.6.F

CR16: Recognizing a definition when it is presented in a sentence
How to improve: Learn how such elements as appositives, subordination, and punctuation are used to define words in a sentence.

Texas Standard(s) this skill complements:
No Identified Standards

CR17: Understanding sentences that deal with abstract ideas
How to improve: Broaden your reading to include newspaper editorials, political essays, and philosophical writings.

Texas Standard(s) this skill complements:
Reading Literature:110.42.b.6.C, 110.42.b.6.F, 110.43.b.6.C, 110.44.b.6.C

CR18: Understanding and using a word in an unusual context
How to improve: Work on using word definitions when choosing an answer. Try not to be confused by an unusual meaning of a term.

Texas Standard(s) this skill complements:
Reading Literature: 110.42.b.6.C, 110.43.b.6.C, 110.44.b.6.C

CR19: Comprehending long sentences
How to improve: Practice reducing long sentences into small, understandable parts.

Texas Standard(s) this skill complements:
No Identified Standards

CR20: Choosing a correct answer based on the meaning of the entire sentence
How to improve: Make sure your answer choice fits the logic of the sentence as a whole. Don't choose an answer just because it sounds good when inserted in the blank.

Texas Standard(s) this skill complements:
No Identified Standards

CR21: Understanding sentences that deal with scientific ideas.
How to improve: Read magazine articles about scientific subjects to improve your comfort level in this area.

Texas Standard(s) this skill complements:
No Identified Standards

MATHEMATICS SKILLS - M

M1: Using basic concepts and operations in arithmetic problem solving
How to improve: Practice solving problems involving positive and negative integers, fractions, decimals, ratio, percent, exponents, square roots, place value and digits. Also, practice solving problems involving odd and even integers, prime numbers, multiples, divisibility, and remainders.

Texas Standard(s) this skill complements:
111.32.c.2.G, 111.34.c.1, 111.34.d.2.A, 111.34.e.1.B, 111.34.f.2, 111.34.f.3, 111.34.f.4, 111.35.c.4.A, 111.35.c.4.B

M2: Understanding geometry and coordinate geometry
How to improve: Review geometry units in your textbook involving perimeter, area, volume, circumference, angles, lines, slope. Familiarize yourself with the formulas given at the beginning of math sections of the test.

Texas Standard(s) this skill complements:
111.32.b.2.A, 111.32.b.2.C, 111.32.c.1.C, 111.32.c.2.A, 111.32.c.2.B, 111.32.d.2.B, 111.33.c.1.A, 111.33.c.1.B, 111.33.c.2.A, 111.33.c.2.B, 111.33.c.2.C, 111.33.c.2.D, 111.33.d.2.A, 111.33.d.2.B, 111.33.d.3.C, 111.33.d.4.A, 111.33.d.4.C, 111.33.e.1, 111.33.e.3, 111.34.b.1.A, 111.34.b.1.B, 111.34.b.1.C, 111.34.b.2.A, 111.34.b.2.B, 111.34.b.3.A, 111.34.b.3.B, 111.34.b.3.C, 111.34.b.3.D, 111.34.b.3.E, 111.34.b.4, 111.34.c.1, 111.34.c.2, 111.34.c.3, 111.34.d.1.A, 111.34.d.1.B, 111.34.d.1.C, 111.34.d.2.A, 111.34.d.2.B, 111.34.d.2.C, 111.34.e.1.A, 111.34.e.1.B, 111.34.e.1.C, 111.34.e.1.D, 111.34.e.2.A, 111.34.e.2.B, 111.34.e.2.C, 111.34.e.2.D, 111.34.e.3.A, 111.34.e.3.B, 111.34.f.1, 111.34.f.2, 111.34.f.3, 111.34.f.4, 111.35.c.1.A, 111.35.c.1.B, 111.35.c.1.C, 111.35.c.1.D, 111.35.c.1.E, 111.35.c.2.B, 111.35.c.2.C, 111.35.c.5.A, 111.35.c.5.B, 111.35.c.5.C, 111.35.c.5.D, 111.35.c.6.A, 111.35.c.6.B, 111.36.c.1.B, 111.36.c.2.A, 111.36.c.8.A, 111.36.c.8.B, 111.36.c.9.A, 111.36.c.9.B

M3: Dealing with probability, basic statistics, charts, and graphs
How to improve: Practice solving problems that involve basic probability, basic counting, and finding the average (arithmetic mean), median, and mode. Look for charts and graphs in newspapers and magazines, and practice interpreting the data in them.

Texas Standard(s) this skill complements:
111.32.b.1.B, 111.32.b.1.E, 111.32.b.2.C, 111.32.b.2.D, 111.32.c.2.B, 111.33.b.1.B, 111.36.c.2.A, 111.36.c.2.B, 111.36.c.2.C, 111.36.c.2.D, 111.36.c.3.C, 111.36.c.4.A, 111.36.c.4.B

M6: Making connections among mathematical topics

How to improve: Practice problems that require combining skills acquired in different math courses, such as problems that use combinations of arithmetic, algebra, and geometry.

Texas Standard(s) this skill complements:

111.32.c.2.G, 111.32.d.2.B, 111.33.b.1.B, 111.34.b.1.A, 111.34.b.1.B, 111.34.b.1.C, 111.34.b.3.D, 111.34.c.2, 111.35.c.1.D, 111.35.c.1.E, 111.35.c.3.A, 111.35.c.3.B, 111..c.3.C, 111.35.c.3.D, 111.35.c.5.A, 111.35.c.5.B, 111.35.c.5.C, 111.35.c.5.D, 111.35.c.6.B, 111.36.c.1.A, 111.36.c.1.B, 111.36.c.2.C, 111.36.c.3.A, 111.36.c.3.B, 111.36.c.3.C, 111.36.c.5.A, 111.36.c.5.B, 111.36.c.5.C, 111.36.c.6.A, 111.36.c.6.B, 111.36.c.6.C, 111.36.c.7.A, 111.36.c.7.B, 111.36.c.7.C, 111.36.c.8.A, 111.36.c.8.B, 111.36.c.8.C, 111.36.c.9.A, 111.36.c.9.B.

M7: Organizing and managing information to solve multistep problems

How to improve: Write down your steps in solving the problem. Monitor the steps as you go along, keeping in mind what the question is asking.

Texas Standard(s) this skill complements:

111.32.b.2.D, 111.32.c.2.C, 111.32.c.2.F, 111.32.c.4.A, 111.32.c.4.B, 111.32.d.1.B, 111.32.d.1.C, 111.32.d.2.A, 111.32.d.3.B, 111.32.d.3.C, 111.33.b.1.B, 111.33.d.2.A, 111.33.d.2.B, 111.33.d.4.A, 111.33.d.4.B, 111.33.d.4.C, 111.33.d.4.D, 111.33.d.4.E, 111.33.e.1, 111.33.e.3, 111.33.e.5, 111.33.f.2, 111.33.f.3, 111.35.c.2.A, 111.35.c.2.B, 111.35.c.6.A, 111.36.c.1.C, 111.36.c.2.D, 111.36.c.3.A, 111.36.c.3.B, 111.36.c.5.A, 111.36.c.5.B, 111.36.c.5.C, 111.36.c.6.A, 111.36.c.6.B, 111.36.c.6.C, 111.36.c.7.A, 111.36.c.7.B, 111.36.c.7.C, 111.36.c.8.A, 111.36.c.8.B, 111.36.c.8.C

M8: Using logical reasoning

How to improve: Practice solving problems in which you must consider different possible cases. Make adjustments in your solution strategy when things aren't going as well as they should. It may help to look at the problem from different perspectives. Solving problems that require you to justify your answer may help you develop this skill.

Texas Standard(s) this skill complements:

111.32.b.2.B, 111.32.c.1.B, 111.32.c.3.C, 111.32.c.4.C, 111.32.d.1.A, 111.32.d.1.D, 111.33.b.1.A, 111.33.b.1.B, 111.33.b.3.C, 111.33.d.1.A, 111.33.d.4.A, 111.33.e.1, 111.33.e.3, 111.33.f.3, 111.34.b.1.A, 111.34.b.1.B, 111.34.b.2.A, 111.34.b.2.B, 111.34.b.3.A, 111.34.b.3.B, 111.34.b.3.C, 111.34.b.3.D, 111.34.b.3.E, 111.34.b.4, 111.34.e.2.A, 111.34.e.2.B, 111.34.e.2.C, 111.34.e.2.D, 111.34.e.3.A, 111.34.f.1, 111.34.f.4, 111.35.c.1.B, 111.35.c.4.C, 111.36.c.1.A, 111.36.c.2.C, 111.36.c.3.A, 111.36.c.3.B

M9: Recognizing patterns and equivalent forms
How to improve: Try recognizing a pattern by considering a simpler case. Try rewriting or rearranging the given expressions in a different form.

Texas Standard(s) this skill complements:
111.32.b.1.B, 111.32.b.2.D, 111.32.b.3.B, 111.32.c.1.A, 111.32.c.1.C, 111.32.c.2.C, 111.32.c.2.F, 111.32.d.1.B, 111.32.d.1.C, 111.32.d.2.B, 111.32.d.3.A, 111.32.d.3.B, 111.32.d.3.C, 111.33.c.1.B, 111.33.c.1.C, 111.33.c.2.B, 111.33.c.2.C, 111.33.d.1.B, 111.33.d.1.C, 111.33.d.2.A, 111.33.d.2.B, 111.33.d.3.C, 111.33.d.4.A, 111.33.d.4.C, 111.33.e.2, 111.33.f.4, 111.34.b.1.C, 111.34.b.4, 111.34.c.1, 111.34.c.3, 111.35.c.1.C, 111.35.c.2.A, 111.35.c.2.B, 111.35.c.4.A, 111.35.c.4.B, 111.35.c.4.C, 111.35.c.5.C, 111.36.c.2.D, 111.36.c.3.A, 111.36.c.3.B, 111.36.c.9.A, 111.36.c.9.B

M10: Recognizing logical key words
How to improve: Pay attention to key words, such as "not," "at least," "at most," "must be," "could be," "possible," and "different." These words determine the meaning of the question and therefore must be understood to correctly solve the problem.

Texas Standard(s) this skill complements:
111.34.b.3.A, 111.34.b.3.D, 111.34.b.3.E, 111.36.c.2.C, 111.36.c.5.A, 111.36.c.5.B, 111.36.c.5.C, 111.36.c.6.A, 111.36.c.6.B, 111.36.c.6.C, 111.36.c.7.A, 111.36.c.7.B, 111.36.c.7.C, 111.36.c.8.A, 111.36.c.8.B, 111.36.c.8.C,

M11: Using answer choices to help solve the problem
How to improve: Looking at the answer choices may help you understand the problem. Sometimes the choices can help identify a strategy for solving the problem.

Texas Standard(s) this skill complements:
111.32.c.1.C, 111.32.c.3.C, 111.32.c.4.C, 111.32.d.1.D, 111.33.b.3.C, 111.33.d.1.A, 111.33.f.3, 111.34.b.3.A, 111.36.c.2.C

WRITING SKILLS-W

W1: Being precise and clear
How to improve: Learn to recognize sentence elements that are ambiguous and confusing. In your writing, choose words carefully and connect them for clear meaning.

Texas Standard(s) this skill complements:
Writing: 110.42.b.3.D, 110.43.b.2.C, 110.43.b.3.B, 110.43.b.3.D, 110.44.b.2.C, 110.44.b.3.B, 110.44.b.3.D, 110.45.b.3.B, 110.45.b.3.D

W2: Following conventions in writing
How to improve: Review the chapters in a grammar book that cover grammatical conventions, such as word choice, use of noun and prepositional phrases, and sentence construction. Work with your teacher to become more familiar with the conventions of standard written English.

Texas Standard(s) this skill complements:
Writing: 110.42.b.3.C, 110.42.b.3.D, 110.43.b.3.C, 110.43.b.3.D, 110.44.b.3.C, 110.44.b.3.D, 110.45.b.3.C, 110.45.b.3.D

W3: Recognizing logical connections within sentences and passages
How to improve: Use the writing process to help you revise your draft essays. Work with classmates and teachers to clarify meaning in your writing.

Texas Standard(s) this skill complements:
Writing: 110.42.b.2.C, 110.42.b.3.D, 110.43.b.2.C, 110.43.b.3.D, 110.44.b.2.C, 110.44.b.3.D, 110.45.b.2.C, 110.45.b.3.D

W4: Using verbs correctly
How to improve: Make sure that you can identify the subject and verb of a sentence. Make sure you understand subject and verb agreement.

Texas Standard(s) this skill complements:
Writing: 110.42.b.3.B, 110.42.b.3.C, 110.42.b.3.D, 110.43.b.3.B, 110.43.b.3.C, 110.43.b.3.D, 110.44.b.3.B, 110.44.b.3.C, 110.44.b.3.D, 110.45.b.3.B, 110.45.b.3.C, 110.45.b.3.D

W5: Recognizing improper pronoun use
How to improve: Learn to understand the distinction between informal, spoken pronoun usage and standard written pronoun usage. Review the way you use pronouns in your own writing. Ask your teacher to help you identify and correct pronoun errors in your own writing.

Texas Standard(s) this skill complements:
Writing: 110.42.b.2.C, 110.42.b.3.B, 110.42.b.3.C, 110.42.b.3.D, 110.43.b.2.C, 110.43.b.3.B, 110.43.b.3.C, 110.43.b.3.D, 110.44.b.2.C,

110.44.b.3.B, 110.44.b.3.C, 110.44.b.3.D, 110.45.b.2.D, 110.45.b.3.B, 110.45.b.3.C, 110.45.b.3.D

W6: Understanding the structure of sentences with unfamiliar vocabulary
How to improve: Read material that contains unfamiliar vocabulary. Look for context clues to help you guess at the meaning of unfamiliar words as you read.

Texas Standard(s) this skill complements:
Writing: 110.42.b.3.B, 110.42.b.3.D, 110.43.b.3.B, 110.43.b.3.D, 110.44.b.3.B, 10.44.b.3.D, 110.45.b.3.B, 110.45.b.3.D

W7: Understanding complicated sentence structures
How to improve: Refer to a grammar book to identify various sentence patterns and their effective use. Vary the sentence patterns in your own writing.

Texas Standard(s) this skill complements:
Writing: 110.42.b.3.B, 110.42.b.3.D, 110.43.b.3.B, 110.43.b.3.D, 110.44.b.3.B, 10.44.b.3.D, 110.45.b.3.B, 110.45.b.3.D

W8: Understanding the structure of long sentences
How to improve: As you read, break long sentences into smaller units of meaning.

Texas Standard(s) this skill complements:
Writing: 110.42.b.3.B, 110.42.b.3.D, 110.43.b.3.B, 110.43.b.3.D, 110.44.b.3.B, 10.44.b.3.D, 110.45.b.3.B, 110.45.b.3.D

W9: Understanding the structure of sentences with abstract ideas
How to improve: Read newspapers, magazines, and books that deal with subjects such as politics, economics, history, or philosophy.

