The Link Between Advanced Placement Experience

and Early College Success

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ABSTRACT

The Advanced Placement (AP) Program was originally designed to provide students a means to earn college credit and/or advanced placement for learning college-level material in high school. Today the program serves an equally important role as a signal in college admissions. This paper examines the extent to which AP experience predicts early college grades and retention. We find no evidence that the average student derives a positive benefit from AP experience beyond that provided by a non-AP curriculum strong in math and science. Studies finding positive AP effects do so because they fail to control for the student's non-AP curriculum.

JEL Classification: I2, J7

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Introduction

At its inception in 1957, the Advanced Placement (AP) Program was designed to allow high school students to earn credit, or at least advanced placement, for college-level coursework, thereby avoiding needless repetition once these students arrived at college. The Program primarily served students from elite private high schools. While the structure of the AP Program has not changed in fifty years, its scope has dramatically broadened. Regardless of the exam-taking that earns students college credit, AP course experience has become a primary signal used to identify motivated, high achieving students in the college admissions process (Breland, et al 2002).

This paper investigates the validity of AP experience as a predictor of early college success. Using students who entered Texas public universities directly after graduating from high school in May 1999, we find that, for the average student, regardless of race or income, AP experience does not increase the likelihood of early college success beyond that predicted by the non-AP curriculum. On average, students who take AP do perform better in their first year of college than non-AP students. However, this result is expected based on self selection and is not necessarily causal (Dougherty, Mellor, Jian 2005). We demonstrate that studies which find positive effects of AP enrollment on college outcomes are unreliable when they fail to control for the body of the student's non-AP curricular experience.

AP course experience matters now more than ever. In 2000, a survey of 962 four-year public and private colleges and universities showed that AP experience factors directly or indirectly into at least six of the top nine criteria in college admissions. According to Breland, et al (2002) the following items were the six most important factors in admissions: 1) high school GPA or class rank [as determined by the high school], 2) admissions test scores (e.g. SAT/ACT),

3) pattern of high school course work, 4) college-level coursework in high school (AP, IB, or dual credit), 5) AP coursework specifically, and 6) AP course grades. Grades on AP exams ranked ninth. Note that the five criteria valued most heavily by colleges do not depend on AP exam scores but on course participation.

Given that GPA and class rank, as calculated by the high school, are the number one criteria in the admissions process, it is necessary to examine the non-trivial role of AP experience in these outcomes. The vast majority of high schools, including 98 percent of all Texas public high schools, weight grades in AP courses more heavily than grades in other courses. Grade weighting is mandatory in North Carolina (College Board 2006). The College Board provides no grade-weighting guidelines, so weighting schemes vary dramatically across schools. The most common methods are to add one point on a four-point scale, yielding a 25 percent weight, or to add ten points on a 100-point scale, yielding a 10 percent weight. In schools with a large number of AP course offerings, students must take a substantial number of AP courses to remain competitive in class rank.

The value of the AP Program in the admissions process places immense pressure on high schools to expand their AP course offerings. Nationwide, the number of high schools participating in the AP program increased by 40 percent between 1990 and 2000.[1] Students often take AP courses to increase their chances of admission to selective colleges, and parents interpret the number of AP course offerings as a signal of high school quality and therefore property values. Favorable federal, state, and local policies have also contributed to the explosive expansion of the AP Program. In response to a 1999 ACLU lawsuit disputing

[1] *Participation in AP: Annual Participation*. Retrieved December 12, 2003, from http://apcentral.collegeboard.com/article/0,3045,150-156-0-2055,00.html.

inequities in AP offerings in the Los Angeles area, California enacted the Advanced Placement Challenge Grant program to increase access for students attending schools without AP programs. Some state governments, including Arkansas, Indiana, Mississippi and West Virginia, have reacted more radically, legislating that all high schools, regardless of size and resources, offer a minimum number of AP courses. Other states, including Ohio and South Carolina, have some form of a state mandate regarding AP course offerings (Dounay 2000; Education Commission of the States 2006).

The College Board is conspicuously silent on the use of AP in admissions decisions. Intentionally or not, the College Board supports the use of AP for admissions purposes by advertising AP classes "college prep." Moreover, as revealed by the President's remarks in his 2006 State of the Union Address, government at all levels is devoting considerable resources to expand the program further under the pretense that AP courses are college preparatory. While parents and politicians are well intentioned, their efforts may cause school administrators, acting within existing budgetary and staffing constraints, to maximize AP course offerings at the expense of course quality and/or to redirect funding to AP from proven areas of need. It is time to consider carefully whether the average student is benefiting from the "AP push."

Conceptual Framework

There are two theories to explain why AP experience might be a good predictor of early college success. First, AP experience signals two important but difficult-to-measure personal characteristics: ability and motivation. Second, AP experience might build human capital, in which case AP participation is good preparation for college. AP exposes students to college-level material in a supportive high school environment where students are, presumably, more likely to receive the individualized attention they need to develop study skills and habits of mind that will serve them well in college.

The two models are not mutually exclusive, and colleges are indifferent with respect to which model is at work since a high quality student is identified either way. However, from a policy standpoint, distinguishing which avenue is more or less at play is important. The human capital model provides justification for broadly expanding AP participation while the signaling model does not. Before these theories can be disentangled, however, it must be determined that AP experience is in fact a good predictor of college success *at all*.

Prior research on the predictive power of AP course experience on college success is not compelling. Studies from the College Board, owner of the AP trademark, and the Educational Testing Service (ETS), administrator of the yearly AP examinations, are frequently cited by AP Program proponents (Morgan and Maneckshana 2000; Willingham and Morris 1986). The descriptive nature of these studies, however, is insufficient for isolating the independent impact of the AP Program given that the typical AP student is bright, motivated, and likely to experience positive college outcomes regardless of AP experience. The public enthusiasm for AP waxes unabated, however, as shown by Newsweek's ranking of high schools based exclusively on the ratio of the number of AP exams taken to the number of graduating seniors. "The idea is that schools should be recognized for pushing even average students to take challenging AP courses, the more, the better" (Winerip 2006).

