Research Report

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What Predicts Enrollment in and Number of College-level Courses Taken in High School?

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RESEARCH REPORT

Equity Levers: What Predicts Enrollment in and Number of College-Level Courses Taken in High School?

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This study explores the extent to which student, family, peer, and school factors predict (a) whether students take *Advanced Placement*® (*AP*®) courses, International Baccalaureate (IB) courses, and dual enrollment courses and (b) in models limited to course takers, how many courses they completed. Our findings, based on a nationally representative, longitudinal sample, suggest that, when it comes to college-level high school course taking, the relative advantage of higher socioeconomic status (SES) is less for African American students than it is for White and Asian students. Ninth-grade math skills are the strongest predictor of AP or IB and dual enrollment course taking, above and beyond demographic background characteristics like SES and race or ethnicity. High school girls take AP/IB and dual enrollment courses at a higher rate than boys, and they take more of these courses. The level of academic focus of students and their peers is associated with both AP or IB and dual enrollment course taking, whereas having parents focused on college preparation and course taking only predicts AP or IB course taking. School factors associated with AP or IB course taking include U.S. region and rural location; the percentage of math teachers with a master's degree is also positively associated with the number of AP or IB courses students take. These findings highlight the importance of equitable educational opportunities starting from a young age. They also indicate a need for increased early attention to student math skills and for more supports for parents and school staff to enable them to encourage and prepare all students, especially those from historically marginalized groups, to take college-level courses in high school.

Keywords accelerated learning options; advanced high school course taking; *Advanced Placement*®; college-level high school course taking; credit-based transition programs; dual credit; dual enrollment; International Baccalaureate; rigorous course taking; secondary–postsecondary learning options

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When making admissions decisions, college admissions officers consider not only the grades and test scores of high school student applicants but also the rigor of the courses they took (Clinedinst, 2020, p. 14). Unfortunately, rigorous courses are not equally accessible across high schools serving students from different family backgrounds and family income levels (National Academies of Sciences, Engineering, and Medicine [NAS], 2019). Policy makers have tried to expand equitable access to rigorous courses in recent years in several ways, including providing funding to increase access to the number of *Advanced Placement*® (*AP*®) courses and other college-level high school courses available at high schools primarily serving students from historically underserved populations (Beach et al., 2019; Rodriguez et al., 2021). Student enrollment in these college-level high school courses has increased in recent years; in February 2019, a statement from the *College Board*® organization noted that "over the last 10 years, the number of U.S. public high school graduates who've taken an AP Exam has increased by 65%" (College Board, 2019a).[1] However, rigorous course access and course taking rates are still unequal, and underserved students still take fewer of them (Barnard-Brak et al., 2011; ExcelinEd, 2018; U.S. Department of Education [ED], 2017; U.S. Government Accountability Office [GAO], 2018; Supporting Information).

What does it mean when students miss out on these course taking opportunities? Whether it is through the AP or International Baccalaureate (IB) program or through dual enrollment programs offering college courses to high school students, college-level course taking may increase college readiness,[2] improve the odds of admission to college, and even decrease college costs by reducing the number of courses needed for college graduation (American Association of Community Colleges [AACC], 2018; College Board, 2014; International Baccalaureate Organization [IBO], n.d.-e;

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Jaschik & Lederman, 2018). Thus, underserved students attending schools with fewer of these courses may miss out on the potential advantages of taking college-level courses in high school. Research has shown that when students from underserved populations take college-level courses in high school, they do just as well in them as their peers from historically more advantaged backgrounds (Theokas & Saaris, 2013).

In this study, we investigate factors predictive of college-level course taking in high school with the aim of informing the development and refinement of interventions to increase racially and socioeconomically equitable enrollment in these courses. We examine college-level course taking in terms of (a) factors that predict student completion of college-level high school courses and (b) factors that predict the number of courses of each type completed by students who take college-level high school courses. It is important to study both college-level course taking, that is, whether students take the courses, as well as the number of courses taken. This is because prior research has suggested not only that completing such courses may impact college enrollment, retention, and performance (Fink et al., 2017; Kretchmar & Farmer, 2013; Taylor & Yan, 2018) but also that there is a minimum threshold for the number of courses taken when it comes to predicting outcomes like first-year college grade point average (GPA) and degree completion (An, 2013a; Kretchmar & Farmer, 2013). Prior research demonstrated that African American students, Hispanic students, and students from a low-income family take fewer college-level high school courses, on average, than their peers in other racial and income groups (Klopfenstein, 2004), despite that college applications may be strengthened when high school transcripts include more college-level courses (Geiser & Santelices, 2006). There is a lack of research on factors predicting the number of college-level high school courses taken not only by underserved students but by students from all backgrounds.

Whereas prior studies have explored some factors predictive of AP or IB or dual enrollment course taking, we use a more comprehensive model to examine a broad range of potential predictors of college-level course taking using nationally representative data. Another unique contribution of this study is its focus on the three most common types of college-level course taking — AP or IB and dual enrollment — rather than on only one or two of the college-level course types. We build on the existing research on factors predicting AP or IB and/or dual enrollment course taking by exploring the extent to which specific student, parent, and peer behaviors and school characteristics and practices predict college-level course taking in high school. We also explore the extent to which demographics like race and family socioeconomic status (SES) remain relevant after accounting for these behaviors. We aim to advance our collective understanding of the factors that are most strongly associated college-level course taking during high school, including the number of courses taken, to inform policies and practices that may lead to more equitable rates of college-level high school course taking.

Prior to presenting our research questions, we provide an overview of AP or IB and dual enrollment programs and the issues of inequitable access to and enrollment in these programs or courses. We then summarize prior research on factors that have been shown to be associated with one or more types of college-level course taking. In subsequent sections, we lay out the study methodology and results before presenting a discussion of the implications of the results for policy and practice.

College-Level High School Course Taking: An Overview of Three Options

AP or IB and dual enrollment programs each provide opportunities to complete college-level courses in high school and to earn college credits. Yet, they differ in some important ways (see Table 1). AP and IB courses are high school courses that cover college-level material and skills (College Board, n.d.-e; IBO, 2016). Dual enrollment courses, by contrast, are college courses offered to high school students through a partnership between a student's high school and a local college (National Alliance of Concurrent Enrollment Partnerships, n.d.). To earn college credit for AP and IB courses, students must take end-of-course exams, whereas credit for dual enrollment courses may be received upon successful completion of a course (College Board, n.d.-e; Education Commission of the States [ECS], 2016b; IBO, 2018). A student must be enrolled in an IB class to take an IB exam, whereas students can take an AP exam without taking the corresponding AP course (College Board, n.d.-c; IBO, n.d.-d).

In the following sections, we provide details about AP or IB and dual enrollment programs; their growth in recent years; and their impacts on students' high school and college outcomes.

Table 1 Characteristics of Advanced Placement, International Baccalaureate, and Dual Enrollment Courses

Characteristic	Advanced placement	International Baccalaureate Diploma Programme	Dual enrollment
Course developer	College Board	International Baccalaureate Organization	Local determination: high school and local colleges
Course offerings	Up to 38 AP courses across six subject areas; schools choose which to offer	3 core courses and 1 course from each of 6 subject areas; schools offer all	Local determination: courses that prepare students for college and career readiness
Course structure	Year-long or semester-long courses	2-year-long courses	Varies by course
How students are assessed	Individual course exams[a]	Individual course exams[b]	Varies by course
How colleges award credit[c]	Each college determines	Each college determines	Each college determines
Cost for high school participation	None	Application fee and annual fee	None
Cost per course to students	None	None	Costs vary by school district, as does whether students must pay or schools will cover costs
Cost per exam	\$94 per exam[c,d]	Subject courses are \$119 per exam;[c,e] core courses are \$147 for all 3[f,g]	Not applicable

Note. AP = advanced placement; IB = International Baccalaureate. Data are from College Board (n.d.-d, n.d.-e), Education Commission of the States (2016b, 2016c), International Baccalaureate Organization (2016, 2018, n.d.-a), and National Alliance of Concurrent Enrollment Partnerships (n.d.). [a]Can be taken even if not enrolled in the course. [b]Can be taken only by course completers. [c]Colleges may or may not award college credits for college-level courses taken in high school; moreover, their policies regarding credit awards may differ for Advanced Placement, International Baccalaureate, and dual enrollment courses. [d]Reduced based on financial need; states may cover some or all of remainder. [e]States may cover some or all of the cost. [f]Waived for IB diploma candidates; states may cover some or all of the cost. [g]The U.S. federal government offers grant funds to states to cover the cost of Advanced Placement and International Baccalaureate tests for low-income students (Klein, 2016).