Texas Standard(s) this skill complements:
Writing: 110.42.b.3.B, 110.42.b.3.D, 110.43.b.3.B, 110.43.b.3.D, 110.44.b.3.B, 10.44.b.3.D, 110.45.b.3.B, 110.45.b.3.D

W10: Understanding the structure of sentences that relate to science or math
How to improve: Focus on how something is said as well as on what is said. Write about the things you are learning in math and science classes. Read articles in the science section of newspapers and magazines so that you will feel more comfortable with scientific or math content.

Texas Standard(s) this skill complements:
Writing: 110.42.b.3.B, 110.42.b.3.D, 110.43.b.3.B, 110.43.b.3.D, 110.44.b.3.B, 10.44.b.3.D, 110.45.b.3.B, 110.45.b.3.D

W11: Understanding the structure of sentences that relate to the arts
How to improve: Focus on how something is said as well as on what is said. Read articles in newspapers and magazines about the arts so that you will feel more comfortable with these subjects.

Texas Standard(s) this skill complements:

Writing: 110.42.b.3.B, 110.42.b.3.D, 110.43.b.3.B, 110.43.b.3.D, 110.44.b.3.B, 10.44.b.3.D, 110.45.b.3.B, 110.45.b.3.D

Appendix I:

Depth-of-Knowledge Scales by Subject Area[3]

Mathematics

Level 1: Recall

Level 1 includes the recall of information such as a fact, definition, term, or simple procedure, as well as performing a simple algorithm or applying a formula. That is, in mathematics a one-step, well-defined, and straight algorithmic procedure should be included at this lowest level. Other key words that signify a Level 1 activity include "identify," "recall," "recognize," "use," and "measure." Verbs such as "describe" and "explain" could be classified at different levels depending on what is to be described and explained.

Level 2: Skill/Concept

Level 2 includes the engagement of some mental processing beyond a habitual response. A Level 2 assessment item requires students to make some decisions as to how to approach the problem or activity, whereas a Level 1 item requires students to demonstrate a rote response, perform a well-known algorithm, follow a set procedure (like a recipe), or perform a clearly defined series of steps. Key words and phrases that generally distinguish a Level 2 item include "classify," "organize," "estimate," "make observations," "collect and display data," and "compare data." These actions imply more than one step. For example, to compare data may require first identifying characteristics of the objects and then grouping or ordering the objects.

Level 3: Strategic Thinking

Level 3 requires reasoning, planning, using evidence, and a higher level of thinking than the previous two levels. In most instances, requiring students to explain their thinking is a Level 3 activity. Activities that require students to make conjectures are also at this level. The cognitive demands at Level 3 are complex and abstract. The complexity does not result from the fact that there are multiple answers, a possibility at both Levels 1 and 2, but because the task requires more demanding reasoning. An activity, however, that has more than one possible answer and requires students to justify the response they give would most likely be a Level 3 activity. Other Level 3 activities include drawing conclusions from observations, citing evidence and developing a

3. This material is based upon work supported by the National Science Foundation under contract number EHR 0233445 awarded to the University of Wisconsin–Madison and the Wisconsin Center for Education Research.

logical argument for concepts, explaining phenomena in terms of concepts, and using concepts to solve problems.

Level 4: Extended Thinking

Level 4 requires complex reasoning, planning, developing, and thinking—most likely over an extended period of time. The extended time period is not a distinguishing factor if the required work is only repetitive and does not require applying significant conceptual understanding and higher-order thinking. For example, if a student has to take the water temperature from a river each day for a month and then construct a graph, this would be classified as a Level 2 activity. However, if the student is to conduct a river study that requires taking into consideration a number of variables, this would be a Level 4 activity. At Level 4, the cognitive demands of the task should be high and the work should be very complex. Students should be required to make several connections—relate ideas within the content area or among content areas—and have to select one approach among many alternatives on how the situation should be solved. Level 4 activities include designing and conducting experiments; making connections between a finding and related concepts and phenomena; combining and synthesizing ideas into new concepts; and critiquing experimental designs.

Reading

Level 1: Recall of Information

Level 1 requires students to receive or recite facts or to use simple skills or abilities. Oral reading that does not include analysis of the text as well as basic comprehension of a text is included. Items require only a shallow understanding of text presented and often consist of verbatim recall from text or simple understanding of a single word or phrase.

Level 2: Basic Reasoning

Level 2 includes the engagement of some mental processing beyond recalling or reproducing a response; it requires both comprehension and subsequent processing of text or portions of text. Intersentence analysis of inference *is* required. Some important concepts are covered, but *not* in a complex way. Standards and items at this level may include words and phrases such as "summarize," "interpret," "infer," "classify," "organize," "collect," "display," "compare," and "determine whether fact or opinion." Literal main ideas are stressed. A Level 2 assessment item may require students to apply some of the skills and concepts that are covered at Level 1.

Level 3: Complex Reasoning

Deep knowledge becomes more of a focus at Level 3. Students are encouraged to go beyond the text; however, they are still required to show understanding of the ideas in the text. Students may be encouraged to explain, generalize, or connect ideas. Standards and items at Level 3 involve reasoning and planning. Students must be able to support their thinking. Items may involve abstract theme identification, inference across an entire passage, or students' application of prior knowledge. Items may also involve more superficial connections between texts.

Level 4: Extended Reasoning

Higher-order thinking is central and knowledge is deep at Level 4. The standard or assessment item at this level will probably be an extended activity, with extended time provided. The extended time period is not a distinguishing factor if the required work is only repetitive and does not require applying significant conceptual understanding and higher-order thinking. Students take information from at least one passage and are asked to apply this information to a new task. They may also be asked to develop hypotheses and perform complex analyses of the connections among texts.

Writing

Level 1: Recall of Information

Level 1 requires the student to write or recite simple facts. This writing or recitation does not include complex synthesis or analysis, only basic ideas. The students are engaged in listing ideas or words as in a brainstorming activity prior to written composition, are engaged in a simple spelling or vocabulary assessment, or are asked to write simple sentences. Students are expected to write and speak using standard English conventions. This includes using appropriate grammar, punctuation, capitalization, and spelling.

Level 2: Basic Reasoning

Level 2 requires some mental processing. At this level, students are engaged in first-draft writing or brief extemporaneous speaking for a limited number of purposes and audiences. Students are beginning to connect ideas using a simple organizational structure. For example, students may be engaged in note-taking, outlining, or simple summaries. Texts may be limited to one paragraph. Students demonstrate a basic understanding and appropriate use of such reference materials as a dictionary, thesaurus, or Web site.

Level 3: Complex Reasoning

Level 3 requires some higher-level mental processing. Students are engaged in developing compositions that include multiple paragraphs. These compositions may include complex sentence structure and may demonstrate some synthesis and analysis. Students show awareness of their audience and purpose through focus, organization, and the use of appropriate compositional elements. The use of appropriate compositional elements includes such things as addressing chronological order in a narrative or including supporting facts and details in an informational report. At this stage, students are engaged in editing and revising to improve the quality of the composition.

Level 4: Extended Reasoning

Higher level thinking is central to Level 4. The standard at this level is a multiparagraph composition that demonstrates synthesis and analysis of complex ideas or themes. There is evidence of a deep awareness of purpose and audience. For example, informational papers include hypotheses and supporting evidence. Students are expected to create compositions that demonstrate a distinct voice and that stimulate the reader or listener to consider new perspectives on the addressed ideas and themes.

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The Relationship Between PSAT/NMSQT® Scores and AP® Examination Grades: A Follow-Up Study

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The College Board, New York, 2006

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Contents

Introduction

The Advanced Placement Program® (AP®) offers high school students the opportunity to take rigorous college-level courses while still in high school. AP Examinations are linked to each course and administered annually by participating high schools. In 2005, more than 2 million AP Examinations were taken by more than 1 million high school students. Students who elect to take an AP Examination may earn college credit or placement into higher-level college courses if they perform well on the exam. AP Examination grades are reported on a scale that ranges from 1 (no recommendation) to 5 (extremely well qualified). Colleges and universities set their own AP credit and placement policies; however, most institutions award college credit or placement into higher-level courses to those students who earn AP Examination grades of at least 3 or 4.

Several studies have evaluated the validity of AP Examination grades for course placement. These studies have shown that AP Examination grades are indeed valid for their intended purpose (Burnham and Hewitt, 1971; Dodd, Fitzpatrick, De Ayala, and Jennings, 2002; Morgan and Crone, 1993; Morgan and Ramist, 1998). More specifically, these studies found that AP students who were exempted from an introductory college course because of successful AP Examination performance did as well or better in the subsequent course as those students who were not exempted from the introductory course. At the same time, research has found that the academic intensity and quality of a student's high school curriculum, including AP course work, are predictive of college degree attainment (Adelman, 1999). Bridgeman, Pollack, and Burton (2004) further illustrated that even a coarse index of academic intensity, based partly on the number of AP Examinations taken, can provide a modest increase to the likelihood of college success, holding SAT Reasoning Test™ (SAT®) scores and high school grades constant. It is not surprising, then, that there is interest in developing tools to identify students who are likely to succeed in AP courses.

Camara and Millsap (1998) investigated the validity of using the Preliminary SAT/National Merit Scholarship Qualifying Test (PSAT/NMSQT®) to identify students who have the potential to do well in AP courses, and found that PSAT/NSMQT scores were predictive of AP Examination performance. Haag (1983) found similar results, although he used sample sizes that were smaller than those used by Camara and Millsap and analyzed only 10 AP Examinations. The PSAT/NMSQT is a shorter version of the SAT designed to measure critical reasoning and thinking skills in verbal, math, and writing.[1] It is taken mostly by high school sophomores and juniors (College Board, 2003), and provides an opportunity for students to practice for the SAT and for high school juniors to qualify for the National Merit Scholarship competition. The use of a reasoning test such as the PSAT/NMSQT to predict achievement outcomes is certainly not new. Gussett (1980) showed that the SAT was useful for predicting performance on College-Level Examination Program® (CLEP®) exams, which, similar to AP, provide students with an opportunity to demonstrate mastery of college-level course content and earn college credit or course exemption.

The primary purpose of the research conducted by Camara and Millsap (1998) was to collect validation evidence for using PSAT/NMSQT scores to identify students for AP course work. Their study used PSAT/NMSQT test data from 1993 and 1994 and AP Exam data from 1994 and 1995. Results showed that grades on most AP Examinations were moderately to strongly correlated with PSAT/NMSQT verbal scores, math scores, or the sum of verbal and math scores. Writing scores were not included because the writing test had not yet been added to the PSAT/NMSQT. For three AP Exams (Calculus AB, English Literature, and U.S. History), Camara and Millsap (1998) also evaluated the role of additional variables in explaining variability in AP Examination performance. These additional variables were all self-reported by students and included overall grade point average, grades in related subjects (e.g., English, math, science), and total years of study in related subjects. Results of multiple regression analyses indicated that once PSAT/NMSQT performance was taken into account, these variables accounted for very little additional variance in AP Examination performance. In addition, findings indicated that the relationship between PSAT/NMSQT scores and AP Examination grades for these three AP subjects did not vary for students who completed the PSAT/NMSQT and AP Examinations in the same academic year or completed the PSAT/NMSQT in the academic year prior to the AP Examination.[2]

Using these results as validation evidence, Camara and Millsap (1998) computed expectancy tables showing the percentage of test-takers earning a grade of 3 or better, as well as 4 or better, on AP Examinations across the range of PSAT/NMSQT scores. The PSAT/NMSQT scores or combination of scores that exhibited the strongest correlation with AP Examination performance were usually selected as the basis for computing each expectancy

[1] In 2004, a new PSAT/NMSQT was administered for the first time. Among the changes were the removal of analogies from the verbal test and the removal of the quantitative comparisons from the math test. In addition, the name of the verbal test was changed to critical reading; however, to be consistent with the version of the test analyzed in this study, we continue with the older naming convention.

[2] See Camara and Millsap (1998) pages 10 and 15 which note that the PSAT/NMSQT is administered in early October and the AP Examinations are administered in May. Therefore, the time intervals between examinations are either seven months (for students taking both tests in one academic year) or 19 months (for students taking the PSAT/NMSQT in the academic year prior to the AP Examinations).

table. The expectancy tables serve as the foundation for AP Potential™, an online tool sponsored by the College Board that provides educators with an objective, data-driven method for identifying students who are likely to succeed in a particular AP course (College Board, 2005).

Purpose of Study

The purpose of this study is to reexamine the relationship between PSAT/NMSQT scores and AP Examination grades using more recent test data in order to obtain additional validation evidence for using the PSAT/NMSQT to identify AP students. Toward this end, PSAT/NMSQT data from October 2000 and October 2001 and AP data from May 2002 and May 2003 were analyzed. There have been several important changes to both the AP and PSAT/NMSQT programs since Camara and Millsap (1998) conducted their research that created the need for this study. First, in 1997, a writing test was added to the PSAT/NMSQT. Second, the number of students completing the PSAT/NMSQT increased by 35 percent, and the number of students taking one or more AP Examinations increased by more than 100 percent. Third, the number of sophomores taking the PSAT/NMSQT has been steadily increasing and, in 2001, represented 35 percent of all test-takers, which was up 6 percentage points from 1993. Finally, AP Examinations in Environmental Science, World History, Statistics, and Human Geography have been added, and the volume for several other AP Examinations has increased dramatically. The present study attempts to replicate and extend findings from earlier research given these changes to both programs.

The analyses involved correlating AP Examination grades with several PSAT/NMSQT scores including: (1) verbal, (2) math, (3) writing, (4) sum of verbal + math (V+M), (5) sum of verbal + writing (V+W), (5) sum of math + writing (M+W), and (6) sum of verbal + math + writing (V+M+W). New expectancy tables were then computed for those AP Examinations showing a moderate to high correlation with PSAT/NMSQT performance. Given the possibility that the relationship between PSAT/NMSQT scores and AP Examination grades could vary by grade level and AP subject, we also evaluated whether separate expectancy tables would be needed for sophomore and junior PSAT/NMSQT test-takers.

As in the previous study (Camara and Millsap, 1998), the usefulness of other academic indicators, aside from PSAT/NMSQT scores, to predict success on AP Examinations was also evaluated. These additional academic indicators included students' self-reported cumulative high school grade point average (HSGPA) and self-reported grades in relevant courses. The analyses involved correlating cumulative HSGPA and course grades with AP Examination grades. In addition, a series of multiple linear-regression analyses were also conducted for a subset of 11 high-volume AP Examinations in order to evaluate the incremental validity of PSAT/NMSQT scores in predicting AP Examination grades over and above cumulative HSGPA and relevant course grades. This question of incremental validity concerns how much variability in AP Examination grades can be explained by PSAT/NMSQT scores after the effects of self-reported cumulative HSGPA and relevant course grades are taken into account. The research question was framed in this way in order to evaluate the utility of the PSAT/NMSQT scores in predicting AP Examination grades over and above more traditional indicators of high school academic performance.

Finally, the extent to which the relationship between PSAT/NMSQT scores and AP Examination grades varies as a function of student characteristics including gender, ethnicity, and grade level (sophomore- and junior-class standing) was also evaluated for the same subset of 11 AP Examinations. These analyses involved examining the incremental validity of PSAT/NMSQT scores in predicting AP Examination grades over and above cumulative HSGPA and relevant course grades as a function of student characteristics. Because the original study conducted by Camara and Millsap (1998) found no significant or practical differences in the relationship between students who completed both the PSAT/NMSQT and AP assessments in the same academic year and those who completed the PSAT/NMSQT in the academic year prior to taking the AP Examination, this research question was not reexamined in the present study.