One study frequently cited by AP proponents as evidence of the program's success is Adelman's *Answers in the Tool Box* (1999). In *The Tool Box Revisited* (2006), a modified replication of his earlier study, Adelman makes clear his results have been repeatedly misinterpreted. In his original study, Adelman finds a rigorous high school curriculum, of which

AP is *one* component, is an important factor in obtaining a bachelor's degree. He does not find that AP participation alone contributes to bachelor's degree completion. Although Adelman never intended to investigate the independent impact of AP course experience on college success, he explores the issue in his 2006 study to address the misreading of the original *Tool Box*. He develops a model that replaces his index measuring the academic intensity of a student's high school curriculum with proxy variables measuring science momentum, foreign language study and AP, while also controlling for academic performance and various demographic characteristics. He finds that AP does not explain bachelor's degree completion, and this is after controlling for a very limited representation of the student's high school experience.

A recent upsurge of independent research on the benefits of the AP Program is of significantly higher quality than the College Board and ETS studies and targets AP course experience specifically (Sadler and Tai 2006, Geiser and Santelices 2004, Dougherty, Mellor, and Jian 2005). Multivariate regression models are used in an attempt to identify the unique impact of AP after controlling for class rank, test scores, and/or high school quality. With the notable exception of Sadler and Tai (2006), these new studies remain problematic in that they omit student experience in non-AP coursework. Given that AP-taking and other rigorous course-taking are positively correlated and that other rigorous courses, particularly math and science, have an established positive impact on the likelihood of college success, omitting student experience in these other courses leads to positive bias on the AP coefficients. In other words, it is misleading *in favor of AP being effectual* to consider the effect of AP on college outcomes without controlling for the body of the student's non-AP curricular experience. Our research suggests that, for the average AP student, much of the estimated AP effect found in previous studies is actually the effect of non-AP coursework in math and science.

Data

We estimate the effect of AP course experience on early success in college using the Texas Schools Microdata Panel (TSMP). Our sample consists of over 28,000 Texas high school graduates who attend 31 four-year Texas public universities in the fall of 1999. We measure early college success via second year retention and first semester GPA. The vast majority of students who drop out of college do so during, or immediately following, the freshman year (Tinto 1998, Tinto 1993, Pascarella and Terenzini 1980), and "academic performance was the overwhelmingly most significant factor affecting a freshman's decision to continue into the sophomore year" (Braunstein, McGrath, and Pescatrice 2000 p. 191). If the AP Program is truly college preparatory, AP experience should improve academic performance in college and increase the likelihood of returning for the second year. Since the AP curriculum replicates freshman-level college courses, any preparatory benefits students derive from the program should be apparent within the first year of college.[2]

In our study, students who had a GPA of less than 2.0 and did not return to any four-year institution in Texas for their second year of study, including those who transfer to 2-year postsecondary institutions, are "not retained." While our data do not include information on students who transfer to private Texas universities or out of state, measurement error should be

[2] While passing AP exam scores should reduce overall time to graduation by earning students credit, this outcome is fully consistent with the original purpose of the AP Program and not the outcome of interest in this study.

minimized by the substantial difficulty students would face transferring from one four-year institution to another with a GPA below 2.0.

White AP students retain at the highest rate among the 1999 cohort of Texas public university students studied, and non-AP taking black and Hispanic students at the lowest rates (Table 1). The freshmen retention rates in our data are consistent with national trends given the range of colleges and universities represented in the sample (U.S. News and World Report 2003). While just ten percent of white AP-takers do not return for a second year, this represents 870 students and provides substantial variation with which to estimate the model. Average first semester GPA is also highest for white AP-takers (2.77) and lowest for black students with no AP experience (2.01).

Such descriptive statistics have led many to the conclusion that AP experience is the cause of improved college outcomes for AP students and has led to a call for widespread expansion of the program, particularly targeting traditionally underrepresented youth. In this vein, during his 2006 State of the Union Address, President George W. Bush promised to facilitate the training of "70,000 high school teachers to lead Advanced Placement courses in math and science."[3] However, the simple correlation between AP course taking and desired college outcomes may not be causal, but rather, attributable to factors correlated with both AP course taking and positive college outcomes, e.g. ability, motivation, high parent or teacher expectations, and other challenging high school courses.

A handful of research, most of it quite recent, does account for individual ability and motivation by including such variables as high school grade point average and test scores (Sadler and Tai 2006, Geiser and Santelices 2004, Dougherty, Mellor, and Jian 2005, Willingham and

[3] http://www.whitehouse.gov/stateoftheunion/2006/

Morris 1986). However, with the exception of Sadler and Tai (2006), they fail to control for the body of the non-AP curriculum taken by AP students. Our data are unique in that we are able to include a broad range of variables describing the student's non-AP curricular experience. Math is frequently shown to be a strong predictor of college success, so the omission of math-taking information in previous studies is particularly problematic (e.g. Rose and Betts 2001, Sadler and Tai 2006). Given that honors courses are often taught by the AP teachers, it is reasonable to expect that honors courses also have a positive effect on college success. Table 2 presents summary statistics of the curriculum variables included in our models.

We include a host of additional controls. Student variables include race, sex, SAT scores, high school GPA, whether a student was in the top ten percent of their graduating class, and whether Hispanic students have ever been designated as Limited English Proficient. We also include fixed effects for the university attended and a variable indicating whether the student enrolled part time.[4] Family characteristics include parent education and family income as well as whether the student received a Stafford Loan. High school characteristics include the percent of students who qualify for free or reduced price lunch, percent of students who took college entrance exams, the student/teacher ratio, percent of inexperienced teachers, and school size.

Results

We consider the impact of the total number of AP credits taken in core subject areas on college retention and grade point average as well as the effect of experience in specific AP subject areas on the same outcomes. The appropriate modeling technique for persistence, which is a dichotomous variable equal to one if a student returns for a second year, is different from

[4] Because we include college fixed effects, it is not possible to use high school fixed effects as well. Consequently, we control for measurable differences across high schools as described.

that for GPA, which is a continuous variable between zero and four. We model persistence using a logit model and GPA using ordinary least squares (OLS).[5] In every model, we include the student, family, and high school characteristics previously described. We estimate each model two ways: first, we simulate previous studies by excluding the non-AP curriculum variables. Then we show how the addition of a host of non-AP course controls reduces the magnitude of the AP variable coefficients, in most cases to the point of eliminating statistical significance at conventional levels.