Advanced Placement Courses

AP courses are developed by the College Board, which provides AP course curricula to high schools around the nation. High schools may offer up to 38 AP courses across six subject areas; however, the extent of offerings varies across schools (College Board, n.d.-a). The uniformity of AP course content across different high schools is expected to lead to high consistency and rigor. AP courses generally last a semester or a year and culminate in an end-of-course exam, offered for a fee. AP exam scores may enable students to earn college course credits or place out of college course requirements, depending on the policies of the college they attend.

The majority of high schools offer AP courses, and upward of 40% of high school students nationally may take them. Approximately 64% of high schools offered AP courses during the 2018–2019 school year (College Board, 2020).[3] AP has remained the most popular option as enrollment in all three types of college-level courses and the number of AP programs have increased steadily in recent years (AACC, 2018; College Board, 2014; IBO, n.d.-e). In 2019, nearly 39% of U.S. public high school graduates took an AP exam, and more than 2.8 million 9th–12th-grade students completed more than 5 million AP course exams in 38 different subjects (College Board, n.d.-b). These figures likely underestimate AP course taking because the College Board tracks exam completion, not course completion, and not all AP students take the end-of-course exams (College Board, 2019b).

Advanced Placement Growth in Recent Years

The availability of AP courses has been increasing since the program's inception in 1951,[4] particularly in the past decade, with the goal of enabling even more students to earn college credit and increase their odds of college admission (College Board, 2019b; Valentine, 1987). Growth in AP course taking has been rapid; 57% more students took AP courses in 2019 than in 2009, and the number of students scoring high enough to earn college credit on at least one college exam increased 60% during the same period (Jacobson, 2020). Expansion of the AP program was even incentivized by the No Child Left

Behind Act of 2001, which provided states with funds to expand access to AP in schools serving large proportions of students from families with low incomes (Conger et al., 2009; ED, n.d.). Moreover, as of 2016, eight states and the District of Columbia required all public high schools to offer AP courses (ECS, 2016a).

Advanced Placement Student Outcomes

There is evidence that completion of AP courses may have a positive impact on students' college-going rates and college outcomes. College Board researchers reported that within a national sample, AP course taking increased the likelihood of college enrollment (Chajewski et al., 2011) and the likelihood of completion of college within 4 years (Mattern et al., 2013). Other College Board research documents have shown that AP exam takers of low income have a higher likelihood of enrolling in, persisting in, and graduating from 4-year colleges compared to similarly achieving students of low income who did not take AP courses (Godfrey et al., 2016). Studies conducted by researchers not associated with the College Board have further validated these findings. For example, one study of a sample of Arkansas high school graduates revealed that AP participants were more likely than non-AP participants to both enroll in college and persist through to the following school year (Taylor & Yan, 2018). Studies also have linked taking AP courses with better performance on the ACT college entrance examination test (Warne et al., 2015; Warne & Anderson, 2015). However, research has also found that AP course taking does not predict early college grades and retention once non-AP courses are accounted for (Klopfenstein & Thomas, 2009).

There is also mixed evidence on the extent to which number of AP courses completed predicts future outcomes. A study of AP student outcomes found that college grades and degree attainment increased as students moved from taking zero to one AP exam and from one to two AP exams, but the same increases were not found for students taking and scoring well on more than four to six AP exams (Beard et al., 2019). In contrast, other research has shown that students demonstrate higher first-year college GPAs only if they take five college-level courses, including AP courses (Kretchmar & Farmer, 2013).

International Baccalaureate Courses

Like AP courses, IB courses are also centrally developed, in this case by the International Baccalaureate Organization. However, IB courses are offered by far fewer schools across the United States. As of the 2019–2020 school year, nearly 3% of all U.S. public and private high schools[5] offered the IB Diploma Programme, a 2-year sequence of courses leading to a diploma that 11th- and 12th-grade students take (IBO, n.d.-c). Like the AP program, the IB program generally enrolls a minority of students within schools that offer it. In fact, an analysis of 2010 data found that IB programs serve an even smaller proportion of students within their schools than do AP programs: 1 in 19 or so, compared with 1 in 9 for AP (Theokas & Saaris, 2013).

Implementation of the IB Diploma Programme requires a substantial commitment of financial resources by schools, including payment of an initial application fee and annual program fees, in addition to staff development time; the availability of such resources undoubtedly varies across schools and districts (Perna et al., 2015). Schools are required to implement the full IB Diploma Programme; however, in some cases, students have the option to take individual IB courses, and enrollment in the full 2-year IB Diploma Programme is optional (IBO, n.d.-b). When they have the option to take individual IB courses, students can earn a certificate for passing an IB exam in a single subject. In 2019, approximately 70% of IB students worldwide completed the full program and earned a diploma (IBO, 2020). In the same year, nearly 1% of U.S. high school students completed the requirements for the IB Diploma Programme (IBO, 2019a, 2019b; National Center for Education Statistics [NCES], 2017)[6]; others may have taken IB courses without completing the program.

International Baccalaureate Growth in Recent Years

Although the proportion of U.S. schools offering the IB Diploma Programme has grown over the years, from 753 high schools in 2011 to 950 in 2020 (IBO, n.d.-c; Perna et al., 2015), it remains the least widely available of the three types of college-level high school courses. Historically, private schools offered IB courses more often than public schools, and this is still the case internationally (IBO, 2017). However, in recent years, far more public than private schools have been offering the IB in the United States; 87% of 2019–2020 U.S. IB schools were public, whereas only 13% were private.

International Baccalaureate Course Taker Outcomes

Some maintain that the IB is the most rigorous of the college-level course taking options, given its many required courses and its focus on developing research and critical thinking skills and fostering personal and interpersonal development (Perna et al., 2015). Indeed, IB program alumni reported that they felt well prepared for the challenges of college coursework, in particular, writing, critical thinking, study skills, and time management (Aldana et al., 2019; Pilchen et al., 2019). Although comparative rigor is difficult to ascertain, ample research has shown that IB students outperform their non-IB peers across a range of college outcomes. Students who participate in the IB program are more likely than nonparticipants to enroll in college, especially 4-year and selective colleges (Pilchen et al., 2019). Higher first-year college math placement scores for students who completed the IB program seem to indicate greater college readiness relative to non-IB students (Conley et al., 2014). Research has also indicated that IB completers have higher college retention rates and graduation rates than their non-IB peers (Aldana et al., 2019; Conley et al., 2014; Pilchen et al., 2019). Students who reported completing or planning to complete eight IB courses had higher high school GPAs and scores on the *SAT*® test than those who reported completing fewer IB courses (Aldana et al., 2019). However, students in the IB program were also more engaged in school and more motivated than their non-IB peers, which suggests that the difference in academic achievement may not be due to IB course taking but rather to the tendency to be more focused on academic achievement in general.

Dual Enrollment Courses

Like the AP and IB programs, dual enrollment programs were developed primarily for academically higher-achieving students. However, dual enrollment also differs from AP and IB in that dual enrollment programs were developed locally, and some are designed to promote college access among a wide range of students, including students with low or moderate levels of prior academic achievement (Tobolowsky & Allen, 2016). Moreover, some dual enrollment programs were developed specifically to target underserved students, including those of low-income background and students from underrepresented racial and ethnic minorities (Cassidy et al., 2010).

Dual enrollment is the most widely available type of college-level high school course. Yet, fewer students take dual enrollment courses than take AP courses. A recent analysis of data from the 2017–2018 Civil Rights Data Collection (CRDC) found that whereas 77% of high schools offered dual enrollment courses, and 68% offered AP courses, only 10% of U.S. high school students took at least one dual enrollment course, whereas 21% of U.S. high school students took at least one AP course (Fink, 2021). Prior analyses of data from the High School Longitudinal Study of 2009 (HSLS:2009), the data source for our study, estimated that, among the cohort of U.S. students who entered high school in 2009, approximately 11% took at least one dual enrollment course and 37% completed at least one AP course by the time they graduated from high school (Dalton et al., 2018).