Method

This study examines sophomores and juniors who completed the PSAT/NMSQT in October 2000 or October 2001 and one or more AP Examinations 19 months later in May 2002 or May 2003. Of the more than 4.2 million students who completed the PSAT/NMSQT in 2000 and 2001 as sophomores or juniors, 24 percent (n=1,035,696) took one or more AP Examinations 19 months later.[3,4]

[3] Students who retook an AP Examination were removed from analyses. In both 2002 and 2003, approximately 6,000 students retook one or more AP Examinations.

[4] Camara and Millsap (1998) examined students who took the PSAT/NMSQT and AP Exams both in the same academic year, as well as 19 months apart and found no differences. They then proceeded to use data from both groups of test-takers in their analysis. Because the number of students completing the PSAT/NMSQT and AP Examinations increased so dramatically in the intervening 8-year period, we were able to eliminate same-year test-takers and conduct all analyses on students who completed testing 19 months apart. This enables us to directly report all results in a manner that demonstrates the validity and efficacy of using PSAT/NMSQT scores in making placement decisions for students in the subsequent year of high school.

Therefore, the students used in this study represent the entire population of tenth- and eleventh-graders who completed the PSAT/NMSQT in either 2000 or 2001 and subsequently took one or more AP Examinations the following academic year.

Of the 1,035,696 students completing both the PSAT/NMSQT and AP Examinations during the specified time periods, 736,228 (71 percent) also completed the SAT Questionnaire prior to November 2003. The SAT Questionnaire, which students are asked to complete when they register for the SAT, collects information about students' academic performance and course-taking patterns while in high school, as well as about their college plans. For the current study, this information was important for supplementing the limited student-level data collected through the PSAT/NMSQT and AP registrations. Thus, additional analyses involving HSGPA, course grades, and PSAT/NMSQT scores were conducted with the subset of students who also completed the SAT Questionnaire.

It is important to note that the students included in this study are of somewhat higher ability than all sophomore and junior PSAT/NMSQT test-takers in 2000 and 2001. The combined average PSAT/NMSQT performance of sophomores and juniors in 2000 and 2001 (n = 4,271,862) was 47.1 for verbal, 47.9 for math, and 47.8 for writing.[5] On the other hand, the combined average performance for students who took the PSAT/NMSQT and also took one or more AP Examinations 19 months later (n = 1,035,696) was several points higher at 54.9 for verbal, 56.2 for math, and 55.0 for writing. In addition, the average PSAT/NMSQT performance of the subsample of sophomores and juniors who completed the SAT Questionnaire (n = 736,228) was also higher than all sophomore and junior test-takers with average scores of 55.2 for verbal, 56.6 for math, and 55.2 for writing. Note, however, that average scores on the PSAT/NMSQT were similar for both the total sample (n = 1,035,696) and the subsample of students who completed the SAT Questionnaire (n = 736,228), suggesting that results from analyses based on the subsample are likely to generalize to the total sample.

To summarize, two overlapping samples were used for all analyses reported in this paper. The first sample was composed of two cohorts of students who took the PSAT/NMSQT in 2000 or 2001 and then took one or more AP Examinations 19 months later. This sample was used to examine the relationship between PSAT/NMSQT scores and AP Examination grades, as well as to compute the expectancy tables. The second sample was composed of students who also completed the SAT Questionnaire in addition to taking the PSAT/NMSQT and AP Exams during the specified periods. Data from the SAT Questionnaire enabled additional analyses to be conducted to evaluate the role of other academic indicators (i.e., cumulative HSGPA and grades in relevant courses) in predicting performance on AP Examinations.

Analyses and Results

Strength of the Relationship Between AP® Examination Grades and PSAT/NMSQT® Scores

Pearson-product moment correlations were computed between grades on 33 AP Examinations[6] and six PSAT/NMSQT scores: (1) verbal (V), (2) math (M), (3) writing (W), (4) V+M, (5) V+W, (6) M+W, and (7) V+M+W. Table 1 shows the means and standard deviations for AP Examination grades and PSAT/NMSQT scores by AP subject, and the sample sizes that were involved. The number of students per AP Examination ranged from 2,500 students for AP French Literature to 324,151 for AP English Literature. The median number of students across all AP Examinations was 30,421. For six AP Examinations, the analyses involved more than 100,000 students.

Table 2 presents the correlations between PSAT/NMSQT scores and AP Examination grades. Results show that one or more PSAT/NMSQT scores were moderately to strongly correlated to grades on all AP Examinations with the exception of four exams. The exceptions were: (1) German Language, (2) Spanish Language, (3) Studio Art: Drawing, and (4) Studio Art: 2-D Design. Camara and Millsap (1998) found similar results, and speculated that one reason for the low correlations among PSAT/NMSQT scores and the language exams was because a large proportion of students taking these exams may have been exposed to the language in their household or have acquired language skills outside of the classroom. In the case of AP Studio Art, the low correlations may be because the AP Studio Art Examinations consist entirely of portfolio assessments, with traditional assessments not being used.

Of the remaining 29 AP Examinations, Table 2 shows that all exams exhibited a correlation of .40 or higher with one or more PSAT/NMSQT scores.

[5] PSAT/NMSQT scores are reported on a 20–80 scale with a mean of approximately 50 and a standard deviation of approximately 10.

[6] At the time of this study, 34 AP Examinations were available for analysis; however, AP Studio Art: 3-D Design was not included due to small sample sizes.

Table 1

Means and Standard Deviations of AP Examination Grades and PSAT/NMSQT Scores

AP Art History	*Mean*	*SD*
AP Grade	3.20	1.19
Verbal Score	56.71	10.02
Math Score	56.48	9.70
Writing Score	56.80	10.32
V + M	113.19	17.76
V + W	113.51	19.20
M + W	113.28	17.95
V + M + W	169.99	26.56
N = 16,055		

AP Biology	*Mean*	*SD*
AP Grade	3.15	1.30
Verbal Score	56.28	9.47
Math Score	57.68	9.36
Writing Score	56.17	9.84
V + M	113.96	16.88
V + W	112.45	18.10
M + W	113.85	17.14
V + M + W	170.13	25.14
N = 120,388		

AP Calculus AB	*Mean*	*SD*
AP Grade	3.13	1.33
Verbal Score	56.51	9.22
Math Score	60.64	7.69
Writing Score	56.69	9.60
V + M	117.15	14.85
V + W	113.19	17.57
M + W	117.33	15.10
V + M + W	173.84	22.82
N = 228,922		

AP Calculus BC	*Mean*	*SD*
AP Grade	3.74	1.34
Verbal Score	61.08	9.50
Math Score	66.70	7.08
Writing Score	61.41	9.83
V + M	127.78	14.35
V + W	122.49	18.06
M + W	128.11	14.64
V + M + W	189.19	22.57
N = 66,370		

AP Chemistry	*Mean*	*SD*
AP Grade	2.89	1.37
Verbal Score	56.94	9.71
Math Score	60.84	8.99
Writing Score	56.94	9.96
V + M	117.78	16.64
V + W	113.88	18.46
M + W	117.78	16.80
V + M + W	174.72	25.01
N = 76,704		

AP Computer Science A	*Mean*	*SD*
AP Grade	2.93	1.49
Verbal Score	55.87	9.66
Math Score	60.71	8.90
Writing Score	55.04	9.92
V + M	116.58	16.37
V + W	110.90	18.34
M + W	115.75	16.65
V + M + W	171.61	24.72
N = 16,020		

AP Computer Science AB	*Mean*	*SD*
AP Grade	3.44	1.42
Verbal Score	60.48	9.57
Math Score	65.74	8.00
Writing Score	59.31	10.09
V + M	126.22	15.28
V + W	119.79	18.37
M + W	125.04	15.87
V + M + W	185.53	23.78
N = 8,866		

AP English Language	*Mean*	*SD*
AP Grade	3.02	1.07
Verbal Score	54.74	9.30
Math Score	54.90	9.63
Writing Score	55.05	9.58
V + M	109.64	17.05
V + W	109.79	17.67
M + W	109.95	17.19
V + M + W	164.69	25.05
N = 188,200		

AP English Literature	*Mean*	*SD*
AP Grade	3.07	1.05
Verbal Score	58.00	9.27
Math Score	57.51	9.54
Writing Score	58.12	9.70
V + M	115.50	16.93
V + W	116.12	17.74
M + W	115.63	17.22
V + M + W	173.62	25.03
N = 324,151		

AP Environmental Science	*Mean*	*SD*
AP Grade	2.73	1.35
Verbal Score	54.27	9.39
Math Score	55.36	9.32
Writing Score	54.09	9.67
V + M	109.64	16.77
V + W	108.36	17.85
M + W	109.45	16.88
V + M + W	163.73	24.83
N = 35,679		

Table 1 (continued)

Means and Standard Deviations of AP Examination Grades and PSAT/NMSQT Scores

	Mean	*SD*
AP European History		
AP Grade	3.26	1.15
Verbal Score	59.12	9.16
Math Score	58.17	9.26
Writing Score	58.48	9.72
V + M	117.29	16.40
V + W	117.60	17.62
M + W	116.65	16.87
V + M + W	175.77	24.50
N = 47,027		
AP French Language		
AP Grade	2.72	1.24
Verbal Score	60.09	9.76
Math Score	60.04	9.34
Writing Score	61.21	9.99
V + M	120.13	17.19
V + W	121.30	18.60
M + W	121.25	17.35
V + M + W	181.34	25.69
N = 22,712		
AP French Literature		
AP Grade	3.31	1.33
Verbal Score	63.59	10.09
Math Score	62.68	9.31
Writing Score	65.16	10.12
V + M	126.27	17.61
V + W	128.74	19.12
M + W	127.84	17.71
V + M + W	191.42	26.42
N = 2,500		
AP German Language		
AP Grade	3.02	1.30
Verbal Score	59.59	9.71
Math Score	60.24	9.36
Writing Score	59.96	9.93
V + M	119.83	17.20
V + W	119.55	18.42
M + W	120.21	17.27
V + M + W	179.79	25.55
N = 4,749		
AP Government and Politics: Comparative		
AP Grade	3.02	1.25
Verbal Score	59.92	9.28
Math Score	59.73	9.29
Writing Score	59.13	9.83
V + M	119.65	16.55
V + W	119.05	17.87
M + W	118.87	17.00
V + M + W	178.79	24.76
N = 14,759		

	Mean	*SD*
AP Government and Politics: United States		
AP Grade	2.80	1.11
Verbal Score	57.46	9.43
Math Score	57.92	9.53
Writing Score	57.15	9.85
V + M	115.38	17.02
V + W	114.61	18.07
M + W	115.07	17.30
V + M + W	172.53	25.27
N = 134,996		
AP Human Geography		
AP Grade	3.27	1.34
Verbal Score	55.65	9.54
Math Score	56.40	9.68
Writing Score	55.45	9.91
V + M	112.05	17.23
V + W	111.09	18.26
M + W	111.85	17.55
V + M + W	167.50	25.60
N = 4,600		
AP Latin Literature		
AP Grade	2.85	1.41
Verbal Score	62.28	9.06
Math Score	62.06	8.75
Writing Score	62.45	9.52
V + M	124.34	15.73
V + W	124.74	17.29
M + W	124.51	16.13
V + M + W	186.79	23.61
N = 4,161		
AP Latin: Vergil		
AP Grade	3.01	1.34
Verbal Score	62.06	9.06
Math Score	62.06	8.78
Writing Score	62.40	9.57
V + M	124.12	15.82
V + W	124.46	17.37
M + W	124.46	16.23
V + M + W	186.52	23.77
N = 5,437		
AP Macroeconomics		
AP Grade	3.02	1.31
Verbal Score	58.14	9.64
Math Score	60.53	9.46
Writing Score	57.82	10.03
V + M	118.67	17.10
V + W	115.96	18.46
M + W	118.35	17.40
V + M + W	176.49	25.55
N = 50,791		

Table 1 (continued)

Means and Standard Deviations of AP Examination Grades and PSAT/NMSQT Scores

	Mean	*SD*
AP Microeconomics		
AP Grade	3.07	1.30
Verbal Score	58.48	9.57
Math Score	61.19	9.29
Writing Score	58.15	9.97
V + M	119.68	16.79
V + W	116.63	18.31
M + W	119.34	17.12
V + M + W	177.82	25.16
N = 34,769		
AP Music Theory		
AP Grade	3.29	1.23
Verbal Score	57.05	9.74
Math Score	58.43	9.79
Writing Score	57.76	10.24
V + M	115.48	17.61
V + W	114.81	18.80
M + W	116.19	18.05
V + M + W	173.24	26.35
N = 8,382		
AP Physics B		
AP Grade	2.83	1.33
Verbal Score	57.75	9.49
Math Score	62.13	8.24
Writing Score	57.45	9.91
V + M	119.88	15.58
V + W	115.20	18.15
M + W	119.57	15.95
V + M + W	177.33	23.89
N = 51,915		
AP Physics C: Electricity and Magnetism		
AP Grade	3.36	1.44
Verbal Score	62.92	9.41
Math Score	68.55	7.05
Writing Score	62.63	9.86
V + M	131.47	14.21
V + W	125.55	17.99
M + W	131.17	14.72
V + M + W	194.10	22.51
N = 15,366		
AP Physics C: Mechanics		
AP Grade	3.36	1.36
Verbal Score	61.37	9.66
Math Score	66.64	7.78
Writing Score	61.16	10.08
V + M	128.01	15.30
V + W	122.53	18.51
M + W	127.80	15.72
V + M + W	189.17	23.83
N = 30,421		

	Mean	*SD*
AP Psychology		
AP Grade	3.38	1.27
Verbal Score	55.30	9.25
Math Score	55.88	9.62
Writing Score	55.24	9.64
V + M	111.18	16.97
V + W	110.54	17.67
M + W	111.12	17.22
V + M + W	166.42	25.01
N = 73,720		
AP Spanish Language		
AP Grade	3.23	1.30
Verbal Score	54.37	11.39
Math Score	55.72	11.41
Writing Score	55.76	11.26
V + M	110.09	21.29
V + W	110.13	21.62
M + W	111.47	21.06
V + M + W	165.84	31.27
N = 74,433		
AP Spanish Literature		
AP Grade	3.15	1.22
Verbal Score	51.28	13.65
Math Score	52.24	13.04
Writing Score	53.08	13.06
V + M	103.52	25.44
V + W	104.36	25.85
M + W	105.32	24.82
V + M + W	156.60	37.47
N = 9,250		
AP Statistics		
AP Grade	2.91	1.31
Verbal Score	56.30	9.40
Math Score	59.94	8.75
Writing Score	56.35	9.77
V + M	116.25	16.04
V + W	112.66	17.95
M + W	116.30	16.28
V + M + W	172.60	24.17
N = 73,292		
AP Studio Art: Drawing		
AP Grade	3.20	1.02
Verbal Score	53.31	10.07
Math Score	53.21	9.98
Writing Score	53.34	10.29
V + M	106.52	18.06
V + W	106.64	19.22
M + W	106.55	18.27
V + M + W	159.85	26.88
N = 10,970		

Table 1 (continued)

Means and Standard Deviations of AP Examination Grades and PSAT/NMSQT Scores

	Mean	*SD*
AP Studio Art: 2-D Design		
AP Grade	2.97	1.07
Verbal Score	53.04	9.76
Math Score	52.90	9.58
Writing Score	53.01	9.91
V + M	105.94	17.31
V + W	106.05	18.50
M + W	105.91	17.43
V + M + W	158.95	25.70
N = 8,165		
AP U.S. History		
AP Grade	2.89	1.23
Verbal Score	54.47	9.04
Math Score	54.88	9.38
Writing Score	54.44	9.41
V + M	109.35	16.42
V + W	108.91	17.20
M + W	109.31	16.64
V + M + W	163.79	24.17
N = 231,889		
AP World History		
AP Grade	3.31	1.24
Verbal Score	56.61	9.77
Math Score	56.64	9.79
Writing Score	56.05	9.94
V + M	113.25	17.55
V + W	112.66	18.50
M + W	112.68	17.66
V + M + W	169.29	25.92
N = 7,990		

In general, the strength of the correlation between PSAT/NMSQT scores and AP Examination grades varied by AP subject. For example, AP English Language and AP English Literature Examinations exhibited the highest correlations with PSAT/NMSQT scores, whereas AP Spanish Literature exhibited the lowest correlation. Table 1 also shows that AP Examination grades tended to be more highly correlated (if only slightly) with the combined PSAT/NMSQT scores than with the separate verbal, math, and writing scores. Ten AP Examinations correlated the highest with V+M scores, eight AP Examinations correlated the highest with V+M+W scores, and six AP Examinations correlated the highest with V+W scores. Just one exam, AP Music Theory, correlated the highest with M+W scores. No AP Examinations correlated the highest with the verbal-only scale.