Retention Models

First consider the impact of the number of AP credits taken in high school on college retention.[6] In this model, the effect of AP credits on retention is allowed to follow a quadratic path since diminishing returns are likely to apply. Figure 1 summarizes the effect of the total number of AP credits in core courses on the probability a student persists to the second year of college when non-AP courses are excluded from the analysis.[7] Differences in predicted probabilities between white and black students are generated solely by differences in mean characteristics because the coefficient estimates for white and black students are statistically

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[5] Although GPA is restricted to between zero and four, it is commonly modeled using OLS (see Betts and Morell (1999) and Stinebrickner and Stinebrickner (2003)).

[6] Psychology, Microeconomics, Macroeconomics, U.S. Government and Comparative Government count for half of a credit each while each English, Science, Math, and History course counts as a full credit.

[7] Complete regression results are available from the authors upon request.

indistinguishable.[8] However, marginal effects for Hispanic students differ based on both coefficient estimates and mean characteristics. Consistent with prior research that also omits non-AP course-taking variables, we find a statistically significant positive, albeit small, effect of AP experience on the likelihood of persistence. Taking an additional credit worth of AP courses (up to five credits) has a constant positive impact on white students, while black and Hispanic students appear to gain the greatest benefit from taking two or three courses only.

Using these same data but including non-AP course-taking variables in the model, we find that these positive and significant findings vanish for all but Hispanic students. While there is generally an upward trend in the college retention rate for students with AP experience, the effects are small and insignificantly different from zero, indicating that any upward trend is likely due to random chance. The positive bias displayed in Figure 1 is theoretically predictable given that difficult non-AP courses have a positive expected impact on college retention and are positively correlated with AP-course-taking. It is important to recognize that left out variable error leads to estimates that are biased and inconsistent, and the bias will not diminish as the sample size increases.

Hispanic AP-taking maintains a statistically significant impact on the likelihood of retention even after the inclusion of non-AP control variables. We investigate this robust result further in order to discern which core AP subject area(s) facilitate Hispanic retention: math, science, English, economics, government, history and/or psychology. Once again, we provide regression results for two regression models: one with AP course-taking only and one with additional course-taking information (Table 3).

[8] In addition, coefficient estimates for students with family income below the median are statistically indistinguishable from those with family income greater than or equal to the median.

In the model of interest, that of Hispanic students with controls for a broad measure of curricular experience, we see that the entire AP effect on retention for Hispanic students is caused by AP science. Note, however, that AP science is not a significant predictor of retention for either white or black students and that the marginal effect of AP science is quite large for Hispanic students. This unusual outcome led us to consider potential sources for the AP science effect: omitted variables correlated with AP science-taking, being Hispanic, and staying in college. One clear candidate rose to our attention: the largely Hispanic-serving science program, TexPREP.

TexPREP, the Texas Prefreshmen Engineering Program, began in 1979 and is available at 13 university-affiliated sites across Texas. As stated on its website, TexPREP "is a three-year mathematics-based summer program of approximately eight weeks duration….The PREP curriculum is made up of interdisciplinary applied subject matter, with an emphasis on math-based logic and *preparation for Advanced Placement classes*" (http://www.prep-usa.org/portal/texprep/default.asp, emphasis added). The program has enjoyed phenomenal success. In a 2002 survey, among 5,380 former TexPREP participants over age 18, 88 percent reported attending college. Of those, 87 percent stayed in Texas, and 90 percent earned a postsecondary degree. Although we do not have an indicator for which students in our sample participated in TexPREP, this information provides evidence that TexPREP is one likely cause of the observed positive effect of AP science on Hispanic retention.

The significant effect of AP economics on retention stands out in the white/black pooled sample. Few high schools offer AP economics, and the coefficients may be driven by unobserved characteristics of schools and/or teachers who offer the course. Most high schools who offer AP courses focus on providing calculus, English and history. This will certainly be the most likely route chosen by schools under new state mandates requiring an AP curriculum where none currently exists. These are the very courses—those central to the AP Program--that have no impact on retention when controlling for other rigorous high school courses.

The AP effect on retention may be biased downward if AP experience increases the likelihood of college attendance but colleges and universities do not support traditionally underrepresented students once they arrive on campus. University support is particularly important for first-generation students. Many high school administrators and AP teachers in schools serving a large proportion of low income and minority students believe that AP experience increases college awareness and helps traditionally underrepresented students identify themselves as college material, but this hypothesis has not yet been tested (Spencer 2005).[9]

GPA models

Unlike in the retention models, F tests confirm that the coefficients are statistically different for white and black students as well as for Hispanic students in the GPA models. Figure 3 describes the relationship between AP course experience and changes in grade point average as it is frequently modeled, without controlling for non-AP courses. In Figure 4, the bias in much of the research on AP can be clearly seen. The coefficient estimate on the number of AP credits taken by white students is 1.6 times larger when only AP courses are considered, and only the AP effect for white students remains statistically different from zero. While the effect of the number of AP courses on GPA is insignificant for black and Hispanic students in both cases, bias is evident nonetheless: the coefficient on the number of AP courses is nearly eight-

[9] Since our data do not include college information for students attending private universities or those outside the state of Texas, it is not possible to test this hypothesis here. However, we hope to have enrollment data for private and out-of-state universities soon.

fold larger for Hispanic students when the non-AP curriculum is excluded, and the black coefficient behaves similarly. Thus, the omission of non-AP curriculum in previous studies can lead to erroneous conclusions regarding the effectiveness of the AP program for improving college outcomes, particularly for traditionally underserved students.

Given the significant effect of AP experience on first semester college GPA for white students, we again disaggregate AP courses by subject to identify the source of the positive result (see Table 4). This time, it appears that AP government is the driving force once the appropriate non-AP courses are included in the model. As expected, none of the individual courses emerge as significant for black students, but for Hispanic students, once again AP science is a positive factor, as are AP economics and AP psychology. AP government, economics and psychology are not flagship courses of the AP program. The positive coefficients on these courses are most likely capturing some unobserved characteristics of the high schools that can offer an AP curriculum of such breadth and the students who choose to take AP courses outside the core. Further speculation is not informative. The most striking result of our analysis is that, just as in the retention model, the three most popular AP courses--calculus, English, and history, have no effect on first semester GPA for any group. Participation in the core AP courses has no effect on early college success[10].