Unlike AP and IB courses, dual enrollment courses and programs are not centrally overseen or developed, and options vary across and within districts and localities. This means that dual enrollment courses may differ greatly in terms of course curricula. One example of the expanded breadth of curricula offering dual enrollment is the inclusion of career and technical or vocational education courses or programs. Whereas about three fourths (76%) of all high schools reported that students took dual-credit courses with an academic focus in 2010–2011, about half (49%) reported that students took dual-credit courses with a career and technical/vocational focus (Thomas et al., 2013). Moreover, nearly 30% of dual enrollment students were enrolled in vocational or career and technical education (CTE) courses in 2010–2011 (Thomas et al., 2013).

Another distinguishing characteristic of dual enrollment courses is the variation in where and how they are offered, with some courses or programs offered on high school campuses and others offered at college campuses. Students participate in dual enrollment through programs offered by traditional high schools or by early-college high schools (What Works Clearinghouse, 2017). In traditional programs, students remain enrolled in their high schools but complete college-level courses at their high schools or on college campuses once most high school requirements have been met, during the junior and senior years. Early-college high schools enable participants to complete high school and earn up to 2 years of college credit through courses at their high schools; they also provide access to counseling and other student supports to prepare for college (Cassidy et al., 2010). Dual enrollment models requiring students to travel to college campuses to take college-level courses can present challenges in terms of access for students from families with low incomes, from rural areas, and living farther away from participating colleges (Edwards et al., 2011). Regardless of the manner through which students complete dual enrollment courses, a school–college partnership is often critical in ensuring the program's success.

Dual Enrollment Growth in Recent Years

Like AP, dual enrollment course taking has grown over the last two decades. One estimate of dual enrollment rates using only data on high school students enrolled in colleges, based on the Integrated Postsecondary Education Data System (IPEDS), indicated that dual enrollment course taking rates increased by 67% from 2002 to 2011, growing to roughly 1.4 million high school students during the 2010–2011 academic year (Fink et al., 2017). Data from IPEDS also suggest that dual enrollment rates of high school students attending college courses increased most at community colleges in recent years, as nearly 150,000 more high school students aged 17 years or younger were enrolled in college-level courses in 2015 compared to 2011 (Fink et al., 2017).

Dual Enrollment Course Taker Outcomes

Dual enrollment course completion is associated with a variety of potential benefits ranging from high school graduation to college academic experiences to earning a degree. Early-college programs, in particular, may increase high school graduation rates. Taking dual enrollment courses or programs has been found to be associated with higher levels of college enrollment, retention, and completion (An, 2013a; Edmunds et al., 2017; Fink et al., 2017; Taylor, 2015; Taylor & Yan, 2018), as well as more often finishing college sooner and at a lower cost (American Institutes for Research, 2020; Fink et al., 2017; Godfrey et al., 2014). Students who participated in dual enrollment courses or programs also needed less remediation (An, 2013b); had higher levels of college-readiness skills, such as critical thinking skills and study strategies (An & Taylor, 2015); completed more courses in the first year of college (Allen & Dadgar, 2012); and achieved higher college GPAs (Allen & Dadgar, 2012; An, 2013b) relative to nonparticipants. Math dual enrollment coursework, in particular, has been found to increase the odds of degree completion (Giani et al., 2014).

Although research on the topic seems to be quite limited, differential effects of dual enrollment have been found based on the number of dual enrollment courses in which a student enrolls. Results of a study by An (2013a) found an advantage in college degree attainment only for students who enrolled in two courses, rather than fewer or more courses.

Comparing College-Level High School Course Programs: Availability and Student Outcomes

High schools may offer only one college-level high school course program, multiple programs, or none at all. Our analyses of 2011–2012 school year survey data from school counselors revealed that approximately 7% of U.S. high schools offered no college-level courses (see Figure 1).[7]

In terms of which types of programs schools offered, the majority of schools (60%) offered both AP and dual enrollment courses, and 24% of schools offered only dual enrollment. Six percent offered only AP or IB courses, respectively, and less than 1% offered IB in combination with either AP or dual enrollment. Only 2% of schools offered all three types of college-level courses.

Studies have compared outcomes for AP and dual enrollment programs; we are not aware of research comparing IB to either AP or dual enrollment courses. The research comparing AP and dual enrollment student outcomes has not conclusively demonstrated that one program provides greater advantages than the other. Giani et al. (2014) found that the positive link between college enrollment, persistence, and completion and college-level course taking is stronger for dual enrollment than for AP; Wyatt et al. (2015) found the opposite: that AP course completion has a stronger association with these outcomes. Other studies found that AP and dual enrollment have similar outcomes; one found that the overall effects of community college dual enrollment and AP course taking on college graduation were not significantly different (Speroni, 2011). After controlling for prior achievement, An (2013a) also found no discernible difference between AP and dual enrollment in terms of likelihood of college degree attainment. Speroni (2011) found that dual enrollment students who take classes at community colleges, as opposed to high schools, are more likely than AP students to enroll in any college but that AP students are more likely to enroll in a 4-year college and earn a bachelor's degree. The latter may be due to the fact that dual enrollment courses can be vocational, thus leading vocation dual enrollees to pursue 2-year degrees or technical certifications.

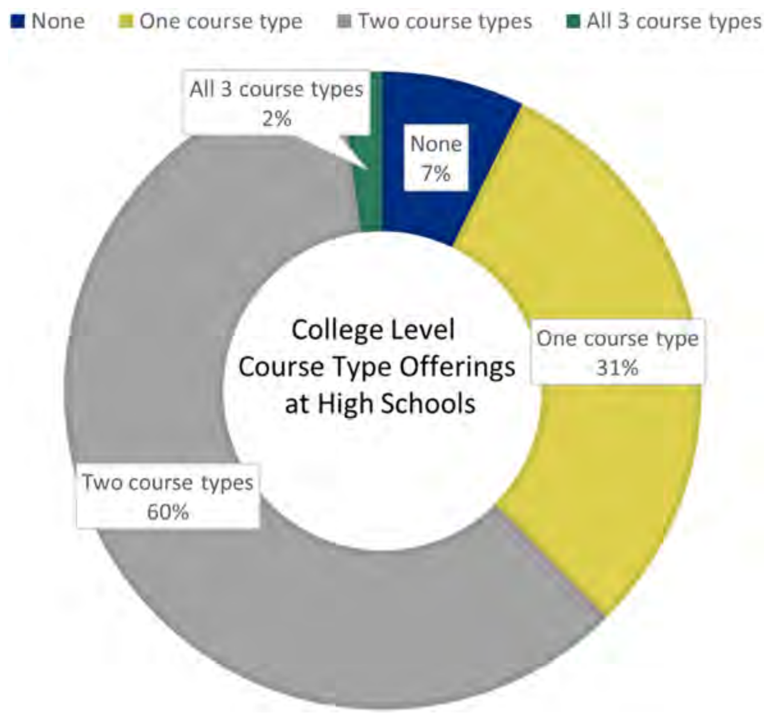

Figure 1 Number of types of college-level courses offered at U.S. high schools in 2011–2012. Data are from the spring 2012 counselor survey of the *High School Longitudinal Study of 2009 (HSLS:09) 2013 Update and High School Transcripts Restricted-Use Data File* (Publication No. 2015038), U.S. Department of Education, National Center for Education Statistics.

In the next section, we provide details on the racial and socioeconomic disparities in access to and enrollment in each type of college-level high course we study. Subsequently, we present prior research on factors associated with college-level high school course taking, situated within an ecological framework incorporating families, peers, and schools.

Racial and Socioeconomic Inequities in College-Level High School Course Taking

The NAS (2019) highlighted the disparity in access to college-level courses as a severe issue and noted that addressing the inequity "represents a potential lever for reducing group disparities in educational attainment." However, all types of college-level courses tend to be less available in schools serving greater numbers of African American students, Hispanic students, and students from families with low incomes (Barnard-Brak et al., 2011; ED, 2017; ExcelinEd, 2018; GAO, 2018). High-poverty schools and schools with high proportions of African American and Hispanic students are less likely to offer these types of courses (Barnard-Brak et al., 2011; ED, 2017; ExcelinEd, 2018; GAO, 2018; Theokas & Saaris, 2013). High-poverty schools and schools with high proportions of African American and Hispanic students are less likely to offer dual enrollment courses as well; this pattern differs for IB courses, which are offered by more schools with high proportions of African American and Hispanic students (see Table 2). ExcelinEd (2018) also found that more low-poverty than high-poverty schools offer AP, IB, or dual enrollment courses (see also NAS, 2019).