As noted earlier, the average scores on the PSAT/NMSQT for students in this study are higher than the average scores for all sophomore and junior test-takers in 2000 and 2001, which is not surprising because only those students taking one or more AP Examinations were included in this study. Given this, correlations between PSAT/NMSQT scores and AP Examination grades are likely to be underestimates of the true correlation because of the restriction of range for the data analyzed in this study.

Finally, Table 2 shows the PSAT/NMSQT scale that was selected as the basis for computing each expectancy table. This is indicated by the "boxed" correlations. The median correlation between the selected PSAT/NMSQT scale and AP Examination grades was .57, and the average correlation was .56. For 20 of the 29 AP Examinations, correlations were above .50. In 18 of 29 instances, the PSAT/NMSQT scale that was selected was the one that had the highest correlation with each AP Examination. In 11 instances, a PSAT/NMSQT scale other than the one with the highest correlation was selected. The reasons for doing so were to ensure consistency across exams of similar AP subject areas and/or to improve the stability of the resulting expectancy data. The difference between the highest correlation and the selected correlation for these 11 AP Examinations was very small (ranging from .001 to .039). As a result, the accuracy of predictions for these AP Examinations was not affected in any meaningful way. Further information about the development of the expectancy tables, as well as their recommended use, will be provided in a subsequent section of this report.

Separate Versus Combined Correlations for Sophomores and Juniors Taking the PSAT/NMSQT

In the past decade, the number of sophomores taking the PSAT/NMSQT has grown steadily, and the number of juniors taking AP Examinations has also grown. It is possible that the relationship between PSAT/NMSQT scores and AP Examination grades varies by grade level and AP subject. Therefore, one of the research questions we considered was whether separate expectancy tables would be needed for sophomore and junior PSAT/NMSQT test-takers. To investigate this possibility, correlations were computed separately for two groups of students: (1) sophomores taking the PSAT/NMSQT and then completing AP Examinations in their junior year, and (2) juniors taking the PSAT/NMSQT and then completing the AP Examinations in their senior year. Although there are seven indices of PSAT/NMSQT performance, these analyses focused on the PSAT/NMSQT index that was selected to compute the expectancy tables based on the combined analyses (see Table 2). Grade-level correlations were not compared for those exams that did not show a strong relationship with performance on the

Table 2

Correlations of PSAT/NMSQT Scores with AP Examination Grades

AP Examination	*V*	*M*	*W*	*V+M*	*V+W*	*M+W*	*V+M+W*	*Sample*
Art History	.566	.424	.521	.551	**.575**	.529	.571	16,055
Biology	.585	.591	.527	**.656**	.592	.625	.646	120,388
Calculus AB	.374	**.530**	.359	.507	.392	.498	.481	228,922
Calculus BC	.324	**.484**	.324	.454	.347	.452	.430	66,370
Chemistry	.472	**.599**	.453	**.599**	.492	.589	.579	76,704
Computer Science A	.423	.511	.401	**.527**	.440	.512	.510	16,020
Computer Science AB	.408	.454	.381	**.493**	.422	.471	.479	8,866
English Language	.712	.543	.659	.695	**.732**	.671	.725	188,200
English Literature	.704	.511	.657	.674	**.727**	.653	.710	324,151
Environmental Science	.591	.542	.515	**.632**	.590	.594	.628	35,679
European History	.577	.451	.503	.577	.577	.537	**.586**	47,027
French Language	.423	.342	.452	.426	**.465**	.445	.461	22,712
French Literature	.464	.382	.499	.468	**.509**	.486	.503	2,500
German Language*	.257	.195	.348	.251	.323	.306	.304	4,749
Government and Politics: Comparative	.520	.413	.458	.523	.522	.490	**.532**	14,759
Government and Politics: United States	.599	.515	.525	.620	.599	.582	**.622**	134,996
Human Geography	.597	.491	.540	.606	.605	.575	**.617**	4,600
Latin Literature	.443	.380	.479	.466	.496	.489	**.504**	4,161
Latin: Vergil	.432	.380	.471	.458	.485	.483	**.495**	5,437
Macroeconomics	.481	.533	.440	**.566**	.490	.543	.551	50,791
Microeconomics	.454	.525	.431	**.549**	.472	.535	.537	34,769
Music Theory	.375	.477	.422	.473	.424	**.498**	.480	8,382
Physics B	.419	.540	.396	**.541**	.435	.525	.517	51,915
Physics C: Electricity and Magnetism	.354	.455	.355	**.460**	.380	.455	.446	15,366
Physics C: Mechanics	.436	**.572**	.426	.567	.460	.556	.544	30,421
Psychology	.582	.523	.538	.614	.598	.593	**.624**	73,720
Spanish Language*	.005	.056	.030	.033	.013	.014	.012	74,433
Spanish Literature	.427	.379	.411	.424	**.433**	.415	.431	9,250
Statistics	.490	.604	.478	**.617**	.516	.612	.602	73,292
Studio Art: Drawing*	.157	.202	.160	.199	.168	.200	.195	10,970
Studio Art: 2-D Design*	.138	.160	.122	.167	.138	.157	.159	8,165
U.S. History	.584	.478	.513	.595	.587	.559	**.603**	231,889
World History	.573	.476	.488	**.584**	.565	.539	.583	7,990

*Correlations too low for reporting.
Bold indicates highest correlation among PSAT/NMSQT scores.
Shaded boxed number indicates the model used for estimating expected grades on AP Examinations from PSAT/NMSQT scores.

PSAT/NMSQT (i.e., German Language, Spanish Language, Studio Art: Drawing, and Studio Art: 2-D Design).

Results are displayed in Table 3, and show that correlations for both groups were nearly identical for most AP Examinations and only differed by more than .05 in four instances. The variance contributed by PSAT/NMSQT over and above HSGPA and relevant course grades was similarly compared for these two groups of students using a subset of AP Examinations. These results are described in a subsequent section and displayed in Table 7. Based on all of these analyses, there was no justification to provide separate expectancy tables by grade level.

Table 3

Correlations of PSAT/NMSQT Scores with AP Examination Grades by Grade Level

AP Examination	*PSAT/NMSQT Scale*	*Sophomore*	*Junior*	*Difference (Sophomore–Junior)*
Art History	V + W	.579 (4,177)	.587 (11,878)	-0.01
Biology	V + M	.660 (40,721)	.674 (79,667)	-0.01
Calculus AB	Math	.564 (27,223)	.526 (201,699)	0.04
Calculus BC	Math	.493 (10,359)	.483 (56,011)	0.01
Chemistry	Math	.610 (36,969)	.612 (39,735)	0.00
Computer Science A	Math	.536 (6,273)	.515 (9,747)	0.02
Computer Science AB	Math	.466 (3,284)	.467 (5,582)	0.00
English Language	V + W	.738 (140,946)	.720 (47,254)	0.02
English Literature	CR + W	.738 (15,897)	.727 (308,254)	0.01
Environmental Science	V + M	.655 (10,042)	.636 (25,637)	0.02
European History	V + M + W	.587 (10,132)	.593 (36,895)	-0.01
French Language	V+W	.432 (5,088)	.497 (17,624)	-0.07
French Literature	Writing	.507 (398)	.521 (2,102)	-0.01
Government and Politics: Comparative	V + M	.546 (1,485)	.525 (13,274)	0.02
Government and Politics: United States	V + M + W	.629 (9,314)	.625 (125,682)	0.00
Human Geography	V + M	.643 (1,506)	.597 (3,094)	0.05
Latin Literature	Writing	.492 (1,608)	.497 (2,553)	-0.01
Latin: Vergil	Writing	.502 (2,289)	.493 (3,148)	0.01
Macroeconomics	V + M	.594 (4,060)	.569 (46,731)	0.03
Microeconomics	V + M	.577 (3,121)	.554 (31,648)	0.02
Music Theory	Math	.510 (2,294)	.466 (6,088)	0.04
Physics B	Math	.572 (14,965)	.541 (36,950)	0.03
Physics C: Electricity and Magnetism	Math	.509 (1,038)	.449 (14,238)	0.06
Physics C: Mechanics	Math	.655 (2,681)	.564 (27,740)	0.09
Psychology	V + M + W	.631 (17,821)	.627 (55,899)	0.00
Spanish Literature	Writing	.488 (2,178)	.405 (7,072)	0.08
Statistics	V + M	.633 (11,822)	.627 (61,470)	0.01
U.S. History	V + M + W	.609 (208,949)	.584 (22,940)	0.03
World History	V + M	.605 (4,631)	.554 (3,359)	0.05

Sample sizes in parentheses.

Strength of Relationship Between AP Examination Grades and High School Grades

SAT Questionnaire data were analyzed to evaluate the relationship between high school grades and AP Examination performance.[7] High school grade data included students' self-reported cumulative HSGPA and their self-reported average grades in six subject areas: (1) arts and music, (2) English, (3) foreign and classical language, (4) math, (5) natural sciences (e.g., biology, chemistry, physics), and (6) social sciences and history (e.g., psychology, European history, government, economics). The SAT Questionnaire asks students to provide their average grade for all courses taken in each subject area using a scale ranging from A ("excellent, usually 90–100") to E or F ("failing, usually 59 or below"). Cumulative HSGPA is reported on a 12-point scale ranging from A (coded as 1) to E/F (coded as 12). Because HSGPA is negatively coded, negative correlations with AP Examination grades were expected.[8] Table 4 reports the Pearson-product moment correlations between these indicators of high school academic performance and AP Examination grades. Only correlations with relevant subject areas are reported.

The AP Examinations that had the highest correlations with cumulative HSGPA were Biology, Psychology, Statistics, and Environmental Science. Correlations between AP Examination grades and HSGPA, however, were still much lower than the correlations between PSAT/NMSQT scores and the same AP Examinations. When considering all of the 29 AP Examinations that exhibited a moderate to strong correlation with PSAT/NMSQT scores, the average correlation between AP Examination grades and HSGPA had a magnitude of .28. By contrast, the average correlation between the same AP Examinations and the PSAT/NMSQT scores used for computing the expectancy tables was much higher at .56.

Table 4 also reports the correlations between AP Examination grades and relevant course grades, but as was the case with cumulative HSGPA, these correlations were all lower than those involving the PSAT/NMSQT. The correlations between AP Examination grades and relevant course grades ranged from .08 (i.e., Studio Art: 2-D Design and Studio Art: Drawing) to .36 (i.e., Statistics). When considering all of the 29 AP Examinations that exhibited a moderate to strong correlation with PSAT/NMSQT scores, the average correlation between AP Examination grades and relevant course grades was .25. This average was again well below the average correlation between AP Examination grades and the PSAT/NMSQT scores used to compute the expectancy tables.[9]

Multiple Regression Analyses

For 11 moderate- to high-volume AP Examinations, a series of multiple regression analyses was also conducted to evaluate the incremental validity of PSAT/NMSQT scores in predicting AP Examination grades over and above other indicators of high school academic performance. As in the correlational analyses, the additional indicators included cumulative HSGPA and relevant course grades. For each AP Examination, the PSAT/NMSQT scale used in the model was the one that was selected to compute the corresponding expectancy table as shown in Table 5. The research question concerned how much variability in AP Examination grades could be explained by PSAT/NMSQT scores after the effects of self-reported cumulative HSGPA and relevant course grades were taken into account. The research question was framed this way in order to evaluate the utility of the PSAT/NMSQT scores in predicting AP Examination grades over and above more traditional indicators of high school academic performance.

The analyses involved a series of hierarchical multiple-linear regressions in which the independent variables were always cumulative HSGPA, relevant course grade, and the PSAT/NMSQT scale used to compute the expectancy table. The dependent variable in all analyses was AP Examination grade. To test the incremental validity of the PSAT/NMSQT, cumulative HSGPA and relevant course grades were entered into the model first, and then the amount of variability accounted for by these two variables, as measured by R-squared, was computed. In the second model, all three predictors were entered, and the additional variance accounted for by considering PSAT/NMSQT, referred to as the R-squared increment, was computed

[7] After analyses were completed, it was determined that a very small percentage of students not of sophomore- or junior-class standing were included in analyses involving the SAT Questionnaire. Because this percentage was very small (less than 1 percent), we do not believe the results were impacted in any meaningful way.

[8] Correlations range from -1.0 to 1.0 with a value closer to 1.0 indicating a stronger relationship between two variables. The sign of the correlation indicates the direction of relationship, whereas the value of the correlation indicates the magnitude of the relationship.

[9] It is important to emphasize that the correlations between AP grades and PSAT/NMSQT scores and the correlations between AP grades and high school grades (i.e., HSGPA and relevant course grades) are based on different samples (SAT Questionnaire versus no questionnaire). As mentioned, however, both samples were similar with respect to average PSAT/NMSQT scores and therefore we would not expect the correlations between AP grades and PSAT/NMSQT scores in the SAT Questionnaire sample to be substantially different from those based on the total sample. Nonetheless, when making comparisons, this caveat should be kept in mind.