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[10] The insignificant effects of AP courses on college outcomes in the disaggregated models are unlikely to be driven by collinearity among AP courses or between AP courses and honors, math or science courses. Because the average AP student takes courses in just two of the seven AP subjects we examine here, the correlations between AP courses are low. Furthermore, the AP course coefficients do not change in sign or significance when the honors courses are jointly removed from the model. While the absence of high pair wise correlations between AP courses

The effect of AP experience on first semester GPA may be negatively biased if students who pass AP exams enroll in more challenging first-semester classes than non-AP students and consequently earn lower grades. Several studies provide evidence that such bias is unlikely to be large. For example, from a random sample of 8,594 students in 128 first semester introductory college science courses at 63 colleges and universities, Sadler and Tai (2006) find that it is not uncommon for students who earn scores of three or higher on an AP science exam to retake the course at the university. Among the students in their sample, 283 out of 1,029 AP-takers had earned a score of three or higher yet were enrolled in the comparable introductory level course. Students reported several reasons for this: some colleges require a score higher than a three for advanced placement; some colleges do not accept AP credit at all; some departments require a placement exam in addition to passing AP scores; and some students voluntarily re-enrolled in an effort to improve their understanding.

Further evidence comes from a recent National Research Council survey showing that, while substantially more than half of mathematics departments *grant credit* to students with passing scores on AP calculus exams, only one third of departments allow *placement* in advanced courses without additional testing and/or interviews (2002). Hurdles such as these reduce the number of students placed directly into more advanced classes in their freshmen year who might suffer lower first semester grades as a result. Lichten (2000) finds that only 22 percent of AP calculus students earning a three on the exam took a more advanced calculus course *at any point* in their college career. In his sample, which comes from the ETS, 24 percent

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and other independent variables does not eliminate the possibility of collinearity involving two or more variables, the robustness of our results is further supported by the general math and science curriculum variables which are the expected sign and significance (see Appendix).

of students who earn threes took no additional calculus, and 17 percent took a remedial course. Students who do place into more difficult courses in the popular subject areas of calculus, English language and composition, and biology generally do well in these classes (Dodd et al 2002).

AP math, which theoretically includes both calculus and statistics classes but in reality is heavily dominated by calculus classes, has a statistically insignificant impact on both retention and GPA. On the surface, this result appears to contradict the finding that rigorous math prepares students for success in college. However, calculus (with or without an AP designation) is included among the math curriculum variables and therein has the expected positive and large impact on both retention and GPA (see Appendix). The inclusion of the AP math dummy captures the additional effect of converting a non-AP calculus class into an AP calculus class; the insignificance of the variable reveals that converting to an AP class confers no additional benefit in terms of college preparation.[11] Given that equally qualified people are likely to teach both AP and non-AP sections of calculus, the only difference in the courses is presumably the pressure for the AP teacher to cover the entirety of the material required for the AP exam. The National Research Council (2002) states that the inclusion of too much content may actually prevent students from achieving "a deep understanding of the content and unifying concepts of a

[11]Sample sizes are large enough to facilitate the division of calculus into non-AP and AP sections. In the white sample, 18 percent of students took AP calculus, 18 percent took non-AP calculus, and the two groups are essentially mutually exclusive. In the black sample, nine percent of students took AP calculus and six percent took non-AP calculus; in the Hispanic sample, 13 percent took AP calculus while 11 percent took non-AP calculus. These numbers do not quite align with those presented in Table 2 because the variable AP math includes statistics.

discipline." Our findings support the National Research Council findings that calculus best prepares students for the rigors of college when teachers are not pressured to sacrifice depth for breadth.

Conclusions

The exam-based structure of the AP Program was designed in 1957 to provide a mechanism by which students might engage in accelerated learning in high school and then bypass previously mastered material once in college. The use of AP experience as a criterion in college admissions is a relatively recent phenomenon and an application of the AP Program that was, we believe, unanticipated. Despite this, policymakers at all levels of government and many members of the public do not recognize the distinction between these two very different, though not necessarily mutually exclusive, applications of the program. Well-intentioned education advocates have come to believe that AP is an appropriate, and even necessary, component in the portfolio of the well-prepared college student. However, our research finds no conclusive evidence that, for the average student, AP experience provides preparation for college superior to that provided by a non-AP curriculum rich in math and science. We unwittingly discovered a truly college preparatory program targeting first generation college students that does provide strong preparation for college, as evidenced by higher first semester college grades and higher probability of retention for Hispanic AP science students in the TexPREP program.

Our findings support a clear distinction between courses that are "college preparatory" and those that are "college level." The former type of courses emphasizes the development of skills needed to succeed in college, such as note taking, study skills, and intellectual discipline; the latter type assumes that such skills are already in place. At-risk high school students particularly benefit from skills-based instruction, including "how to study, how to approach academic tasks, what criteria will be applied, and how to evaluate their own and others' work," where writing and revising are ongoing (Darling-Hammond, et al 2002, p658). AVID, Gear Up, and TexPREP are three programs that provide explicit training in these skills, and implementing such a program in conjunction with a limited, aligned, high quality AP Program is a promising way to improve college outcomes (Watt, Yanez, and Cossio 2003, Dougherty, Mellor and Jian 2006).[12] Future research should synthesize the existing data on these and similar programs and disentangle the most effective aspects of the programs.

The belief that AP course experience, regardless of exam taking, is good preparation for college for the average student is widespread (Stewart 2005, O'Leary 2005, Lewin 2006). Michael Riley, Superintendent of Bellevue School District in Bellevue, Washington, goes so far as to state: "I believe all but a very few students are right for AP because I believe all students deserve a *college-preparatory curriculum*" (CB 2004 AP and Higher Ed brochure,18, emphasis added). While we are strongly in favor of open access to AP and do not wish our results to be interpreted as justification for excluding traditionally underrepresented students from AP classes, it is equally unfair to misplace underprepared students in AP classes when they would be better served in other rigorous courses. For example, Sadler and Tai (2005) find that "students who earn low grades in honors and AP courses perform worse in college science courses than their counterparts in regular high school courses with high grades" (p. 2). Policymakers and education advocates put the cart before the horse by overemphasizing the importance of AP-taking without

[12] The AVID program started in Texas in 1999, after the cohort we study graduated from high school. For information on AVID see http://www.avidonline.org/. For information on Gear Up see http://www.ed.gov/programs/gearup/index.html. For information on TexPREP see http://www.prep-usa.org/portal/texprep/default.asp.

the evidence to support such a course of action. Policymakers and education advocates should not expect high school students to perform as college students when they have not yet been taught how to be good high school students.