Moreover, even when college-level high school courses are available, proportionally fewer students from historically marginalized populations take them (Klugman, 2013; Kolluri, 2018; Musu-Gillette et al., 2017; Shivji & Wilson, 2019). Fewer African American and Hispanic students take AP, IB, or dual enrollment courses than White or Asian students (see Figure 2; College Board, 2014; Musu-Gillette et al., 2017; NCES, 2019a; Shivji & Wilson, 2019), and proportionally fewer students from families with lower incomes take AP, IB, and dual enrollment courses (see Figure 3).

Looking at the issue another way, an analysis by the Education Trust found that Asian students may take AP courses at more than twice the national average, whereas African American students participate at about half the rate of the national average (Theokas & Saaris, 2013). In fact, a study in North Carolina found that, despite the district's open enrollment policy, African American students enrolled in advanced courses at lower rates than their SAT scores indicated they were capable of doing (Corra et al., 2011).

Table 2 College-level High School Courses Offered by All High Schools, Minority and Poverty Profile

Course	All schools	Low-minority high schools (<20%)	High-minority high schools (>80%)	Low-poverty high schools (<20%)	High-poverty high schools (>80%)
AP (%)	45	52	38	59	35
IB (%)	3	1	3	4	3
DE (%)	48	67	31	56	35

Note. Numbers of schools included in this study range from 2,088 to 6,313. AP = advanced placement; DE = dual enrollment; IB = International Baccalaureate. Data are from "College and career pathways: Equity and access," by ExcelinEd, 2018, https://www.excelined.org/wp-content/uploads/2018/10/ExcelinEd.Report.CollegeCareerPathways.CRDCAnalysis.2018.pdf

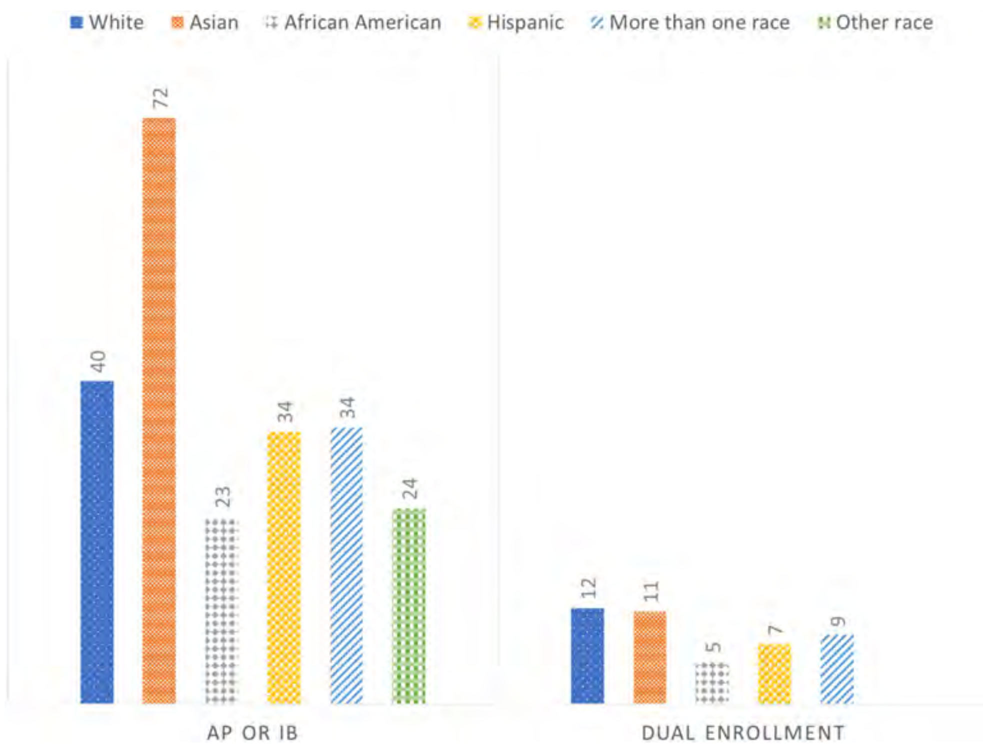

Figure 2 Percentage of fall 2009 ninth graders taking high school Advanced Placement or International Baccalaureate or dual enrollment courses by race/ethnicity. From Dalton, B., Ingels, S. J., Fritch, L., & Christopher, E. M. (2018). *High School Longitudinal Study of 2009 (HSLS:09) 2013 Update and High School Transcript Study: A First Look at Fall 2009 Ninth-Graders in 2013*. National Center for Education Statistics. Data on other race dual enrollment takers were not provided in the Dalton et al. report because the value did not meet NCES reporting standards. This was due to the standard error.

In addition to racial and socioeconomic disparities in whether students take college-level high school courses, there seem to be disparities in how many courses are taken by those who do take them. Although there is relatively little research on the topic, existing studies have revealed that students from historically underserved groups tend to earn fewer college-level high school course credits than their counterparts in high school. The NCES reported that only students in the highest SES quintile group took a higher number of AP or IB courses (3.8) than the overall average for high school students (3.2; Dalton et al., 2018); in contrast, students from families of low and middle SES took fewer courses (2.6 and 3, respectively). Similarly, the number of courses taken differed by parents' education level: Students who had parents with some college or less had taken, on average, 2.7 courses, whereas students with parents who had a bachelor's degree or higher had taken 3.4–4.0 courses. Divergent patterns of the number of courses taken are also evident across racial groups (see Figure 3). Asian students earned the highest number of AP or IB course credits (4.5), and African American students the lowest (2.7). Students who were White (3.1), Hispanic (3.2), or more than one race (3.2) had taken just over three courses.

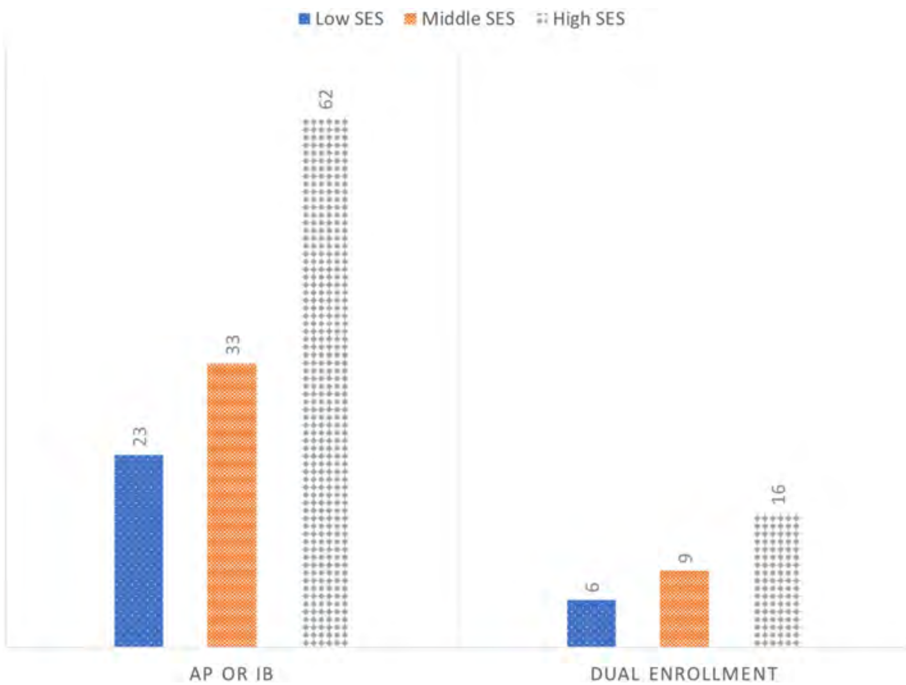

Figure 3 Percentage of fall 2009 ninth graders earning high school Advanced Placement or International Baccalaureate or dual enrollment courses, by socioeconomic status. From Dalton, B., Ingels, S. J., Fritch, L., & Christopher, E. M. (2018). *High School Longitudinal Study of 2009 (HSLS:09) 2013 Update and High School Transcript Study: A First Look at Fall 2009 Ninth-Graders in 2013*. National Center for Education Statistics.