Table 4

Means and Correlations of AP Examination Grades with High School Courses and Grades

	Mean	sd	n	Correlation with AP Grade
Art History				
AP Grade	3.20	1.18	12,479	-
HSGPA*	3.06	1.43	9,949	-.299
Art and Music Grades**	3.89	0.35	8,386	.156
Biology				
AP Grade	3.19	1.29	90,170	-
HSGPA*	2.59	1.28	76,291	-.399
Natural Science Grades**	3.72	0.48	69,733	.328
Calculus AB				
AP Grade	3.15	1.33	159,871	-
HSGPA*	2.45	1.19	136,882	-.199
Math Grades**	3.75	0.46	126,779	.228
Calculus BC				
AP Grade	3.74	1.34	49,250	-
HSGPA*	2.16	1.04	41,366	-.175
Math Grades**	3.86	0.36	37,962	.210
Chemistry				
AP Grade	2.94	1.37	59,090	-
HSGPA*	2.30	1.16	49,914	-.272
Natural Science Grades**	3.82	0.40	45,585	.267
Computer Science A				
AP Grade	2.96	1.49	12,485	-
HSGPA*	2.88	1.48	10,141	-.259
Math Grades**	3.64	0.55	9,367	.276
Computer Science AB				
AP Grade	3.45	1.42	6,963	-
HSGPA*	2.68	1.38	5,479	-.257
Math Grades**	3.75	0.46	4,991	.225
English Language				
AP Grade	3.10	1.06	142,137	-
HSGPA*	2.59	1.30	118,619	-.304
English Grades**	3.72	0.48	108,813	.295
English Literature				
AP Grade	3.10	1.06	221,838	-
HSGPA*	2.59	1.29	190,151	-.296
English Grades**	3.74	0.46	177,865	.275
Environmental Science				
AP Grade	2.76	1.34	27,944	-
HSGPA*	3.18	1.47	22,708	-.351
English Grades**	3.55	0.56	20,711	.269
European History				
AP Grade	3.29	1.15	34,772	-
HSGPA*	2.71	1.32	29,097	-.294
Social Science Grades**	3.79	0.43	26,700	.277
French Language				
AP Grade	2.73	1.23	17,598	-
HSGPA*	2.58	1.22	14,442	-.167
Language Grades**	3.82	0.40	13,261	.158
French Literature				
AP Grade	3.28	1.32	1,931	-
HSGPA*	2.76	1.20	1,487	-.257
Language Grades**	3.79	0.43	1,327	.249
German Language				
AP Grade	3.04	1.31	3,239	-
HSGPA*	2.59	1.32	2,688	-.153
Language Grades**	3.83	0.41	2,487	.162
Government and Politics: Comparative				
AP Grade	3.21	1.09	8,806	-
HSGPA*	2.70	1.35	8,961	-.313
Social Science Grades**	3.77	0.45	8,259	.287

	Mean	sd	n	Correlation with AP Grade
Government and Politics: United States				
AP Grade	2.80	1.11	98,233	-
HSGPA*	2.67	1.35	83,558	-.309
Social Science Grades**	3.76	0.45	77,007	.271
Human Geography				
AP Grade	3.29	1.34	3,509	-
HSGPA*	2.98	1.42	2,813	-.335
Social Science Grades**	3.68	0.51	2,521	.314
Latin Literature				
AP Grade	2.81	1.41	2,523	-
HSGPA*	2.52	1.23	2,070	-.321
Language Grades**	3.82	0.39	1,921	.288
Latin: Vergil				
AP Grade	3.04	1.33	4,502	-
HSGPA*	2.40	1.15	3,599	-.274
Language Grades**	3.86	0.36	3,265	.240
Macroeconomics				
AP Grade	3.24	1.28	16,313	-
HSGPA*	2.62	1.32	31,541	-.258
Math Grades**	3.61	0.57	28,848	.293
Social Science Grades**	3.76	0.45	28,709	.182
Microeconomics				
AP Grade	3.07	1.30	25,755	-
HSGPA*	2.64	1.30	21,628	-.261
Math Grades**	3.63	0.56	19,774	.296
Social Science Grades**	3.76	0.45	19,708	.188
Music Theory				
AP Grade	3.29	1.24	5,924	-
HSGPA*	3.02	1.51	4,788	-.303
Art and Music Grades**	3.96	0.20	4,458	.114
Physics B				
AP Grade	2.84	1.33	39,836	-
HSGPA*	2.43	1.22	33,501	-.220
Natural Science Grades**	3.78	0.44	30,679	.233
Physics C: Electricity and Magnetism				
AP Grade	3.32	1.44	11,061	-
HSGPA*	2.31	1.15	9,194	-.205
Natural Science Grades**	3.85	0.38	8,392	.215
Physics C: Mechanics				
AP Grade	3.31	1.36	22,127	-
HSGPA*	2.35	1.18	18,513	-.228
Natural Science Grades**	3.83	0.39	16,860	.240
Psychology				
AP Grade	3.38	1.28	51,889	-
HSGPA*	2.99	1.42	43,021	-.391
Social Science Grades**	3.68	0.51	39,316	.303
Spanish Language				
AP Grade	3.22	1.29	54,887	-
HSGPA*	2.78	1.41	46,104	.021
Language Grades**	3.80	0.43	42,560	.101
Spanish Literature				
AP Grade	3.22	1.19	6,890	-
HSGPA*	3.15	1.58	5,768	-.279
Language Grades**	3.77	0.47	5,390	.194
Statistics				
AP Grade	2.90	1.31	54,635	-
HSGPA*	2.79	1.35	45,338	-.367
Math Grades**	3.59	0.56	41,585	.359

Table 4 (continued)

Means and Correlations of AP Examination Grades with High School Courses and Grades

	Mean	*sd*	*n*	*Correlation with AP Grade*
Studio Art: Drawing				
AP Grade	3.21	1.01	7,406	-
HSGPA*	3.29	1.55	5,999	-.160
Art & Music Grades**	3.94	0.26	5,696	.076
Studio Art: 2-D Design				
AP Grade	2.97	1.08	5,532	-
HSGPA*	3.40	1.55	4,482	-.146
Art and Music Grades**	3.93	0.26	4,311	.076
U.S. History				
AP Grade	2.98	1.22	186,729	-
HSGPA*	2.61	1.29	155,224	-.305
Social Science Grades**	3.74	0.47	140,754	.303
World History				
AP Grade	3.37	1.21	6,644	-
HSGPA*	2.71	1.37	5,427	-.243
Social Science Grades**	3.77	0.44	4,906	.290

*HSGPA is negatively coded (A+ =1, A = 2, A- = 3, ...D = 11, E/F = 12)
**A = 4, B = 3, C = 2, D = 1, E/F = 0.

and tested for statistical significance. Appendix A presents the results of the full regression analyses. Table 5 summarizes the amount of variability in AP Examination grades accounted for in each model, as well as the increment to R-squared that occurred when PSAT/NMSQT was added. Notice that the best-fitting model for each AP Examination, as indicated by higher R-squared values, was always Model 2—the one that includes PSAT/NMSQT scores. In other words, for each AP Examination, the amount of variability explained by Model 2 was always substantially greater than the amount of variability explained by Model 1. Specifically, the R-squared increments ranged from .19 to .43.

Multiple Regression Analyses: Gender, Ethnic, and Grade-Level Differences

Additional analyses were also conducted to evaluate the extent to which the relationship between PSAT/NMSQT scores and AP Examination grades varied as a function of student characteristics including gender, grade level, and ethnicity for the same subset of 11 AP Examinations. Table 6 shows the correlations between AP Examination grades and the PSAT/NMSQT scores used to compute the expectancy tables by racial/ethnic groups and gender. Refer back to Table 3 for correlations by grade level. All correlations were based on the total sample. In all cases, the strength of the correlations between AP Examination grades and PSAT/NMSQT scores were consistently high across all groups; however, some differences did emerge. With respect to gender, all correlations were slightly higher for female students than for male students. The correlations for racial/ethnic groups were all higher than for white students, with the exception of AP Chemistry, where the correlation for African American students was slightly lower than that of the correlation for white students. In general, however, none of the differences were large in absolute terms across any of the subgroups.

To evaluate whether the incremental validity of PSAT/NMSQT scores in predicting AP Examination grades varied as a function of student characteristics, we again conducted hierarchical multiple linear-regression analyses, using the same procedure as described previously. These analyses were conducted using the subsample of students who completed the SAT Questionnaire, and were conducted separately for gender, grade level, and racial/ethnic subgroups. The goal was to evaluate whether the

Table 5

R-Squared and R-Squared Change for Models with and without PSAT/NMSQT Scores

AP Examination	*R-Squared Model 1*	*R-Squared Model 2*	*R-Squared Increment*	*Sample Size*
Biology	.142	.449	.307	68,358
Calculus AB	.062	.303	.241	124,493
Calculus BC	.052	.244	.192	37,153
Chemistry	.095	.370	.275	44,752
English Language	.116	.540	.424	106,710
English Literature	.108	.542	.434	174,182
Government and Politics: United States	.115	.408	.293	75,506
Macroeconomics	.090	.338	.248	28,105
Psychology	.166	.427	.261	38,396
Statistics	.170	.429	.259	40,593
U.S. History	.122	.378	.256	138,237

Note: All results are significant at the .000 alpha level.
Model 1 predictors include cumulative HSGPA and relevant course grades.
Model 2 predictors include cumulative HSGPA, relevant course grades, and PSAT/NMSQT scores.

Table 6

Correlations of PSAT/NMSQT Scores with AP Examination Grades by Racial/Ethnic Groups and Gender

PSAT/NMSQT Index	*AP Examination*	*African American*	*Asian American*	*Hispanic*	*White*	*Female*	*Male*
Math	Calculus AB	.555 (9,045)	.522 (33,096)	.552 (13,375)	.492 (162,029)	.536 (114,196)	.509 (114,644)
	Calculus BC	.556 (1,352)	.482 (16,163)	.538 (2,314)	.459 (42,802)	.492 (27,382)	.463 (38,955)
	Chemistry	.561 (2,905)	.597 (15,607)	.577 (3,751)	.570 (50,359)	.601 (36,458)	.572 (40,207)
V+M	Biology	.664 (5,845)	.651 (20,607)	.667 (6,764)	.623 (80,101)	.665 (73,376)	.624 (46,955)
	Macroeconomics	.585 (1,639)	.528 (9,669)	.596 (4,422)	.524 (31,956)	.575 (23,274)	.538 (27,497)
	Statistics	.601 (2,929)	.625 (12,231)	.632 (3,747)	.592 (50,493)	.610 (38,175)	.608 (35,088)
V+W	English Language	.726 (10,317)	.742 (21,539)	.755 (16,300)	.691 (129,380)	.741 (118,966)	.716 (69,103)
	English Literature	.726 (16,929)	.742 (34,758)	.753 (22,002)	.692 (232,670)	.739 (207,552)	.710 (116,425)
V+M+W	Government and Politics: United States	.629 (6,035)	.633 (17,832)	.657 (11,062)	.573 (92,309)	.640 (71,807)	.591 (63,128)
	Psychology	.641 (4,219)	.621 (9,472)	.651 (4,177)	.590 (51,817)	.633 (48,780)	.610 (24,907)
	U.S. History	.603 (12,356)	.627 (29,556)	.623 (15,350)	.557 (161,274)	.618 (130,098)	.579 (101,640)

Sample sizes in parentheses.

incremental validity of PSAT/NMSQT scores to predict AP Examination grades over and above cumulative HSGPA and relevant course grades varied by gender, grade level, and racial/ethnic groups. Tables 7 and 8 display the R-squared increments of the PSAT/NMSQT by student characteristics. Differences in these R-squared increments were tested for statistical significance using a procedure that is explained in detail in Appendix B. For the group differences with regard to gender, the results showed that all differences were statistically significant except for AP Statistics and, in all cases, female students had the higher R-squared increments than male students. These results are consistent with findings that correlations between high school grades or admissions test scores with

Table 7

R-Squared Increments for PSAT/NMSQT by Gender and Grade Level

PSAT/NMSQT Index	*AP Examination*	*Gender*		*Class Status*	
		Female	*Male*	*Sophomore*	*Junior*
Math	Calculus AB	.237*	.220	.238	.241
	Calculus BC	.194*	.169	.187	.194
	Chemistry	.274*	.234	.290	.294
V+M	Biology	.307*	.276	.313	.332*
	Macroeconomics	.241*	.218	.262	.253
	Statistics	.249	.245	.284	.273
V+W	English Language	.429*	.409	.428	.421
	English Literature	.444*	.419	.467*	.433
V+M+W	Government and Politics: United States	.292*	.270	.297	.298
	Psychology	.268*	.246	.242	.281*
	U.S. History	.260*	.236	.261	.250

*Gender difference or class-status difference was significant at $p \leq .05$.

Table 8

R-Squared Increments for PSAT/NMSQT by Ethnicity

PSAT/NMSQT Index	*AP Examination*	*African American*	*Asian American*	*Hispanic*	*White*
Math	Calculus AB*	.241	.229	.244	.212
	Calculus BC*	.249	.186	.229	.171
	Chemistry	.262	.271	.250	.256
V+M	Biology*	.312	.300	.330	.284
	Macroeconomics*	.290	.213	.263	.209
	Statistics	.273	.248	.285	.243
V+W	English Language*	.428	.434	.454	.399
	English Literature*	.439	.446	.450	.407
V+M+W	Government and Politics: United States*	.283	.280	.335	.252
	Psychology*	.288	.253	.308	.239
	U.S. History*	.270	.274	.275	.229

*Omnibus difference was significant at $p \leq .05$.

college grades are consistently higher for female students than for male students (Willingham and Cole, 1997). With regard to grade level, the only significant differences that were found were for AP English Literature, Biology, and Psychology. In the case of Biology and Psychology, juniors had the higher increments, whereas sophomores had the higher increment for English Literature.

For the group differences with regard to ethnicity, which compared R-squared increments for African American, Asian American, Hispanic, and white students, significant differences between at least one of the four groups were found on all tests except for AP Statistics and AP Chemistry. Because four student groups were being compared, additional analyses were conducted to determine which groups differed. For five AP Examinations (i.e., Biology, Calculus AB, English Language, English Literature, and U.S. History), the same pattern emerged. That is, white students had significantly lower R-squared increments than Asian American, African American, and Hispanic students, and the R-squared increments for these three groups did not differ significantly from each other. For AP U.S. Government, the R-squared increments for Asian American students and African American students did not differ, but the R-squared increments for all other groups did differ. For AP Calculus BC, the R-squared increments for Hispanic students and Asian American students did not differ, although the R-squared increments for all other groups did. For AP Psychology, the R-squared increments for Hispanic students differed from the R-squared increments for the other three groups, but the R-squared increments for African American, Asian American, and white students did not differ from each other. Finally, for AP Macroeconomics, the R-squared increments for Asian American and white students did not differ, nor did the R-squared increments for African American and Hispanic students, but the R-squared increments for Asian American and white students did differ from the R-squared increments for African American and Hispanic students.

In summary, while statistically significant differences were found among the R-squared increments, the differences were generally not large. Coupled with the results from the correlations, these findings suggest that the relationship between PSAT/NMSQT scores and AP Examination grades, as well as the incremental validity of the PSAT/NMSQT in predicting AP Examination grades, is fairly consistent across various student characteristics. When statistically significant differences were found between R-squared increments, the R-squared increments for the white students were the lowest among the four ethnic groups in each instance. These results differ from studies comparing the relationship of high school grades and admissions tests with college performance, which generally show stronger relationships for white students than Hispanic or African American students (Camara and Echternacht, 2000). This study demonstrates that PSAT/NMSQT scores are as strong or even stronger predictors of AP Examination performance for minority students than they are for white students. Differences in the population of students taking AP Examinations may be partially responsible for these inconsistent findings.