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Figure 1
Estimates of AP Effect on Retention
Without Non-AP Course Experience

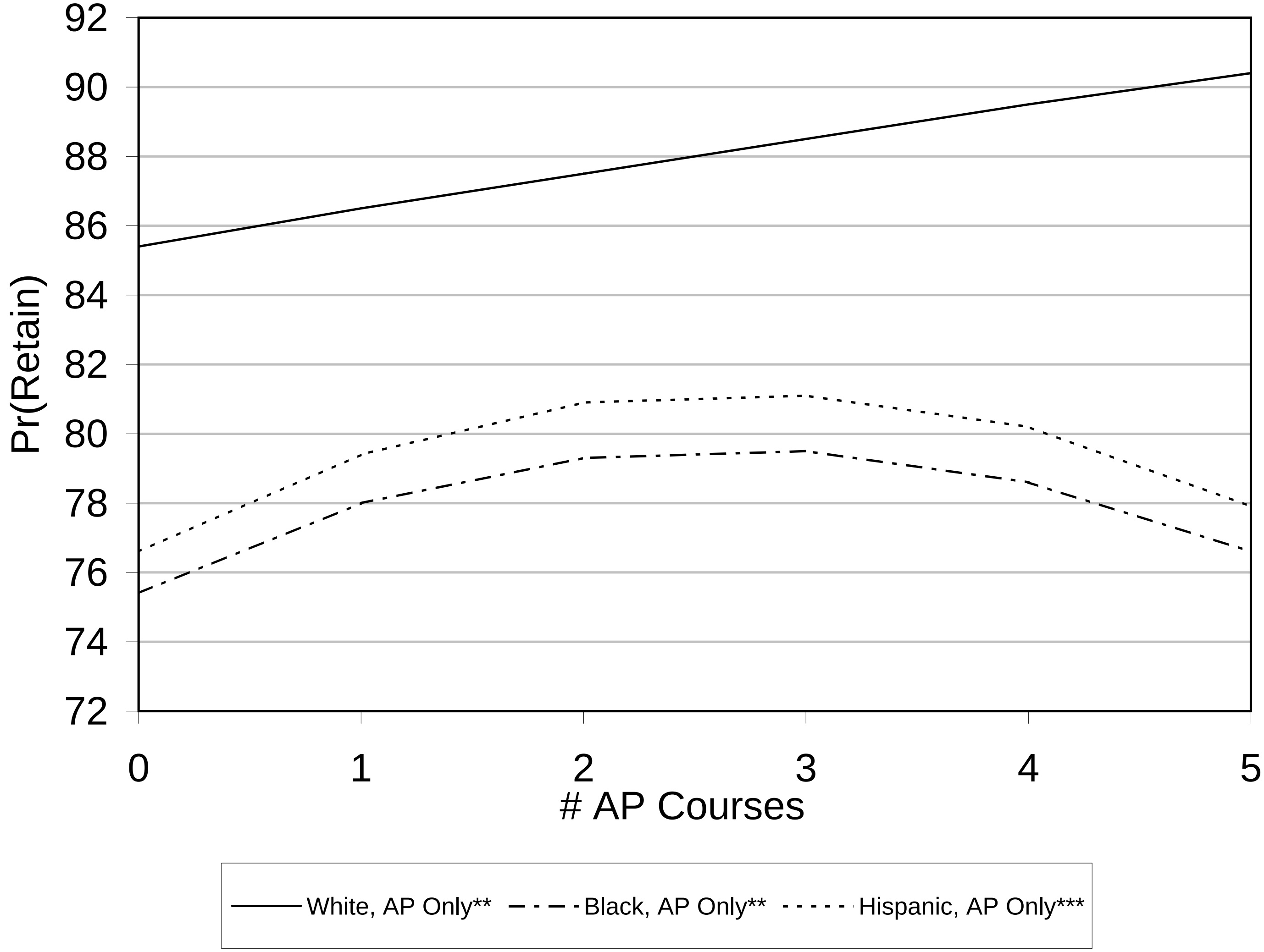

Figure 2
Estimated Effect of AP on Retention
With and Without Non-AP Course Experience