Despite efforts in recent years to address them, including a federal grant program authorized by the Every Student Succeeds Act of 2015, racial and income inequities persist in college-level high school course taking. The persistence of these disparities highlights the need for additional research to identify predictors of course taking and the number of courses completed, particularly given the aforementioned advantages offered by college-level high school courses.

Study Background: An Ecological Perspective on Influences on College-Level Course Taking

This section details prior research on factors predictive of AP or IB or dual enrollment course taking or, relatedly, of college preparation more generally. Our study of factors predictive of college-level course taking is situated within an ecological framework that encompasses the contextual influences of student, peer, family, and school factors (see Figure 4). Prior related frameworks identifying some of these factors include the student-focused college-readiness framework proposed by Conley (2012), Nuñez and Kim's (2012) multicontextual model of college enrollment, Bronfenbrenner and Morris's (2006) bioecological model, and Perna and Thomas's (2008) multicontextual student success framework.

Individual Student Influences on College-Level Course Taking

As we noted, students from historically underserved groups take college-level high school courses less often, even when they do have access to them; the reasons for this are likely complex and include social and cultural forces and norms, in addition to prior academic preparation and differences in educational opportunities. They also include factors associated with low family incomes, such as low parental education.

Socioeconomic Status

SES may be a proxy for access to social and cultural capital (Perna, 2000; Perna & Titus, 2005), which may include information about college-preparation activities like college-level high school course taking. Parent education levels, which are included in our measure of SES, along with family income and occupational prestige,[8] could also serve as a proxy

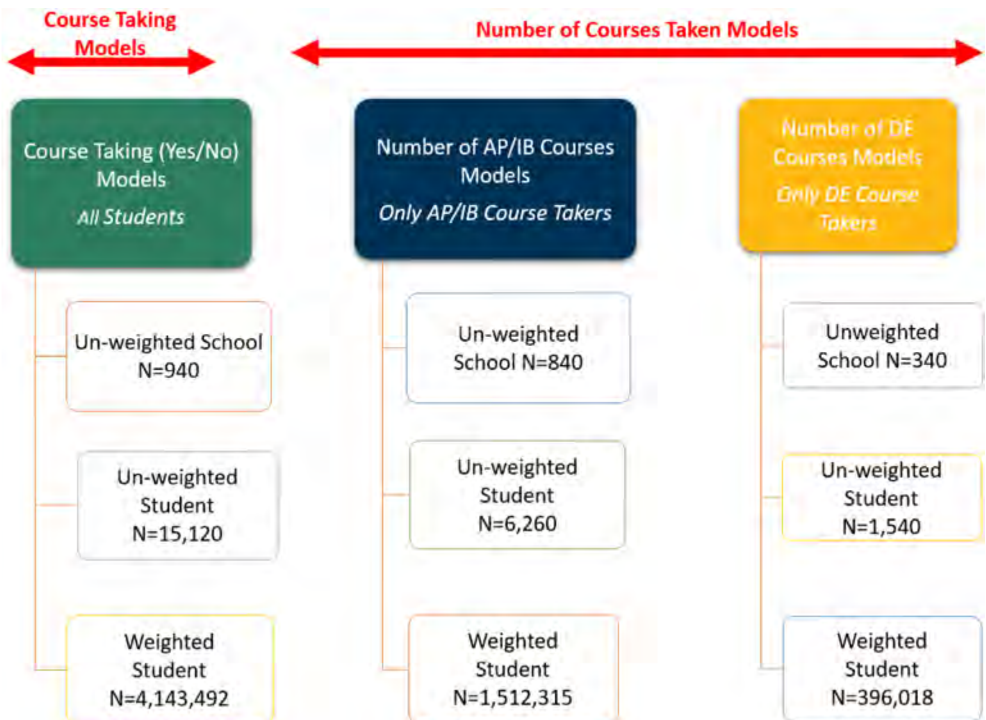

Figure 4 Study sample sizes, course taking, and number of courses taken models, unweighted and weighted *N*s. Unweighted *N*s are rounded per NCES restricted-use data disclosure requirements. *Source*: U.S. Department of Education, National Center for Education Statistics (NCES), *High School Longitudinal Study of 2009 (HSLS:09) 2013 Update and High School Transcripts Restricted-Use Data File*.

measure of cultural capital in the form of access to information about college preparation, including college-level high school course taking. Research has documented that students from historically underrepresented racial groups and their parents, in particular African American students and parents, may more often lack an understanding of the process for enrolling in AP courses and may be less likely to advocate for access to these courses than their White counterparts (Taliaferro & DeCuir-Gunby, 2008). This may be largely related to differences in education levels, as college-educated parents are more likely to be aware of their children's course placements, discuss course taking with other parents and school staff, try to influence their children's course preferences, and advocate for their children to be enrolled in more advanced classes (Useem, 1992).

Prior Academic Achievement

Students who were high academic achievers prior to entering high school are more likely to take an advanced curriculum (Zietz & Joshi, 2005). Disparities in prior achievement may be associated to a large extent with disparities in the quality of elementary schooling and are also complicated by factors related to poverty, such as higher rates of disability and limited English proficiency in students' families of origin (Conger et al., 2009). In fact, the data revealed that after accounting for these other factors, in particular, for prior academic achievement, African American and Hispanic students actually took AP or IB high school courses at higher rates than White students. However, another study found that non-White students other than Asian students still took advanced high school math courses at lower rates, even after accounting for prior achievement (Riegle-Crumb, 2006).

Social and Cultural Forces

Messages from peers, family, teachers, and school staff about belonging and expectations can have a powerful influence on adolescents' academic choices. African American and Hispanic students may choose not to participate in AP courses due to feelings of isolation in these courses (Tyson & Darity, 2005) and the perception that educators have not encouraged the students to take such courses (Saunders & Maloney, 2005). However, mentoring or role modeling by a teacher from the same racial background may increase the odds that African American students will choose to enroll in AP courses or other rigorous high school courses (C. M. D. Hart, 2020; Klopfenstein, 2004, 2005).

Although there is now evidence against the theory that some African American students choose not to take academically challenging courses to avoid "acting White" (e.g., Fordham & Ogbu, 1986; Tyson & Darity, 2005), this perception, and the related potential for negative peer reactions, may still contribute to lower rates of college-level course taking among students who identify as being from historically underrepresented racial groups (Tyson & Darity, 2005). The potential for negative peer reactions may also contribute to lower rates of college-level course taking among White students from families with lower incomes (Tyson & Darity, 2005). This may be even more likely at high schools in rural locations, according to Tyson and Darity. At the same time, findings from their study also highlighted equivalent levels of focus on academic achievement among African American and White students (e.g., Fordham & Ogbu, 1986; Tyson & Darity, 2005). Similar to the way in which high-achieving African American students may face the racial stigma of "acting White," high-achieving White students from families with lower incomes may be stigmatized as "acting high and mighty" (Tyson & Darity, 2005). Thus, White students from families with lower incomes and higher-SES students from minority families may face similar stigmas and need supports to overcome them.

Parent and Peer Factors

Both parents and peers exert influence over high school students' academic decisions (Gottfried et al., 2017). Direct and indirect mechanisms of parent and peer influence occur through their behaviors, attitudes, and interactions around academics (Gottfried et al., 2017; Parsons et al., 1982; Perna & Titus, 2005; Riegle-Crumb et al., 2006).

Parents

First, although parents' school involvement has been studied extensively and deemed an important correlate of academic achievement, less is known about the link between parents' school involvement and high school students' college-level course taking (Gottfried et al., 2017; Hill & Taylor, 2004). Communication with schools, integration into school networks, and participation in school-sponsored activities and meetings purportedly equip parents with knowledge and social capital to align their academic support with the goals of their children's schools (Epstein, 2010; Lareau, 2011). More involved parents—who often tend to have higher education levels—play a larger role in mathematics course tracking and assignment to ability groups during middle school (Useem, 1991, 1992). Findings from two studies using National Education Longitudinal Study of 1988 data (Kelly, 2004; Valadez, 2002) suggest that parent participation in parent–teacher organizations (PTOs) and contact with the school are associated with high school students taking more advanced math courses, but less consistently so among students from families of low SES or Hispanic students.