Computing Expectancy Tables

For the 29 AP Examinations that exhibited a moderate to high correlation with AP Examination grades, expectancy tables were computed showing the percentage of test-takers earning a 3 or better, and a 4 or better, on AP Examinations across the range of PSAT/NMSQT scores. The data used for these analyses included all sophomores and juniors who took the PSAT/NMSQT in October of 2000 or 2001 and completed an AP Examination 19 months later. The expectancy tables are presented in Tables 9 through 13, and are organized according to the PSAT/NMSQT scale that was selected to compute the table. As noted earlier, in 18 of 29 instances, the PSAT/NMSQT scale with the highest correlation with AP Examination grades was selected. In 11 instances, however, a scale other than the one with the highest correlation was selected. This slight loss in prediction was offset by the desire to maintain consistency among PSAT/NMSQT scales employed for similar AP subjects (e.g., math, sciences, and social sciences) and/or to improve the stability of the expectancy data.

To develop each expectancy table, the selected PSAT/NMSQT scale was divided into 5-point or 10-point score ranges. Five-point score ranges were used when one or two PSAT/NMSQT scales were used, and resulted in 12 or 24 score intervals, respectively. When all three PSAT/NMSQT scales were used, 10-point score ranges were used in order to provide sufficient power at each range and to avoid overinterpretation of minor differences. Eighteen score intervals resulted when three PSAT/NMSQT scales were used, which provides sufficient discrimination for the purposes of this study. For each score range, the percentages of test-takers earning a 3 or better, and a 4 or better, were then calculated. For example, consider AP Chemistry (see Table 9). The table shows that 50 percent of students who earned a PSAT/NMSQT math score between the range of 56 and 60 also earned a 3 or better on the AP Chemistry Examination. This percentage, as well as the other resulting percentages, may be interpreted as probabilities, or success rates, for how future students are likely to perform on AP Examinations given the same PSAT/NMSQT score range.

There are two important points to make about the computation of these expectancy tables. First, if the number of AP students falling within the PSAT/NMSQT score interval was less than 20, or if only two students or fewer within a given interval earned a 3 or better, or a 4 or better, percentages were not reported. Second, in a few cases, the computations yielded percentages that were unstable, particularly at the very low end of the PSAT/NMSQT scale, in that the percentages did not always increase as PSAT/NMSQT scores increased. This result is relatively common with the empirical approach used in this study, especially when the number of students per interval is small. To help address this issue, 10-point PSAT/NMSQT score intervals were used when all three PSAT/NMSQT scales were used to compute the expectancy table in order to increase the number of students per interval. In addition, AP Potential (College Board, 2005), the online tool that uses these expectancy tables as the basis for helping educators identify students for AP course work, reports percentages only once an increasing trend has stabilized.

Using Expectancy Tables

The expectancy tables are designed to assist educators in identifying potential students who may be successful in AP courses. Educators may also use AP Potential, which is based on this research and provided free to schools that administer the PSAT/NMSQT (see College Board, 2005). In using these tables or AP Potential, educators would first select the appropriate AP Examination and then determine the probability of success (or success rate) that they feel is appropriate for their school.[10] As discussed in previous research (Camara and Millsap, 1998), there should be no absolute rules for selecting the appropriate success rate. Although a reasonable starting point may be to select the probability level that is closest to 50 percent for earning an AP Examination grade of 3 or better, schools may wish to adjust that level up or down depending on their school's AP program.

To better understand how to use the expectancy tables, consider the following example based on the expectancy table for AP English Literature (see Table 12). The first step is to identify the score range that comes closest to a 50 percent success rate. A score range on V+W of 101–105 indicates that 45.4 percent of students have attained an AP Examination grade of 3 or higher on the AP English Literature Examination. A counselor might begin by identifying all students who have combined V+W scores of 101 or above as a starting point when considering placement decisions in this course. Similarly, if a student or parent expresses interest in AP English Literature, the table can also be used to look up the student's expected success rate to help make a more informed decision. In this example, it is important to understand that not every student with a combined V+W score of 101 or higher will achieve a grade of 3 or higher on the AP English Literature Examination. Similarly, the table does not mean that all students with a V+W score below 101 will earn an AP Examination grade of 1 or 2. The expectancy tables provide probabilistic statements that describe the likely outcome on each AP Examination given performance on the relevant PSAT/NMSQT scales.

While counselors and teachers may use the expectancy tables in many ways to have an additional indicator of the likelihood of success in AP, the tables cannot be used as the only source of information or as an absolute standard or minimum requirement. Student interest and motivation are important aspects for success in any course, and these are likely to be more important for rigorous college level courses, such as AP, where a highly motivated student with average ability in a subject may be more successful than a disinterested student

[10] In AP Potential, the success rates that users may select from correspond to earning an AP Examination grade of 3 or better.

Table 9

AP Examinations Using PSAT/NMSQT Math Scores

PSAT/NMSQT M Score	AP Grade ≥3	AP Grade ≥4	n
Calculus AB			
80–76	96.4	86.4	4,401
75–71	94.0	78.6	14,339
70–66	87.8	65.1	42,992
65–61	77.1	48.2	64,237
60–56	61.9	31.2	49,616
55–51	45.8	18.1	30,170
50–46	29.1	9.0	15,791
45–41	17.7	3.9	5,113
40–36	8.1	1.5	1,626
35–31	3.6	0.8	521
30–26	3.4	-	87
25–20	-	-	29
Total	-	-	228,922
Calculus BC			
80–76	97.1	87.7	6,847
75–71	94.0	79.3	12,552
70–66	87.6	65.5	19,864
65–61	77.9	48.2	15,933
60–56	62.8	32.0	6,989
55–51	46.0	18.0	2,787
50–46	30.9	9.1	1,061
45–41	15.7	3.5	255
40–36	12.7	4.8	63
35–31	-	-	14
30–26	-	-	3
25–20	-	-	2
Total	-	-	66,370
Chemistry			
80–76	96.6	84.3	3,570
75–71	91.7	72.2	6,565
70–66	82.8	56.3	13,685
65–61	69.0	37.4	18,391
60–56	50.0	20.9	14,468
55–51	34.6	11.1	9,922
50–46	19.6	4.8	6,262
45–41	11.1	2.0	2,506
40–36	4.2	0.6	924
35–31	1.9	-	313
30–26	-	-	70
25–20	-	-	28
Total	-	-	76,704
Computer Science A			
80–76	92.5	81.3	678
75–71	87.1	73.9	1,309
70–66	81.6	62.5	2,919
65–61	70.5	49.4	3,849
60–56	56.0	33.4	2,978
55–51	42.1	20.7	2,150
50–46	26.6	11.6	1,322
45–41	16.6	6.2	531
40–36	5.8	1.9	208
35–31	-	-	63
30–26	-	-	11
25–20	-	-	2
Total	-	-	16,020

PSAT/NMSQT M Score	AP Grade ≥3	AP Grade ≥4	n
Computer Science AB			
80–76	92.4	78.0	1,018
75–71	89.1	67.5	1,419
70–66	82.9	56.3	2,290
65–61	72.9	40.1	2,034
60–56	58.9	27.4	1,176
55–51	43.8	15.4	609
50–46	34.9	10.2	235
45–41	21.3	-	61
40–36	-	-	19
35–31	-	-	4
30–26	-	-	0
25–20	-	-	1
Total	-	-	8,866
Music Theory			
80–76	96.6	84.8	322
75–71	91.4	72.8	537
70–66	88.0	65.3	1,157
65–61	80.9	51.9	1,723
60–56	74.9	42.8	1,580
55–51	63.3	31.9	1,246
50–46	50.0	19.8	1,006
45–41	41.5	14.0	501
40–36	29.2	9.7	195
35–31	15.1	2.2	93
30–26	-	-	16
25–20	-	-	6
Total	-	-	8,382
Physics B			
80–76	93.0	74.7	2,351
75–71	88.6	63.5	5,108
70–66	80.0	47.3	10,850
65–61	66.1	30.1	13,611
60–56	49.5	16.6	9,687
55–51	33.4	7.6	5,786
50–46	18.6	3.3	3,109
45–41	9.2	0.9	927
40–36	2.0	-	342
35–31	-	-	111
30–26	-	-	27
25–20	-	-	6
Total	-	-	51,915
Physics C: Electricity and Magnetism			
80–76	88.0	79.4	2,667
75–71	79.8	67.0	3,402
70–66	68.1	53.1	4,438
65–61	53.7	37.3	3,047
60–56	38.8	23.5	1,174
55–51	21.7	11.6	456
50–46	11.6	5.4	129
45–41	5.4	-	37
40–36	-	-	11
35–31	-	-	4
30–26	-	-	1
25–20	-	-	0
Total	-	-	15,366

Table 9 (continued)

AP Examinations Using PSAT/NMSQT Math Scores

PSAT/NMSQT M Score	*AP Grade* ≥3	≥4	*n*
Physics C: Mechanics			
80–76	95.3	85.6	3,843
75–71	90.1	73.4	5,637
70–66	81.2	56.1	8,318
65–61	66.2	36.9	6,907
60–56	45.1	19.3	3,267
55–51	26.2	9.0	1,526
50–46	11.0	3.7	619
45–41	4.4	1.7	181
40–36	-	-	77
35–31	-	-	37
30–26	-	-	6
25–20	-	-	3
Total	-	-	30,421

who has higher test scores. In addition, counselors still must determine if prospective students have completed prerequisite courses and demonstrated success in a subject area before concluding that a student with high test scores will be successful in a particular AP course.

Many factors will ultimately determine a student's success in a rigorous course. Counselors and teachers often rely on many different indicators in making placement decisions for AP courses, such as previous courses completed, grades in those courses, teacher recommendations, student and parent requests, student motivation and interest, and additional course load. Each of these factors may be important in determining the ultimate success of students in any rigorous course. PSAT/NMSQT scores can supplement existing procedures and provide standardized and objective information. This study and previous research (Camara and Millsap, 1998) demonstrate that PSAT/NMSQT scores are significantly more informative for such placement decisions than a

Table 10

AP Examinations Using PSAT/NMSQT Writing Scores

PSAT/NMSQT W Score	*AP Grade* ≥3	≥4	*n*	*PSAT/NMSQT W Score*	*AP Grade* ≥3	≥4	*n*
French Literature				Latin: Vergil			
80–76	95.9	81.1	418	80–76	90.7	72.1	484
75–71	86.1	66.4	452	75–71	86.9	60.5	701
70–66	78.8	50.0	504	70–66	75.2	45.6	1,109
65–61	65.6	37.2	366	65–61	69.4	34.7	919
60–56	57.0	27.8	291	60–56	57.9	25.9	791
55–51	46.5	22.4	241	55–51	45.6	18.5	790
50–46	32.8	20.3	128	50–46	35.4	14.7	429
45–41	29.3	13.8	58	45–41	19.2	7.1	156
40–36	30.6	22.2	36	40–36	10.9	-	46
35–31	-	-	5	35–31	-	-	12
30–26	-	-	1	30–26	-	-	0
25–20	-	-	0	25–20	-	-	0
Total	-	-	2,500	Total	-	-	5,437
Latin Literature				Spanish Literature			
80–76	89.1	67.9	358	80–76	95.3	79.5	464
75–71	81.1	55.3	533	75–71	91.7	69.0	617
70–66	73.8	44.1	848	70–66	87.2	57.7	999
65–61	62.0	32.7	707	65–61	82.3	50.5	820
60–56	52.1	25.5	652	60–56	80.5	47.0	875
55–51	35.1	14.7	619	55–51	77.9	44.9	1,125
50–46	27.9	8.6	280	50–46	70.6	34.1	1,216
45–41	12.8	5.5	109	45–41	64.7	24.3	1,265
40–36	8.0	-	50	40–36	54.8	19.1	1,280
35–31	-	-	3	35–31	49.6	14.0	470
30–26	-	-	2	30–26	42.4	8.5	118
25–20	-	-	0	25–20	-	-	1
Total	-	-	4,161	Total	-	-	9,250

Table 11

AP Examinations Using PSAT/NMSQT Verbal and Math Scores

PSAT/NMSQT V+M Score	AP Grade ≥3	AP Grade ≥4	n
Biology			
160–156	99.6	96.9	482
155–151	99.4	95.8	1,191
150–146	98.3	92.1	1,951
145–141	98.4	89.1	3,400
140–136	96.4	83.9	5,091
135–131	94.5	78.2	7,562
130–126	90.6	68.3	10,205
125–121	85.3	57.9	12,536
120–116	77.4	46.9	13,941
115–111	69.0	37.0	14,059
110–106	58.9	26.6	13,457
105–101	46.3	18.1	11,506
100–96	34.8	11.2	8,676
95–91	24.4	6.8	6,266
90–86	16.1	3.8	4,228
85–81	9.1	2.5	2,607
80–76	5.6	1.4	1,578
75–71	3.1	0.5	836
70–66	3.4	0.5	435
65–61	-	-	206
60–56	-	-	102
55–51	-	-	53
50–46	-	-	18
45–40	-	-	2
Total	-	-	120,388
Environmental Science			
160–156	100.0	100.0	49
155–151	98.0	95.4	151
150–146	97.0	93.3	269
145–141	97.0	89.1	598
140–136	95.2	84.4	976
135–131	91.1	78.2	1,619
130–126	86.5	66.7	2,445
125–121	80.8	58.2	3,247
120–116	74.8	48.1	3,808
115–111	64.1	38.0	4,205
110–106	53.9	28.4	4,274
105–101	40.7	17.8	3,917
100–96	30.6	10.9	3,193
95–91	22.9	8.3	2,408
90–86	15.7	4.6	1,770
85–81	8.1	1.7	1,116
80–76	6.0	0.8	732
75–71	3.1	-	445
70–66	1.8	-	223
65–61	-	-	121
60–56	-	-	53
55–51	-	-	36
50–46	-	-	16
45–40	-	-	8
Total	-	-	35,679

PSAT/NMSQT V+M Score	AP Grade ≥3	AP Grade ≥4	n
Government and Politics: Comparative			
160–156	100.0	80.0	130
155–151	97.0	74.1	232
150–146	92.4	67.8	450
145–141	92.9	62.7	678
140–136	89.8	58.0	1,051
135–131	85.6	50.2	1,322
130–126	79.7	40.0	1,626
125–121	74.4	33.9	1,808
120–116	66.2	26.5	1,722
115–111	58.6	20.5	1,610
110–106	51.8	14.4	1,302
105–101	42.4	10.4	967
100–96	34.1	6.5	750
95–91	26.4	4.3	440
90–86	23.5	3.2	281
85–81	17.1	1.2	170
80–76	9.1	1.8	110
75–71	12.9	-	62
70–66	6.5	-	31
65–61	-	-	9
60–56	-	-	7
55–51	-	-	1
50–46	-	-	0
45–40	-	-	0
Total	-	-	14,759
Human Geography			
160–156	-	-	11
155–151	98.0	98.0	49
150–146	98.3	93.2	59
145–141	98.1	83.2	107
140–136	96.6	83.9	174
135–131	93.1	81.5	259
130–126	94.3	76.1	348
125–121	90.6	66.9	405
120–116	85.1	59.0	556
115–111	79.4	50.0	528
110–106	69.8	34.7	487
105–101	63.3	28.6	469
100–96	52.5	19.1	362
95–91	47.2	18.3	284
90–86	32.3	8.6	220
85–81	19.5	6.3	128
80–76	18.5	4.6	65
75–71	12.2	-	49
70–66	-	-	18
65–61	-	-	13
60–56	-	-	6
55–51	-	-	1
50–46	-	-	2
45–40	-	-	0
Total	-	-	4,600