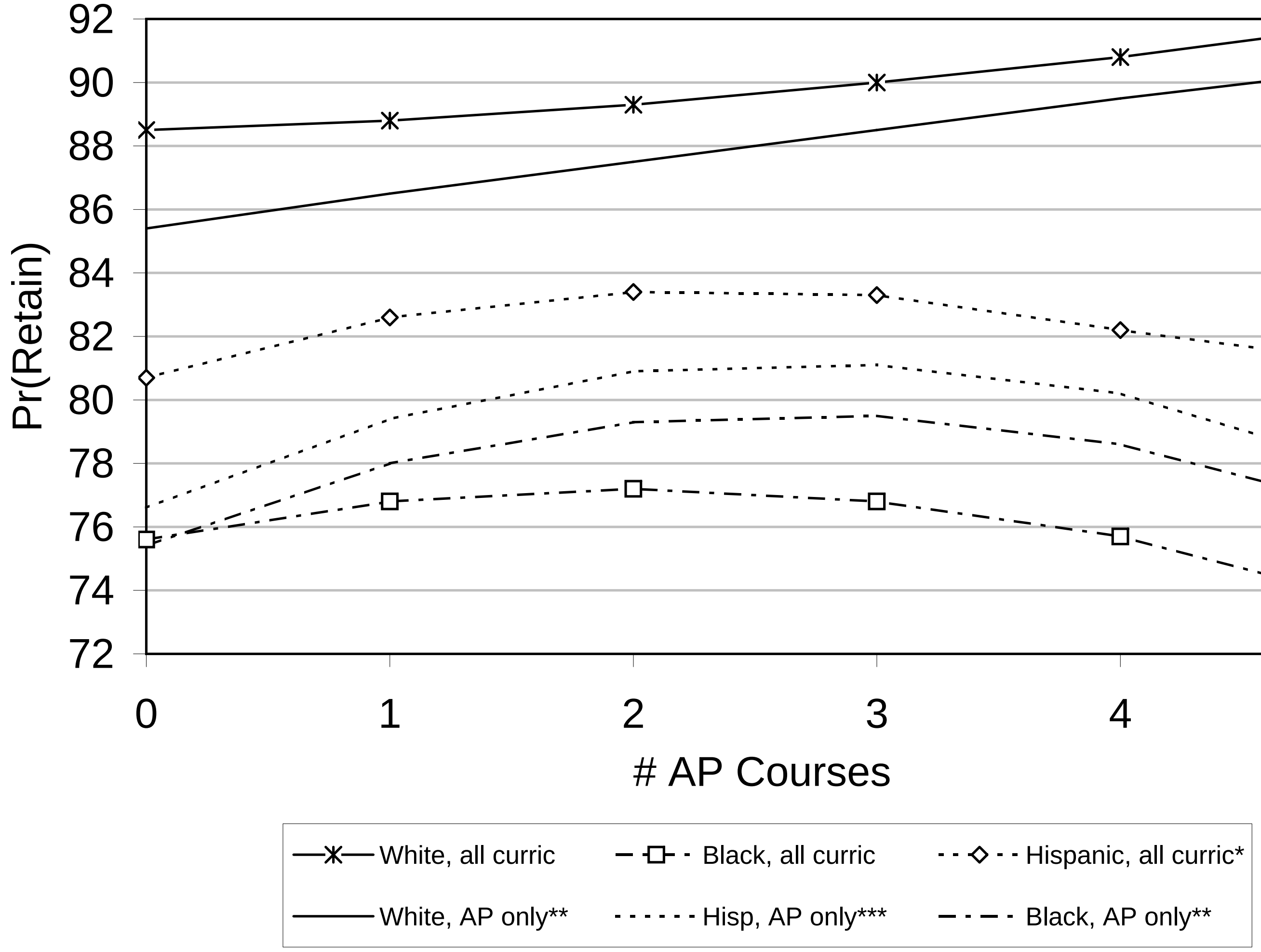

Figure 3
Estimates of AP Effect on College GPA
Without Non-AP Course Experience

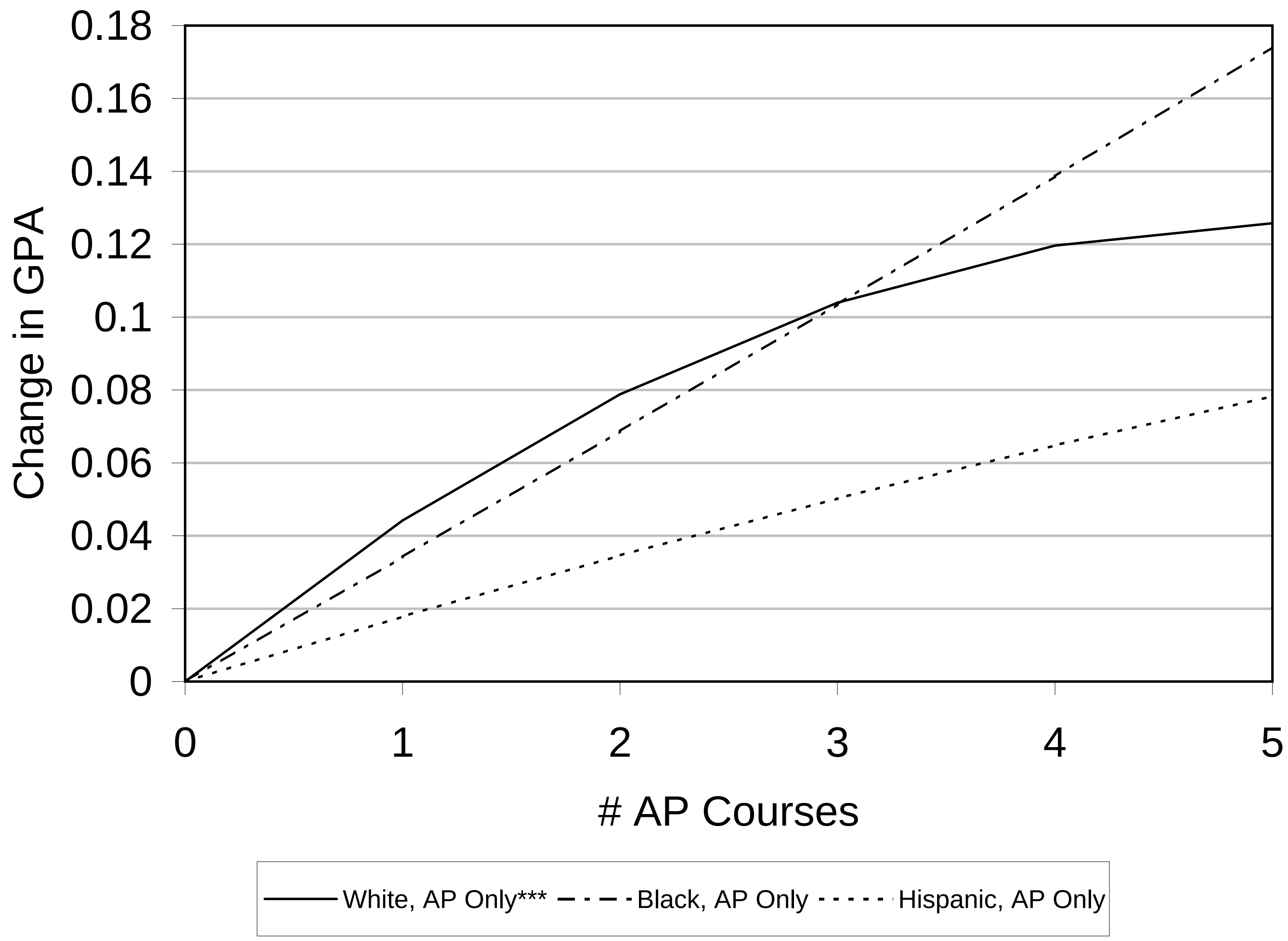

Figure 4
Estimates of AP Effect on College GPA
With and Without Non-AP Course Experience