The second and more direct form of parental influence involves parents sharing their expectations about academics and providing academic-focused encouragement and instrumental and emotional support to students (Gottfried et al., 2017; Parsons et al., 1982; Witenko et al., 2017). Sciarra (2010) found that White and Asian high school students whose parents had higher academic aspirations for them took more advanced math courses beyond Algebra II; a similar association was not evident between the higher academic aspirations American Indian, African American, and Hispanic parents held for their children and the number of advanced math courses completed by their children. Parent–student discussion about academics may also have positive implications for academic behaviors; studies have shown that it is associated with an increased likelihood of taking advanced mathematics courses (Ozturk & Singh, 2006; Valadez, 2002). Conversations students have with their mothers around math and science, in particular, when there is more discussion about their usefulness and importance, are associated with higher math and science course taking in high school (Hyde et al., 2017). In fact, informational interventions that educate parents about the importance of student science, technology, engineering, and mathematics (STEM) course taking for college and career planning may increase the likelihood that high school students take more advanced math and science courses (Harackiewicz et al., 2012). High school students have reported that parents are a significant source of encouragement for taking college-level courses like AP (Witenko et al., 2017). High parent academic encouragement is associated with taking more advanced coursework during middle school and, in turn, is likely a positive predictor of college-level course taking (Filer & Chang, 2008). In sum, prior findings suggest that parents influence students' academic decision-making in a multitude of ways and, in turn, may shape high school students' decisions to take college-level courses.

Peers

Peer influence on students' academic decisions and aspirations tends to grow as students move through adolescence (Gottfried et al., 2017; Ryan, 2000). Adolescents tend to select peers who exhibit similar academic attitudes and behaviors (McPherson et al., 2001). Yet, they can be indirectly impacted by social norms about academics within the larger peer network (Zietz & Joshi, 2005) or motivated to engage in academic behaviors as a result of interactions with close peers or friends (Riegle-Crumb et al., 2006). For students from historically marginalized groups, in particular, African American students, stigmatization or lack of close peers with similar academic aspirations may undermine future academic engagement (Saunders & Maloney, 2005).

Extant research has suggested that having more close friends who plan to attend college increases the likelihood that high school students will hold higher college aspirations and enroll in a college-prep program with more rigorous coursework (Ozturk & Singh, 2006; Zietz & Joshi, 2005). In fact, students who take more advanced coursework in math or Honors, AP, or IB English have more friends who do as well (Barber & Wasson, 2015). Students who take AP courses may also develop relationships with supportive, academically oriented peers (Davis et al., 2013). Riegle-Crumb et al. (2006) found that when either male or female students have female friends with high grades, they are more likely to take advanced courses like Physics, Precalculus/Calculus, or AP/Honors English. Moreover, peer influence also appears to vary with race and ethnicity, as White students report more consistent, positive peer influence on their aspirations to go to college and likelihood of taking AP or dual enrollment than African American, Asian, or Hispanic students (Alvarado & An, 2015). Collectively, these findings underscore the value of understanding peer influences on college-level course taking.

To date, parents and peers have often been studied separately to understand their contributions to students' course taking decision-making (Gottfried et al., 2017). High school students have reported that both parents and peers serve as sources of encouragement for college-level course taking, such as AP (Witenko et al., 2017). Furthermore, we see that each source of influence uniquely predicts long-term academic outcomes, such as college enrollment, when studied together (Engberg & Wolniak, 2010; Perna & Titus, 2005). In turn, this study aims to advance current knowledge on the roles parents and peers play in college-level course taking.

School-Level Contextual Factors

Whereas a large amount of the influence on student course taking may come from family and peers, along with students' prior academic experiences and home environments, school staff and cultural factors may also influence college-level course taking rates among students of all backgrounds and, in particular, among students from families with low incomes or historically underrepresented racial groups. In fact, prior academic preparation may be less of a factor than some assert, and racial and income gaps in course taking could be addressed through school-level policies (Corra et al., 2011).

In this section, we summarize prior literature on school policies and practices, including those related to course offerings and course placement; because school demographics and culture may influence student course taking, to which we alluded earlier, we also summarize prior studies on these topics.

Placement and Tracking Decisions

As the strong influence of prior achievement would suggest, pre-high school experiences with tracking and academic placement may dictate or influence whether students are eligible for and academically prepared to take college-level high school courses (Fong & Finkelstein, 2014). In fact, early studies of tracking revealed that many teachers and principals saw high school students' abilities as "fixed" and placed students accordingly, such that students who are high achievers at the end of middle school are placed in high-level courses throughout high school, whereas students of lower-achieving students are placed in lower-level courses (Oakes & Guiton, 1995; Yonezawa et al., 2002). Lower-level ninth-grade course placements are a problem because they leave students ineligible or unprepared to take advanced courses later in high school (NAS, 2019), effectively removing them from the pipeline of potential college students. Research on a reformed version of tracking—sometimes referred to as "neotracking"—found that the use of college or career preparatory "courses of study" in place of more traditional tracks may actually reinforce racial and social class stratification of opportunities to learn (Mickelson & Everett, 2008).

Access to College-Level Courses

As we noted previously, despite successful federal and state efforts to increase access to college-level high school courses (Conger et al., 2009), disparities in access and course taking rates remain an issue. Increasing equitable access to AP, IB, and dual enrollment is viewed as one potential lever to reduce racial and socioeconomic disparities in high school students' college-level course taking rates (NAS, 2019). Increasing access to college-level courses is viewed as increasing the likelihood that students, particularly students from families with low incomes and from historically underrepresented racial groups, will take them. Course offerings may be influenced by school size and financial resources, and the qualifications and expertise of a school's teachers may also influence students' college-level course taking rates. School financial resources and the student body composition influence the proportion of qualified teachers—teachers with a master's degree—within a school (Theokas & Saaris, 2013). Larger schools may have more resources that give them a greater capacity to offer AP, IB, or dual enrollment courses and to offer more of them. Schools in rural areas tend to be smaller and also offer college-level courses less often, leading to lower course taking rates among students in rural areas (ECS, 2017).

School Characteristics

Within high schools, potential influences on student rates of advanced course taking include teachers and school staff, such as guidance counselors. The fact that private school students take AP, IB, or dual enrollment at higher rates than public school students (NCES, 2012, 2019a) may be due to a greater focus on academic rigor in many private schools, as well as lower student-to-teacher and student-to-counselor ratios.

School size may influence the likelihood of course taking in multiple ways. On one hand, larger schools, such as those serving more than 1,000 students, may have the financial resources, teaching staff, and critical mass of students necessary to offer a range of college-level courses, whether AP, IB, or dual enrollment. At the same time, however, students attending larger schools may be more likely to feel isolated and lack access to mentoring or guidance from counselors and staff; this may especially be the case in overcrowded high schools. And although teachers with master's degrees may influence student achievement (Gándara & Contreras, 2009), it is unclear whether such teachers might influence college-level course taking rates once other factors are accounted for (Conger et al., 2009).

Other influential school factors include the composition of the student body. As explained, schools serving higher percentages of students from families with low incomes tend to have lower levels of student achievement and college enrollment (Engberg & Wolniak, 2010; Konstantopoulos, 2006). Studies have also found lower rates of advanced math and science course taking in schools with higher percentages of students from families with low incomes (Asim et al., 2019) and African American students (Southworth & Mickelson, 2007). In addition to the already-noted disparities in course offerings between schools with smaller or larger proportions of low-income and underrepresented minority students, schools with higher concentrations of high-achieving students tend to offer more high-level courses, including AP and IB courses (Iatarola et al., 2011; Oakes & Guiton, 1995).

School Racial Diversity and Segregation

Clotfelter et al. (2020) showed that within-school segregation could actually be more of an issue than between-school segregation and that schools with more African American students tend to have more within-school segregation. They also found that White students are more likely to be enrolled in advanced classes. Other research has found that the more racially diverse a school is, the better are White students' chances and the worse are African American students' chances of college-preparatory course taking (Lucas & Berends, 2007). This is distressing, considering the prevalence of calls for reforms to diversify schools, based on prior research showing that peer achievement levels influence individual student achievement.

School Culture

Cultural factors are at play within high schools, where the school culture, exemplified by the behaviors and attitudes of teachers and administrators, may influence students' focus on college-preparation activities, such as college-level course taking (Oakes et al., 2006). A college-going culture is defined by a school's norms and practices related to college preparation and enrollment; in schools with such a culture, school staff help students to meet high educational expectations (Jarsky et al., 2009). One indicator of a college-going culture is the proportion of graduates who attend college (Konstantopoulos, 2006).