Table 11 (continued)

AP Examinations Using PSAT/NMSQT Verbal and Math Scores

PSAT/NMSQT V+M Score	*AP Grade* ≥3	≥4	*n*
Macroeconomics			
160–156	98.0	91.9	396
155–151	95.4	87.5	920
150–146	92.6	81.0	1,395
145–141	89.5	76.8	2,267
140–136	87.1	71.2	3,328
135–131	83.2	64.4	4,334
130–126	75.7	55.2	5,407
125–121	69.6	46.6	5,918
120–116	62.4	38.9	5,954
115–111	54.6	30.8	5,429
110–106	45.5	23.7	4,554
105–101	37.1	16.7	3,598
100–96	28.2	12.7	2,592
95–91	21.8	8.7	1,836
90–86	14.3	4.8	1,197
85–81	7.0	1.9	689
80–76	7.0	2.6	469
75–71	3.5	1.9	260
70–66	3.3	-	120
65–61	-	-	70
60–56	-	-	35
55–51	-	-	10
50–46	-	-	10
45–40	-	-	3
Total	-	-	50,791
Microeconomics			
160–156	97.7	87.3	306
155–151	95.7	85.4	697
150–146	92.1	80.1	1,040
145–141	90.4	74.1	1,656
140–136	88.2	70.0	2,366
135–131	83.6	63.3	3,169
130–126	78.5	55.4	3,852
125–121	72.4	46.8	4,089
120–116	65.3	37.9	4,044
115–111	57.6	30.6	3,632
110–106	51.4	24.7	3,073
105–101	41.8	17.6	2,424
100–96	31.3	12.2	1,641
95–91	24.1	8.4	1,171
90–86	17.9	5.6	711
85–81	10.0	2.5	402
80–76	10.7	1.7	234
75–71	5.3	-	132
70–66	3.1	-	64
65–61	-	-	37
60–56	-	-	15
55–51	-	-	10
50–46	-	-	3
45–40	-	-	1
Total	-	-	34,769

PSAT/NMSQT V+M Score	*AP Grade* ≥3	≥4	*n*
Statistics			
160–156	99.7	95.1	346
155–151	98.7	92.7	855
150–146	97.0	88.9	1,409
145–141	95.9	82.5	2,386
140–136	93.2	74.2	3,661
135–131	89.2	66.4	5,105
130–126	82.9	55.9	6,967
125–121	77.1	45.7	8,098
120–116	68.5	35.1	8,967
115–111	58.2	26.1	9,014
110–106	48.2	17.9	8,215
105–101	38.0	11.5	6,637
100–96	27.0	6.8	4,662
95–91	19.4	4.3	3,073
90–86	12.1	2.0	1,836
85–81	7.6	1.4	997
80–76	5.5	0.9	560
75–71	3.8	-	263
70–66	1.5	-	132
65–61	-	-	66
60–56	-	-	25
55–51	-	-	9
50–46	-	-	4
45–40	-	-	5
Total	-	-	73,292
World History			
160–156	100.0	95.1	41
155–151	100.0	92.6	68
150–146	98.4	93.0	128
145–141	97.3	84.4	225
140–136	97.4	86.2	341
135–131	94.0	77.6	504
130–126	93.8	71.5	662
125–121	89.3	61.3	783
120–116	82.3	53.1	892
115–111	78.3	42.5	915
110–106	71.2	34.4	875
105–101	64.5	29.5	733
100–96	57.9	22.1	598
95–91	46.6	14.2	429
90–86	40.4	10.1	287
85–81	31.9	9.8	235
80–76	21.8	3.2	124
75–71	11.3	-	71
70–66	7.5	-	40
65–61	-	-	17
60–56	-	-	12
55–51	-	-	7
50–46	-	-	2
45–40	-	-	1
Total	-	-	7,990

Table 12

AP Examinations Using PSAT/NMSQT Verbal and Writing Scores

PSAT/NMSQT V+W Score	AP Grade ≥3	AP Grade ≥4	n
Art History			
160–156	99.4	94.3	174
155–151	98.9	87.2	274
150–146	97.6	84.7	380
145–141	97.1	80.8	548
140–136	95.2	73.3	778
135–131	93.1	67.5	1,044
130–126	91.3	59.6	1,239
125–121	88.3	57.8	1,388
120–116	83.9	48.0	1,464
115–111	81.2	41.2	1,592
110–106	73.9	33.7	1,607
105–101	65.9	26.5	1,436
100–96	57.7	20.7	1,215
95–91	50.6	14.9	1,003
90–86	38.3	9.8	728
85–81	33.2	6.7	521
80–76	27.7	3.2	314
75–71	13.6	3.1	191
70–66	9.8	2.9	102
65–61	16.2	-	37
60–56	-	-	15
55–51	-	-	4
50–46	-	-	1
45–40	-	-	0
Total	-	-	16,055
English Language			
160–156	99.7	96.8	692
155–151	99.8	95.6	1,316
150–146	99.6	92.5	2,495
145–141	99.5	90.7	3,996
140–136	98.9	84.5	6,147
135–131	98.3	77.6	9,274
130–126	96.6	68.0	12,203
125–121	94.5	57.2	15,280
120–116	90.1	45.0	17,930
115–111	82.9	32.2	20,126
110–106	72.7	21.2	20,879
105–101	60.1	12.2	20,372
100–96	45.5	6.5	17,386
95–91	30.1	2.8	14,141
90–86	19.3	1.3	10,303
85–81	9.7	0.3	6,996
80–76	5.0	0.1	4,307
75–71	2.8	0.2	2,343
70–66	0.7	-	1,189
65–61	0.8	-	530
60–56	1.4	-	207
55–51	-	-	78
50–46	-	-	10
45–40	-	-	0
Total	-	-	188,200

PSAT/NMSQT V+W Score	AP Grade ≥3	AP Grade ≥4	n
English Literature			
160–156	99.9	97.1	2,906
155–151	99.5	94.8	4,957
150–146	99.4	91.6	8,364
145–141	99.0	85.3	12,702
140–136	97.9	77.3	17,329
135–131	96.2	66.9	23,674
130–126	93.3	54.7	28,556
125–121	88.7	42.2	33,126
120–116	81.8	30.1	35,214
115–111	71.8	19.7	35,025
110–106	60.0	11.7	32,604
105–101	45.4	6.1	27,940
100–96	31.7	2.8	21,418
95–91	19.6	1.3	15,565
90–86	10.6	0.4	10,454
85–81	5.9	0.3	6,666
80–76	2.4	0.1	3,853
75–71	1.1	-	2,086
70–66	0.8	-	1,035
65–61	0.5	-	428
60–56	-	-	175
55–51	-	-	63
50–46	-	-	11
45–40	-	-	0
Total	-	-	324,151

student's HSGPA, grades in prior courses, and even the number of additional courses in a subject area a student has completed. PSAT/NMSQT scores account for between two and three times as much variation in AP Examination grades as HSGPA and relevant course grades. However, these factors remain important and should be used in combination with PSAT/NMSQT scores, student interest, and other factors in making final placement decisions. Certainly, a student who is not interested in AP Music Theory is not likely to be successful in such a course irrespective of PSAT/NMSQT scores. Similarly, a student who has not completed prerequisite courses in a foreign language or other discipline will likely be unprepared to succeed in advanced courses despite high test scores. In 1998, Camara and Millsap explained how this research could be appropriately used to inform sound educational decisions, and these recommendations are just as relevant today:

> "PSAT/NMSQT scores should never be used as the sole or even the primary indicator. Schools should not establish minimum 'cut scores' on the PSAT/NMSQT or any other assessment for placing students into AP courses—such practices are a clear misuse of assessment scores. Faculty and counselors should be cautious in using these tables." (p. 17)

Table 13

AP Examinations Using PSAT/NMSQT Verbal and Math and Writing Scores

PSAT/NMSQT V+M+W Score	AP Grade ≥3	AP Grade ≥4	n
European History			
240–231	99.2	94.5	365
230–221	99.4	90.0	1,132
220–211	98.4	83.1	2,358
210–201	96.9	73.1	3,836
200–191	94.2	63.4	5,522
190–181	89.1	49.2	6,915
180–171	83.1	37.5	7,377
170–161	73.7	26.7	6,819
160–151	63.3	17.7	5,414
150–141	51.6	11.5	3,720
140–131	37.7	6.1	2,028
130–121	24.5	2.8	967
120–111	15.7	1.6	369
110–101	7.6	-	144
100–91	6.4	-	47
90–81	-	-	10
80–71	-	-	4
70–60	-	-	0
Total	-	-	47,027
Government and Politics: United States			
240–231	99.0	87.4	792
230–221	97.5	80.4	2,628
220–211	93.8	71.1	5,714
210–201	90.3	61.0	9,623
200–191	83.7	48.2	14,276
190–181	75.9	36.5	18,636
180–171	64.4	25.8	20,779
170–161	51.5	16.3	20,059
160–151	37.3	9.2	16,582
150–141	24.5	4.6	11,655
140–131	12.9	1.7	7,215
130–121	6.6	0.6	4,007
120–111	2.7	0.1	1,903
110–101	1.6	-	773
100–91	0.7	-	278
90–81	3.2	-	62
80–71	-	-	13
70–60	-	-	1
Total	-	-	134,996

PSAT/NMSQT V+M+W Score	AP Grade ≥3	AP Grade ≥4	n
Psychology			
240–231	100.0	98.3	242
230–221	99.8	97.5	837
220–211	99.0	93.7	1,939
210–201	98.5	90.2	3,762
200–191	96.3	84.0	5,880
190–181	93.8	75.1	8,630
180–171	88.4	63.4	10,541
170–161	80.5	50.8	11,642
160–151	69.7	37.8	10,561
150–141	55.8	25.2	8,455
140–131	39.8	14.7	5,745
130–121	25.9	7.3	3,120
120–111	14.0	3.6	1,513
110–101	7.9	1.2	604
100–91	2.2	0.0	186
90–81	3.7	3.7	54
80–71	-	-	9
70–60	-	-	0
Total	-	-	73,720
U.S. History			
240–231	99.3	94.0	417
230–221	97.7	91.5	1,687
220–211	96.5	84.4	4,352
210–201	93.8	77.7	8,944
200–191	89.1	67.7	16,320
190–181	82.9	56.5	25,242
180–171	73.7	43.6	33,039
170–161	61.0	31.5	38,104
160–151	47.7	20.5	36,216
150–141	34.2	12.2	28,803
140–131	23.3	7.2	19,169
130–121	12.9	3.2	10,967
120–111	7.0	1.4	5,399
110–101	3.1	0.8	2,242
100–91	1.6	-	770
90–81	2.1	-	188
80–71	-	-	30
70–60	-	-	0
Total	-	-	231,889

This study was based on the entire population of students who completed the PSAT/NMSQT and subsequently completed one or more AP Examinations across two cohorts—more than 1 million students. However, there are more students who completed the PSAT/NMSQT who did not enroll in AP courses or chose not to complete an AP Examination if they did enroll in an AP course. It is not possible to know exactly how these groups of students differ from study participants in ways that could impact predicted performance on AP Examinations. We do know, however, that students in this study earned higher PSAT/NMSQT scores than all sophomores and juniors who took the PSAT/NMSQT in 2000 and 2001. It is fair to say then that the expectancy tables presented in this report are based on rather motivated students who performed, on average, better than all sophomore and junior PSAT/NMSQT test-takers. Because the expectancy tables are based on students completing AP Examinations, the tables do not necessarily represent the general high school population; however, it is apparent that the population of students completing the PSAT/NMSQT and AP assessments in this study is nearly 50 percent larger than the group of students examined by Camara and Millsap (1998) and comprise a much greater and more representative group of college-bound tenth- and eleventh-graders.

Determining Whether AP Courses Can Be Offered in a School

The expectancy tables can also be useful for schools considering introducing AP courses or expanding the number of sections offered for an existing AP course. Schools can quickly identify the number of students who may be successful in various AP courses if those courses were offered or enrollment was expanded. To do so, schools would first determine the appropriate success rate for their school and for the particular AP Examination. As mentioned, some schools may employ a 50 percent success rate, while other schools may prefer a lower or higher success rate. Using the expectancy tables or AP Potential, schools would then be able to generate potential class rosters and see the number of students who have a certain probability level of being successful on the corresponding AP Examination. Of course, schools would still need to verify that the identified students meet other requirements for enrollment.

Conclusion

This study is a replication and extension of two earlier studies (Camara and Millsap, 1998; Haag, 1983) that examined the relationship between PSAT/NMSQT test scores and AP Examination grades. Results of this study showed that PSAT/NMSQT scores of sophomores and juniors were moderately to highly correlated with subsequent grades on 29 AP Examinations. The median correlation between the PSAT/NMSQT scale selected to build the expectancy table and AP Examination grades was .57 and the average correlation was .56, with correlations for 20 of the 29 AP Examinations above .50. Sample sizes ranged from 2,500 students in AP French Literature to 324,151 students in AP English Literature. Of the 25 AP Examinations included in Camara and Millsap (1998), 18 had more than twice as many students in the sample for this study, using more restrictive conditions, and 11 of those had more than three times as many students. In comparison to the 1998 study, the total sample in this study increased by nearly 50 percent and the correlations with test scores increased for 19 of the 25 AP Examinations. The current study also confirms findings from the earlier study that PSAT/NMSQT scores were not useful in predicting AP Examination grades on four examinations (German Language, Spanish Language, Studio Art: Drawing, and Studio Art: 2-D Design) and have a weaker predictive relationship with foreign language exams. This latter finding may be partially attributed to the large proportion of students who acquire language skills at home or outside the classroom. However, test scores from the PSAT/NMSQT were strong predictors for four AP Examinations added since the 1998 study (Environmental Science, Human Geography, Statistics, and World History).

The larger number of students completing 11 AP Examinations also permitted the comparison of variance-explained statistics for PSAT/NMSQT scores in predicting AP Examination grades over and above HSGPA and high school grades in the relevant subject areas. In each instance, the increment added by PSAT/NMSQT test scores far exceeded the variance accounted for by HSGPA and relevant course grades. In 9 of 11 comparisons, test scores from the PSAT/NMSQT accounted for more than twice the variance contributed by grades. This may not be unusual given that students who are successfully completing AP Examinations generally have extremely high grades. Increased grade inflation and the lack of variance in HSGPA, particularly among students in the top 25 percent of their class, severely limit the predictive power of grades among top performers (Camara and Kimmel, 2003). Similarly, other research studies involving college admissions tests have demonstrated that SAT and ACT scores may have slightly greater validity than high school grades in predicting college performance among students with the highest grades in college (Kobrin and Robert, 2005; Noble and Sawyer, 2002).