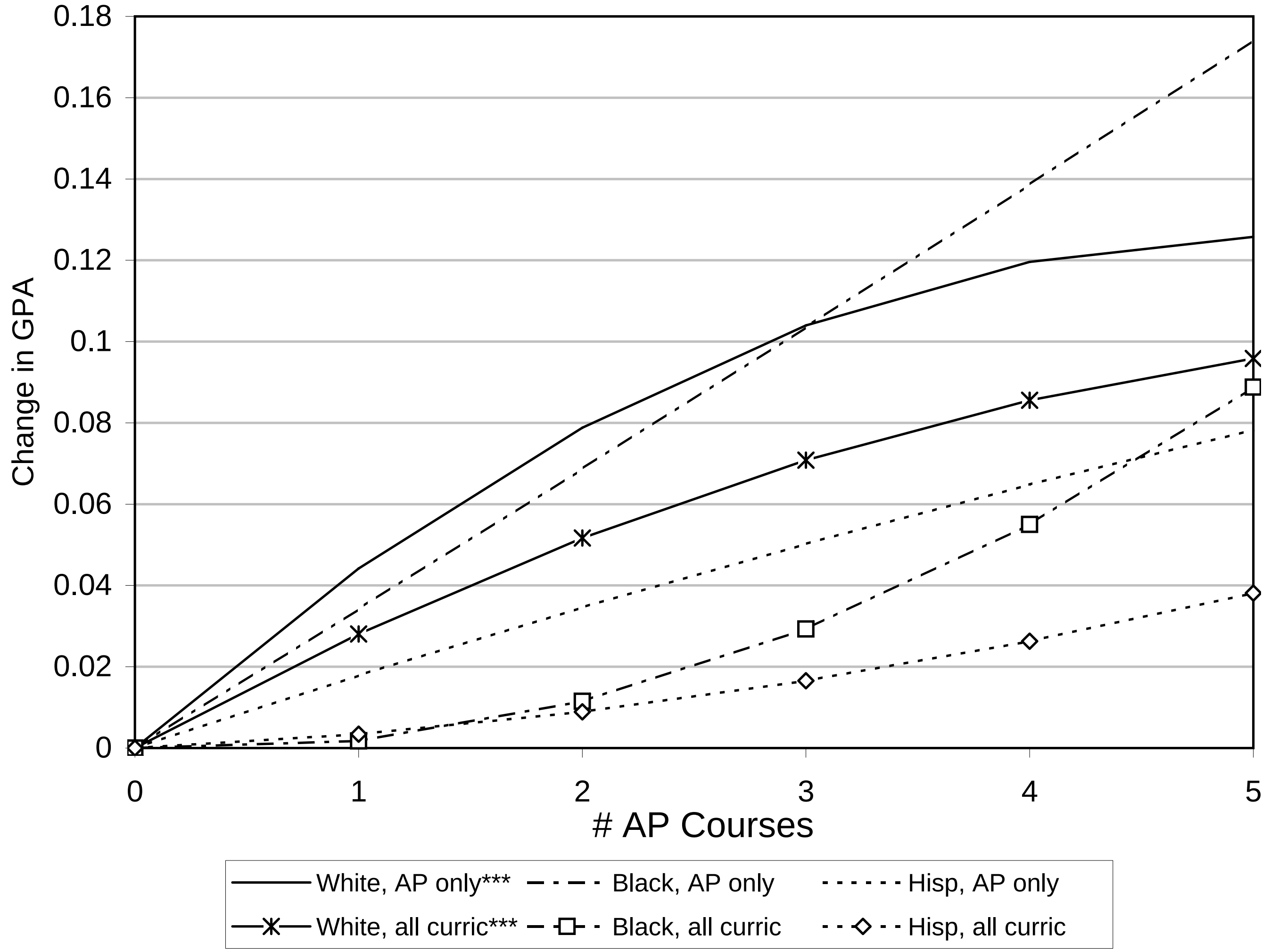

Table 1
Descriptive Statistics of Dependent Variables

	White		Black		Hispanic	
	No AP	AP Taker	No AP	AP Taker	No AP	AP Taker
Percent Retained	83.7	90.6	78.7	84.9	78.0	86.0
Average Fall GPA	2.43	2.77	2.01	2.33	2.11	2.39
	(1.02)	(0.96)	(0.98)	(1.02)	(1.06)	(1.05)
N	10,112	9,240	2,093	939	2,883	2,154

Table 2
Descriptive Statistics of Curriculum Variables

Variable	White	Black	Hispanic
Science=3 years	0.39	0.44	0.38
Science>3 years	0.47	0.32	0.48
Foreign language=2 years	0.41	0.51	0.45
Foreign language>2 years	0.48	0.29	0.44
High math geometry	0.02	0.07	0.02
High math algebra 2	0.23	0.40	0.27
High math trigonometry	0.09	0.06	0.09
High math pre-calculus	0.38	0.30	0.36
High math calculus	0.29	0.14	0.25
Honors English	0.58	0.42	0.54
Honors science	0.49	0.30	0.44
Honors social science	0.46	0.31	0.41
AP math	0.19	0.09	0.14
AP science	0.15	0.10	0.13
AP English	0.29	0.18	0.25
AP economics	0.13	0.07	0.10
AP government	0.16	0.09	0.14
AP history	0.13	0.07	0.08
AP psychology	0.03	0.03	0.01
AP-taker	0.47	0.31	0.42
Number of AP courses taken | take one	2.3	2.0	2.1
	(1.5)	(1.3)	(1.4)
N	19801	3126	5240

Source: Texas Schools Microdata Panel
The means for dummy variables represent the proportion of the sample reporting a one.
Standard deviations are reported in parentheses below the mean for continuous variables.