Our Study

In sum, the existing literature has suggested that student background, prior achievement, and academic behavior patterns; family and peer influences; and school characteristics, culture, and practices predict racial and socioeconomic disparities in college-level course taking during high school. Yet, to date, no study has used national data to explore the combined influence of these factors on the likelihood of taking AP or IB courses or dual enrollment courses or on the number of such courses taken. Importantly, prior studies also have not explored the overlap of race and SES when it comes to college-level high school course taking. Whereas these factors are often studied separately, doing so may obscure important differences in the experiences of individuals belonging to one or many marginalized groups (Proctor et al., 2017).

This study aims to address these gaps in the literature to increase understanding of the factors that may have the greatest influence on college-level course taking. The following research questions guided our study:

1. How does AP or IB and dual enrollment course taking vary by SES within racial and ethnic groups?
2. To what extent are student, family, and peer behaviors and student and school characteristics associated with college-level course taking?
3. To what extent are student, family, and peer behaviors and student and school characteristics associated with the number of college-level courses high school students take?
4. How do these associations differ between AP or IB and dual enrollment?

Our Approach

To address the study research questions, we used nationally representative, longitudinal data on a cohort of high school students entering ninth grade in 2009, collected for the NCES's HSLS:2009. Our analysis included two types of models. The first type, course completion models, predicted whether students took each type of course and were designed to investigate factors that may increase or decrease the odds of students taking college-level courses in high school. The second type of model we used predicted the number of courses taken by AP or IB and dual enrollment course takers. These models were designed to explore factors that might be associated with AP or IB and dual enrollment students taking more or fewer AP or IB and dual enrollment courses, respectively.

In this section, we provide an overview of the study samples, measures, and analyses undertaken. A more comprehensive methodology section, including details on the study measures, regression equations, multiple imputation of missing data, and a comparison of the overall study sample to the full HSLS:09 sample, is included in Appendix A.

Study Data and Samples

The HSLS:09 data were collected in a nationally representative sample of U.S. high schools (Ingels et al., 2011). Data collection included student surveys and mathematics and science cognitive assessments; school counselor, administrator, and teacher surveys; and high school transcript requests. Our longitudinal study sample included HSLS:09 student respondents with data for fall 2009 (at the outset of ninth grade), spring 2012 (at the end of 11th grade), and fall 2013 (post high school) surveys, along with high school transcript data. The use of student and school sampling weights[9] resulted in statistical estimates representing 4,123,063 U.S. Grade 9 students in 22,815 high schools during the 2009–2010 school year. For the models predicting the numbers of each type of course taken, we restricted the study samples to include only students who took a particular type of course. For these subsamples, the use of sampling weights resulted in statistical estimates representing 396,018 dual enrollment course takers and more than 1.5 million AP or IB course takers who entered Grade 9 during the 2009–2010 school year (see Figure 4).

Measures

Outcomes

We used two sets of outcome variables. The first set of outcomes, used in multilevel logistic regression models of factors associated with course taking, included indicators of having taken (a) any AP or IB course or (b) any dual enrollment course, based on the number of AP or IB and dual enrollment courses on students' high school transcripts. We combined AP and IB courses because of the similarities between the programs and the small size of the IB program nationally, as the NCES does in its studies of these programs (e.g., Thomas et al., 2013); however, we recognize that there are clear distinctions between the AP and IB programs and courses.

The second set of outcomes, used in multilevel Poisson regression models of factors associated with the number of courses taken by course takers, included counts of (a) the number of AP or IB courses taken and (b) the number of dual enrollment courses taken, based on the same transcript data.[10] Transcript data were standardized by the NCES to Carnegie units, which are each equivalent to a 1-year academic course taken one period a day, 5 days a week (Ingels et al., 2015). This means that each course credit in the transcript data file represents a completed college-level high school course of its respective type.

Student-Level Predictors

We included multiple student-level variables in our analyses to simultaneously explore the extent to which various student, peer, and family characteristics and practices predicted the likelihood of AP or IB and dual enrollment course taking and the number of such courses taken by course takers, based on relationships indicated in prior research. Given the well-documented inequities in course taking rates by racial background and SES, our models included dummy variables representing student race along with a continuous measure of family SES, and interaction terms to enable a deeper understanding of the overlap between race and SES, given historical patterns of racial discrimination and marginalization. Other student-level predictors supported by prior research included measures of immigrant status, gender, and prior math skills. The latter was represented as HSLS:09 ninth-grade math assessment scores and served as a proxy for prior academic achievement more generally, given the strong association between math skills and other academic skills (Martin & Mullis, 2013). Our models also included derived measures of student focus on academics, family involvement in and encouragement of education, peer focus on academics, student conversations with others about course taking, and school experiences. For details on specific measures and variable creation, refer to the more detailed methodology section in Appendix A.

School-Level Predictors

We included a broad range of school-level factors in analytic models to explore the extent to which various school characteristics and practices were related to AP or IB and dual enrollment course taking by all students and to the number of these college-level high school courses completed by those who opted to take any of them. Given the prior literature highlighting the importance of particular school factors, we included in our models measures of school demographic characteristics, teacher qualifications, school culture, and school counselor perceptions of the importance of various factors for ninth-grade mathematics course placement. We included measures of college-level course access within a student's high school, specific to the program type modeled as the outcome variable, because students are more likely to take advanced courses when their schools offer them. For details on specific school-level measures and variable creation, refer to the more detailed methodology section in Appendix A.

Analyses

We used multilevel models to estimate the extent to which student, family, and peer behaviors; student and family demographics; and school demographics, experiences, and practices were associated with college-level high school course taking and the number of courses taken. Multilevel modeling is ideal for studies of educational phenomena because it enables researchers to address nested data by simultaneously accounting for variations at each level (Raudenbush & Bryk, 2002). Models of the dichotomous outcome of course taking used hierarchical generalized linear modeling (HGLM), or multilevel logistic regression modeling, an extension of the generalized linear model that provides estimates of how various factors predict the likelihood of an outcome while also accounting for the nested nature of the data. Next, we ran models of the count outcomes of the number of courses taken, restricted to students who had completed the specific type of college-level high school coursework being modeled as the outcome. These models were specified as multilevel Poisson regression models to allow for explorations of factors that might increase the number of courses taken by students who opted to take at least one AP or IB or dual enrollment course.

We specified multilevel models with students nested within schools, adding variables in steps, beginning with student demographics, then adding in prior math achievement, then our three measures of student academic focus, then our two measures of parent involvement, followed by two measures of peer academic focus, then three measures of students' discussions of course taking with others, and, in the final model of only-student-level variables, indicators of same-race math teacher. In the final four models, school-level variables were added to student-level variables in steps, including school demographics, course access, and school culture, for a total of 10 models predicting AP or IB and dual enrollment course taking and the number of courses taken.

Prior to the multilevel modeling, we conducted descriptive analyses, including frequencies and means of student and school predictor variables for all students in the analytic sample and for the subsamples of students who took AP or IB courses or dual enrollment. The next section details the results of these analyses, to set the stage for the multilevel model results.

Demographic Characteristics of Advanced Placement or International Baccalaureate and Dual Enrollment Course Takers: Digging Deeper Into Disparities

Our results reveal different trends in the demographic composition of AP or IB[11] and dual enrollment course takers (see Table 3). More female students than male students took AP or IB and dual enrollment courses (56% vs. 44%). First-generation immigrant students were also overrepresented among AP or IB course takers and, at the same time, underrepresented among students who took dual enrollment courses. In terms of racial and ethnic group differences, Asian students were overrepresented among dual enrollment course takers and even more so among AP or IB course takers. White students were also overrepresented among AP or IB course takers and even more so among dual enrollment course takers. Hispanic students were slightly underrepresented in AP or IB courses and even more so in dual enrollment courses. African American students were even more underrepresented than Hispanic students in AP or IB courses and dual enrollment courses relative to their proportion within the population of fall 2009 high school students.

Our results confirm not only the previously documented racial disparities in college-level course taking but also the disparities in course taking rates by family SES, a measure of parental education, income, and occupational prestige. The majority of students who took college-level courses were from middle- to high-SES households. Students in the top family SES quintile were overrepresented among all types of course takers and even more so among AP or IB course takers. Relative to their proportion of the fall 2009 student population, students in the middle three family SES categories were slightly underrepresented, and students from the bottom family SES quintile were even more underrepresented across these groups.