The relationship between PSAT/NMSQT scores and AP Examination grades remains strong and consistent across sophomore and junior PSAT/NMSQT test-takers, gender, and ethnic groups. Generally, correlations between PSAT/NMSQT test scores and AP Examination grades were slightly higher and account for more variance among female students and minority students. The finding that test scores were slightly better predictors of AP Examination grades for minority students runs counter to research on admissions testing that consistently demonstrates that both grades and test scores are better predictors for white students than underrepresented minority students. One possible explanation for this difference could lie in the criteria. In this study, the criteria are AP Examination grades, which are a standardized measure, whereas the criteria in admissions studies are freshman grades, which differ markedly by institution and courses taken.

This study provides additional validation evidence for the use of PSAT/NMSQT scores in predicting success on AP Examinations. Despite the stronger relationships between PSAT/NMSQT test scores and AP Examination grades, a larger and more representative population of students in this study, and the consistent finding that the PSAT/NMSQT is the most powerful predictor examined to date of success on AP Examinations, the expectancy tables or related AP Potential tool should not be used alone to determine placement in AP courses. Many factors, including student motivation and interest, student persistence and willingness to put in extra effort, performance in prerequisite courses, and teacher recommendations, should always be considered in making such placement decisions.

The results from this study and AP Potential can be useful in identifying students who are likely to be successful in AP and other rigorous courses. For example, for many AP Examinations, students with scores in the middle of the distribution on the PSAT/NMSQT have an excellent chance of succeeding in many AP courses, and their probability of success could increase given motivation and interest in the subject area. This study provides further evidence that the placement of only the highest ability students into rigorous courses, such as AP, is without merit. A much larger proportion of students are likely to be successful in many AP courses if identified early and given the opportunity and support needed to succeed.

The results also show that a significant group of students have a less-than-break-even chance of succeeding on many AP Examinations today, but many of these students can and will succeed in AP courses because of factors that cannot be measured by tests, grades, or past performance. The high school years are a period of transition and growth for students. Given the opportunity, many students will develop a passion for an activity or subject and, thus, entry into AP courses for highly motivated students should not be denied based on past test scores or grades. On the contrary, more effort should be placed on preparing students for rigorous advanced courses to ensure greater success and access for students in all schools.

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Appendix A:
Linear Regressions of PSAT/NMSQT Score, Cumulative HSGPA, and Course Grades in Predicting AP Examination Grades

Predictor	*B*	*SE B*	*BETA*	*T*	*Sig. T*
AP Biology					
Model 1					
HSGPA*	-.230	.004	-.226	-52.028	.000
Grades in Natural Science**	.532	.012	.197	45.258	.000
Constant	1.784	.051		34.678	.000
Model 2					
HSGPA*	-.059	.004	-.058	-16.233	.000
Grades in Natural Science**	.302	.009	.112	31.814	.000
PSAT/NMSQT VM	.046	.000	.599	194.979	.000
Constant	-3.090	.048		-64.065	.000
R-Squared Change	.307				
F Change	38016.973				
Sign. F. Change	.000				
AP Calculus AB					
Model 1					
HSGPA*	-.130	.004	-.116	-36.339	.000
Grades in Math**	.497	.009	.171	53.638	.000
Constant	1.578	.040		39.420	.000
Model 2					
HSGPA*	-.066	.003	-.059	-21.234	.000
Grades in Math**	.213	.008	.073	26.259	.000
PSAT/NMSQT M	.087	.000	.509	207.333	.000
Constant	-2.778	.040		-68.763	.000
R-Squared Change	.241				
F Change	42986.786				
Sign. F. Change	.000				
AP Calculus BC					
Model 1					
HSGPA*	-.130	.007	-.100	-17.868	.000
Grades in Math**	.633	.021	.166	29.506	.000
Constant	1.559	.091		17.125	.000
Model 2					
HSGPA*	-.072	.007	-.055	-10.964	.000
Grades in Math**	.343	.019	.090	17.709	.000
PSAT/NMSQT M	.085	.001	.450	97.132	.000
Constant	-3.137	.095		-33.160	.000
R-Squared Change	.192				
F Change	9434.539				
Sign. F. Change	.000				
AP Chemistry					
Model 1					
HSGPA*	-.214	.006	-.180	-33.980	.000
Grades in Natural Science**	.591	.018	.172	32.335	.000
Constant	1.153	.079		14.654	.000
Model 2					
HSGPA*	-.090	.005	-.076	-16.861	.000
Grades in Natural Science**	.296	.015	.086	19.276	.000
PSAT/NMSQT M	.085	.001	.551	139.973	.000
Constant	-3.196	.073		-44.037	.000
R-Squared Change	.276				
F Change	19592.332				
Sign. F. Change	.000				

Predictor	*B*	*SE B*	*BETA*	*T*	*Sig. T*
AP English Language					
Model 1					
HSGPA*	-.168	.003	-.205	-58.738	.000
Grades in English**	.402	.008	.180	51.642	.000
Constant	2.018	.034		59.690	.000
Model 2					
HSGPA*	-.049	.002	-.060	-23.405	.000
Grades in English**	.143	.006	.064	25.134	.000
PSAT/NMSQT VW	.042	.000	.691	313.719	.000
Constant	-1.972	.028		-71.695	.000
R-Squared Change	.424				
F Change	98419.906				
Sign. F. Change	.000				
AP English Literature					
Model 1					
HSGPA*	-.176	.002	-.213	-79.322	.000
Grades in English**	.369	.006	.160	59.645	.000
Constant	2.151	.027		80.347	.000
Model 2					
HSGPA*	-.031	.002	-.038	-19.357	.000
Grades in English**	.126	.004	.055	28.133	.000
PSAT/NMSQT VW	.042	.000	.704	406.461	.000
Constant	-2.131	.022		-97.358	.000
R-Squared Change	.434				
F Change	165210.60				
Sign. F. Change	.000				
AP Government and Politics: United States					
Model 1					
HSGPA*	-.195	.003	-.235	-59.227	.000
Grades in Social Science**	.380	.010	.152	38.289	.000
Constant	1.877	.043		43.951	.000
Model 2					
HSGPA*	-.031	.003	-.038	-11.114	.000
Grades in Social Science**	.225	.008	.090	27.570	.000
PSAT/NMSQT VMW	.026	.000	.590	193.406	.000
Constant	-2.430	.041		-58.660	.000
R-Squared Change	.293				
F Change	37405.813				
Sign. F. Change	.000				
AP Macroeconomics					
Model 1					
HSGPA*	-.231	.007	-.231	-34.422	.000
Grades in Social Science**	.307	.020	.105	15.650	.000
Constant	2.429	.085		28.718	.000
Model 2					
HSGPA*	-.066	.006	-.066	-11.108	.000
Grades in Social Science**	.135	.017	.046	8.063	.000
PSAT/NMSQT VM	.041	.000	.538	102.644	.000
Constant	-2.219	.085		-26.053	.000
R-Squared Change	.248				
F Change	10535.777				
Sign. F. Change	.000				
AP Psychology					
Model 1					
HSGPA*	-.291	.005	-.324	-58.006	.000
Grades in Social Science**	.317	.014	.125	22.400	.000
Constant	3.076	.062		49.691	.000
Model 2					
HSGPA*	-.103	.004	-.115	-23.477	.000
Grades in Social Science**	.164	.012	.065	13.934	.000
PSAT/NMSQT VMW	.029	.000	.568	132.402	.000
Constant	-1.755	.063		-27.876	.000
R-Squared Change	.262				
F Change	17530.402				
Sign. F. Change	.000				

Predictor	B	SE B	BETA	T	Sig. T
AP Statistics					
Model 1					
HSGPA*	-.240	.005	-.244	-44.547	.000
Grades in Math**	.528	.013	.221	40.336	.000
Constant	1.654	.057		28.907	.000
Model 2					
HSGPA*	-.094	.005	-.096	-20.572	.000
Grades in Math**	.339	.011	.142	30.918	.000
PSAT/NMSQT VM	.045	.000	.549	135.855	.000
Constant	-3.287	.060		-54.971	.000
R-Squared Change	.260				
F Change	18456.689				
Sign. F. Change	.000				
AP U.S. History					
Model 1					
HSGPA*	-.194	.003	-.205	-68.837	.000
Grades in Social Science**	.506	.008	.194	65.100	.000
Constant	1.572	.034		46.607	.000
Model 2					
HSGPA*	-.042	.002	-.044	-16.919	.000
Grades in Social Science**	.317	.007	.121	48.114	.000
PSAT/NMSQT VMW	.028	.000	.547	238.481	.000
Constant	-2.763	.034		-81.955	.000
R-Squared Change	.256				
F Change	56873.048				
Sign. F. Change	.000				

*HSGPA is negatively coded (A+ =1, A = 2, A- = 3, ...D = 11, E/F = 12)
**A = 4, B = 3, C = 2, D = 1, E/F = 0.

Appendix B: A Test for Invariance in Independent Semipartial Correlations

Suppose that in K independent populations, we wish to calculate the increment to the squared multiple correlation in predicting a variable Y from another variable X, after controlling for a set of predictors **Z**. We can describe this increment as $\rho_k^2 = R^2_{kYX.Z} - R^2_{kY.Z}$, where $R^2_{kYX.Z}$ is the squared multiple correlation for predicting Y from X after controlling for **Z** in the kth population, and $R^2_{kY.Z}$ is the squared multiple correlation from predicting Y from **Z** in the kth population. The square root of the increment, ρ_k, is known as the *semipartial correlation* between Y and X, controlling for **Z**, for the kth population. We wish to compare $\rho_1, \rho_2, \ldots, \rho_k$ for invariance across the K populations: does the addition of X to the regression of Y on **Z** produce the same increment across all K populations?

A statistical test of invariance in ρ_k can be developed by noting that ρ_k is just the bivariate correlation between Y and the residual in X after regressing X on the set of predictors **Z**. Steiger and Browne (1984) provide the theory that permits the derivation of the required standard error for testing the significance of ρ_k in a single population. Steiger (2005) describes the extension to multiple independent populations, allowing tests of invariance of ρ_k. All of the following developments were derived using these two sources.

To begin, let $X^* = X - bZ$ be the residual score for X after its regression on **Z**, ignoring the intercept in that regression. Then as noted above, we know that $\rho_k = \rho_{kYX^*}$, where ρ_{kYX^*} is just the bivariate correlation between Y and X^* in the kth population. Assuming multivariate normality among all variables involved, standard theory suggests that the covariance between any pair of sample bivariate correlations (r_{ij}, r_{gh}) based on a sample of size n can be expressed

$$\psi_{ij,gh} = (1/2n)\rho_{ij}\rho_{gh}(\rho_{ig}^2 + \rho_{ih}^2 + \rho_{jg}^2 + \rho_{jh}^2) + \rho_{ig}\rho_{jh} + \rho_{ih}\rho_{jg} - \rho_{ij}(\rho_{jg} + \rho_{jh} + \rho_{ig} + \rho_{in}) - \rho_{gh}(\rho_{jg}\rho_{ig} + \rho_{jh} + \rho_{in})$$

where ρ_{ij} is the population value of r_{ij}, the sample correlation. For the case in which $i = g$, $j = h$, the covariance above is just the variance of r_{ij}. In this case, $\psi_{ij,gh}$ simplifies to $\psi_{ij,gh} = Var(r_{ij}) = \frac{(1-\rho_{ij}^2)^2}{n}$. This expression for the variance of a sample bivariate correlation can be found in the literature (e.g., Rao, 1973).

Now let $N_k = n_k + 1$ be the sample size for the sample from the kth population that yields the sample semipartial correlation r_k corresponding to the population correlation ρ_k, already defined. Let **N** be a $K \times K$ diagonal matrix whose diagonal elements are the $(n_1, n_2, \ldots, n_k)$. Also define a second $K \times K$ diagonal matrix ψ whose diagonal elements are $(1 - \rho_k^2)^2$, $k = 1, 2, \ldots, K$, which are proportional (by n_k) to the variances of the sample semipartial correlations in the K populations. We will then define $\hat{\psi}$ as the matrix ψ with r_k substituted for ρ_k. It can be shown that the ordinary least squares (OLS) estimator of the common semipartial correlation ρ, assuming invariance of these semipartial correlations across the K populations, is

$$\hat{\rho}_{OLS} = \frac{\sum_{j=1}^{K} n_j r_j}{\sum_{j=1}^{K} n_j}.$$

Define $\hat{\Omega} = N^{-1}\hat{\psi}$. The generalized least squares (GLS) estimator of the common semipartial correlation across the K populations (assuming invariance again) is

$$\hat{\rho}_{GLS} = (1'\hat{\Omega}1)^{-1}1'\hat{\Omega}^{-1} r$$

where 1 is a $K \times 1$ unit vector and $r' = (r_1, r_2, \ldots, r_K)$ is a $1 \times K$ vector of sample semipartial correlations from the K samples. It can be shown that the GLS estimator is equal to

$$\hat{\rho}_{GLS} = A^{-1}\sum_{j=1}^{K}\frac{n_j r_j}{(1-r_j^2)^2},$$

with the quantity A equal to

$$A = \sum_{j=1}^{K}\frac{n_j}{(1-r_j^2)^2}.$$

Once the GLS estimator is available, a test statistic for the null hypothesis

$H_0 : \rho_k = \rho$ for $k = 1, 2, \ldots, K$

can be shown to be

$$\chi^2 = (r - 1\hat{\rho}_{GLS})'\hat{\Omega}^{-1}(r - 1\hat{\rho}_{GLS}).$$

Under the null hypothesis, this statistic will have a chi-square distribution in large samples with $df = K-1$. We used this test statistic to test the null hypothesis of invariance in the semipartial correlations, with K varying depending on which groups were being compared.

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Partnership Models

The **Baltimore County Public School System** serves nearly 109,000 students. Their partnership with the College Board, now in its sixth year, arose out of their focus on improving instructional quality throughout the entire system through use of the PSAT/NMSQT, CollegeEd, AP Potential, the Advanced Placement Program (AP), Professional Development, and SpringBoard.

Among other successes, the percentage of students in AP increased 65 percent, and the number of minority students taking one or more AP courses nearly doubled. The number of minority sophomores taking the PSAT/NMSQT more than quadrupled.

About CollegeEd, Superintendent Joe Hairston says: "It's important for students to understand why we're asking them to do the work—to prepare for the future. Parents must understand how important the continuation of the learning process is—it doesn't end at the end of the school day but extends beyond into the community."

Volusia County, Florida, serves more than 65,000 students. They partnered with the College Board with a goal of getting more students enrolled in AP courses. The College Board responded by providing an integrated approach involving AP, PSAT/NMSQT, Professional Development, and SpringBoard.

Some results: The number of students taking AP courses almost doubled in five years. The PSAT/NMSQT, which is administered to students in grades 8 to 11, is used by teachers as a significant program evaluation tool and a means (through AP Potential) of finding students who can succeed in AP courses. AP Vertical Teams® in language arts and mathematics across grades 5 to 12 enable teachers to build curricula, not repeat it. Nicki Junkins, director, K–12 curriculum, says "SpringBoard is the vehicle that allows us to bring together in one program the training, resources, tools, and ideas teachers need to motivate students."

The College Board's mission is to connect students to college success and opportunity. We are a not-for-profit membership organization committed to excellence and equity in education.

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