Table 3
Disaggregated Marginal Effects† of AP Experience on Student Retention

	White		Black		Hispanic	
	AP Only	Broad Curr‡	AP Only	Broad Curr‡	AP Only	Broad Curr‡
Baseline Pr(retain)	85.20	88.23	73.58	73.25	75.33	82.29
AP math	1.91 **	-0.02	3.00 **	-0.04	3.17 *	-1.25
	(2.25)	(-0.02)	(4.08)	(-0.05)	(4.21)	(-1.52)
AP science	0.23	0.22	0.35	0.41	3.58 **	2.93 *
	(0.27)	(0.25)	(0.48)	(0.56)	(4.75)	(3.57)
AP English	1.20 **	0.29	1.86 **	0.55	0.04	-1.09
	(1.40)	(0.33)	(2.53)	(0.75)	(0.05)	(-1.32)
AP economics	2.68 ***	2.21 ***	4.24 ***	4.31 ***	-0.03	-1.86
	(3.15)	(2.51)	(5.76)	(5.89)	(-0.05)	(-2.26)
AP government	0.90	0.66	1.40	1.27	1.86	1.13
	(1.06)	(0.75)	(1.91)	(1.73)	(2.46)	(1.37)
AP history	0.92	0.72	1.44	1.37	0.21	-0.56
	(1.08)	(0.82)	(1.95)	(1.87)	(0.28)	(-0.68)
AP psychology	0.21	0.67	0.33	1.28	-3.06	-4.59
	(0.25)	(0.76)	(0.45)	(1.74)	(-4.07)	(-5.58)

†Marginal effects are presented as point differences from the baseline with the percent differences from the baseline in parentheses.

‡Broad Curriculum includes: the highest level of math achieved (six categories); years of science (three categories); years of foreign language (three categories); and a dummy variable each for honors English, natural science, and social science.

***p≤0.01; **p≤0.05; *p≤0.10 based on one-tailed hypothesis tests.

Table 4

Disaggregated Marginal Effects† of AP Experience on First Semester Grade Point Average

	White		Black		Hispanic	
	AP Only	Broad Curr‡	AP Only	Broad Curr‡	AP Only	Broad Curr‡
AP math	0.07 ***	0.03	0.11 **	0.07	0.01	-0.09
	(0.02)	(0.02)	(0.07)	(0.09)	(0.04)	(0.06)
AP science	-0.01	-0.01	0	0.01	0.08 **	0.10 **
	(0.02)	(0.02)	(0.06)	(0.06)	(0.04)	(0.05)
AP English	0.03 **	0.02	-0.02	-0.05	-0.01	-0.01
	(0.02)	(0.02)	(0.05)	(0.05)	(0.04)	(0.04)
AP economics	0.02	0.02	-0.02	-0.05	0.08 *	0.08 *
	(0.03)	(0.03)	(0.09)	(0.09)	(0.06)	(0.06)
AP government	0.04 *	0.04 *	0.10	0.09	0.02	0.02
	(0.03)	(0.02)	(0.08)	(0.08)	(0.06)	(0.06)
AP history	0.02	0.02	0.02	-0.01	-0.09	-0.07
	(0.02)	(0.02)	(0.07)	(0.07)	(0.05)	(0.05)
AP psychology	-0.01	0.02	0.10	0.10	0.16 *	0.15 *
	(0.04)	(0.04)	(0.10)	(0.10)	(0.11)	(0.11)

†Standard errors in parentheses.

‡Broad Curriculum includes: the highest level of math achieved (six categories); years of science (three categories); years of foreign language (three categories); and a dummy variable each for honors English, natural science, and social science.

***p≤0.01; **p≤0.05; *p≤0.10 based on one-tailed hypothesis tests.

Appendix
Coefficient Estimates of Non-AP Curriculum Variables

	Disaggregated Retention Model†			Disaggregated GPA model		
Variable	White‡	Black‡	Hispanic	White	Black	Hispanic
Science=3 years (relative to <3)	0.19 ***	0.19 ***	0.36 ***	0.05 **	0.02	0.06
	(0.07)	(0.07)	(0.13)	(0.03)	(0.05)	(0.06)
Science>3 years (relative to <3)	0.16 **	0.16 **	0.39 ***	0.02	0.07	0.02
	(0.07)	(0.07)	(0.14)	(0.03)	(0.06)	(0.06)
Foreign language=2 years (relative to <2)	0.02	0.02	0.02	-0.01	0.10 **	0.07
	(0.08)	(0.08)	(0.16)	(0.03)	(0.06)	(0.07)
Foreign language>2 years (relative to <2)	0.03	0.03	-0.02	0.01	0.10 *	0.08
	(0.09)	(0.09)	(0.17)	(0.04)	(0.07)	(0.07)
High math algebra	-0.59 ***	-0.35 **	-0.21	-0.31 ***	-0.11	0.03
	(0.18)	(0.17)	(0.38)	(0.10)	(0.10)	(0.18)
High math geometry	-0.45 ***	-0.21 **	-0.26	-0.21 ***	0.07	-0.04
	(0.11)	(0.11)	(0.26)	(0.06)	(0.07)	(0.10)
High math algebra 2	-0.24 ***	omitted	-0.21 **	-0.09 ***	omitted	-0.08 **
	(0.05)		(0.10)	(0.02)		(0.04)
High math trigonometry	-0.05	0.20 ***	0.06	-0.01	0.07	-0.002
	(0.08)	(0.08)	(0.15)	(0.02)	(0.08)	(0.05)
High math pre-calculus	omitted	0.24 ***	omitted	omitted	0.08 **	omitted
		(0.05)			(0.04)	
High math calculus	0.19 **	0.43 ***	0.07	0.05 **	0.10	0.12 ***
	(0.08)	(0.09)	(0.15)	(0.02)	(0.08)	(0.05)
Honors English	0.20 ***	0.20 ***	0.12	0.02	0.04	0.02
	(0.06)	(0.06)	(0.11)	(0.02)	(0.05)	(0.04)
Honors science	-0.17	-0.17	-0.10	-0.07	-0.10	-0.04
	(0.06)	(0.06)	(0.11)	(0.02)	(0.05)	(0.04)
Honors social science	0.01	0.01	-0.07	0.04 **	0.09	-0.02
	(0.06)	(0.06)	(0.11)	(0.02)	(0.05)	(0.04)

†As with all logit estimates, the coefficients presented for the retention model are not equal to the marginal effects.
"Disaggregated models" are those including the seven categories of AP courses.
‡White and black retention results based on a pooled sample.
***p≤0.01; **p≤0.05; *p≤0.10 based on one-tailed hypothesis tests. Standard errors are in parentheses.