Our findings on SES subgroups within each racial group also reveal some interesting trends. One is that students with high SES from all racial and ethnic subgroups were overrepresented among AP or IB and dual enrollment course takers, and this was even more the case among Hispanic and African American students. Whereas African American students with high SES are only slightly overrepresented among dual enrollment course takers, they are much more overrepresented among AP or IB course takers. In contrast, Hispanic students with high SES are much more overrepresented among dual enrollment course takers than among AP or IB course takers. Asian students of all SES backgrounds are less overrepresented than African American and Hispanic students relative to their proportions of the weighted study sample, among AP or IB and dual enrollment course takers. Moreover, whereas White and Asian students of middle SES are slightly underrepresented among college-level course takers, Hispanic and African American students of middle SES are slightly overrepresented among college-level course takers. Students from bottom-quintile SES backgrounds are the most underrepresented among course takers out of all racial and ethnic subgroups, and especially so among White students. The exception is dual enrollment course taking among African American students from a low-SES background, which occurs at a rate proportional to their representation within the overall student population.

Table 3 Characteristics of College-Level High School Course Takers: Who Is Taking Each Type of Course?

Characteristic	Total population		Took AP or IB courses		Took dual enrollment courses	
	N	Mean/%	N	Mean/%	N	Mean/%
Total	4, 143, 492	100.0	1, 520, 008	36.7	396, 582	9.6
Student sex						
Male	2, 084, 953	50.3	664, 659	43.7	174, 732	44.1
Female	2, 058, 539	49.7	855, 349	56.3	221, 850	55.9
Immigrant status[a]						
First-generation	1, 266, 845	30.6	468, 548	32.7	142, 183	25.5
Other	2, 875, 140	69.4	938, 426	67.3	381, 901	74.5
Student race[b]						
Hispanic	902, 880	21.8	300, 537	19.8	63, 533	16.0
White	2, 148, 829	51.9	853, 843	56.2	252, 975	63.8
African American	567, 947	13.7	136, 458	9.0	32, 758	8.3
Asian	146, 718	3.5	105, 769	7.0	16, 973	4.3
All other races[c]	377, 120	9.1	123, 401	8.1	30, 342	7.7
Student has same-race math teacher						
Asian	28, 129	1.2	21, 833	2.5	2, 594	1.0
African American	106, 573	4.7	22, 682	2.6	5, 869	2.3
Hispanic	156, 104	6.8	55, 537	6.3	14, 363	5.6
White	1, 989, 393	87.2	785, 120	88.7	233, 230	91.1
SES quintile						
First	805, 605	19.4	169, 417	11.1	34, 686	8.7
Middle three	2, 485, 094	60.0	815, 257	53.6	230, 851	58.2
Fifth	852, 792	20.6	535, 334	35.2	131, 044	33.0
Race by SES						
Asian						
Low	19, 697	13.4	9, 724	9.2	1, 784	10.5
Middle	75, 486	51.4	51, 198	48.4	7, 799	45.9
High	51, 535	35.1	44, 846	42.4	7, 390	43.5
Hispanic						
Low	377, 774	41.8	98, 728	32.9	13, 079	20.6
Middle	456, 896	50.6	156, 360	52.0	34, 962	55.0
High	68, 210	7.6	45, 449	15.1	15, 492	24.4
African American						
Low	150, 574	26.5	18, 410	13.5	8, 320	25.4
Middle	361, 847	63.7	92, 818	68.0	21, 064	64.3
High	55, 527	9.8	25, 230	18.5	3, 374	10.3
White						
Low	208, 131	9.7	33, 652	3.9	9, 660	3.8
Middle	1, 332, 382	62.0	439, 823	51.5	148, 195	58.6
High	608, 315	28.3	380, 369	44.5	95, 120	37.6
Other race						
Low	55, 073	15.4	6, 868	5.9	1, 842	6.2
Middle	237, 407	66.6	72, 460	62.6	18, 268	61.3
High	64, 210	18.0	36, 379	31.4	9, 668	32.5
Ninth-grade math skills	4, 143, 492	−0.007	1, 520, 008	0.567	396, 582	0.469
Student academic focus						
College access program participation[d]	525, 150	12.7	182, 267	12.0	40, 626	10.2
Plans to take college entrance exams	2, 862, 530	69.1	1, 285, 136	84.5	307, 376	77.5
Plans to enroll in college	2, 561, 436	61.8	1, 161, 218	76.4	297, 598	75.0
Parent involvement						
Family encouragement of math/science course taking	4, 143, 492	0.201	1, 520, 008	0.300	396, 582	0.275
Parent involvement in school	4, 141, 985	0.453	1, 519, 240	0.493	396, 582	0.508

Table 3 Continued

Characteristic	Total population N	Mean/%	Took AP or IB courses N	Mean/%	Took dual enrollment courses N	Mean/%
Peer academic focus						
Peers take college entrance exams[e]	2,269,279	54.8	1,097,244	72.2	261,773	66.0
Peers plan to attend college[f]	2,604,272	62.9	1,168,288	76.9	285,283	71.9
Discusses course taking						
Talks to friends about academics	4,143,492	0.378	1,520,008	0.459	396,582	0.440
Talks to parents about academics	4,143,492	0.506	1,520,008	0.621	396,582	0.611
Talks to school staff about academics	4,143,492	0.187	1,520,008	0.227	396,582	0.217

Note. AP = advanced placement; IB = International Baccalaureate; SES = socioeconomic status. Data are from the fall 2009 student surveys and high school transcripts of the *High School Longitudinal Study of 2009 (HSLS:09) 2013 Update and High School Transcripts Restricted-Use Data File* (Publication No. 2015038), U.S. Department of Education, National Center for Education Statistics. [a]Immigration status and parent involvement in school data were missing for 1,508 students out of the estimated population of 4,143,492. [b]Race categories exclude Hispanic origin, unless otherwise specified. [c]Includes students who self-identified as American Indian or Alaska Native, Native Hawaiian or Other Pacific Islander, or two or more races. [d]Measure is a derived indicator of participation in one of five national college access programs (Talent Search, Upward Bound, Gear Up, AVID, or MESA) during high school. [e]Data on peers taking college entrance exams were missing for 439 students out of the estimated population of 4,143,492. [f]Data on peers planning to attend college were missing for 1,273 students out of the estimated population of 4,143,492.

Trends Among College-Level Course Takers: Patterns Within Demographic Categories

In this section, we present the data in another way, as the percentages of students taking AP or IB and dual enrollment courses within each demographic category. Presenting the data in this way further highlights how college-level course taking varies across student populations, as prior literature has largely documented. Female and higher-SES students took AP or IB and dual enrollment courses at higher rates, first-generation immigrant students took AP or IB courses at a higher rate and dual enrollment courses at a lower rate, and Asian students took AP or IB courses at a much higher rate than all other racial groups. At the same time, they also took dual enrollment courses at the same rate as White students (see Figure 5 and Appendix B [Table B1]).

Patterns of course taking within race × SES subgroups are just as striking when seen from this perspective (see Figure 6 and Appendix B). For example, greater proportions of Asian students of all SES levels took AP or IB courses than students in all other racial/ethnic groups. Comparing across racial groups reveals that proportionally more Hispanic students than White students took AP or IB courses; the highest rate of dual enrollment course taking also occurred among Hispanic students with high SES. Moreover, even Asian students from low-SES backgrounds took college-level courses more often than African American students with high SES and White and Hispanic students with middle SES.

The results are also striking in that they highlight that Asian students of all SES levels are taking AP or IB courses at high rates, whereas students with low-SES backgrounds from other racial groups are not. Eighty-seven percent of Asian students with high SES took AP or IB courses. The proportion of Asian students with middle SES who took AP or IB courses (68%) was very close to the proportion of Hispanic students with high SES doing so (67%) and was higher than the proportions of students with high SES of all other racial backgrounds. The lowest rates of AP or IB course taking were seen among African American and White students of low-SES backgrounds.

Whereas fewer students took dual enrollment courses in all racial groups, like AP or IB course taking, more students of higher SES levels in each racial group took dual enrollment courses; the exception was African American students, who took dual enrollment courses at the same rate (6%), regardless of family SES. The highest rate of dual enrollment course taking (23%) was found among Hispanic students with high SES, followed by White students with high SES (16%). Although Asian students were especially overrepresented among AP or IB course takers, proportionally fewer took dual enrollment courses in high school.

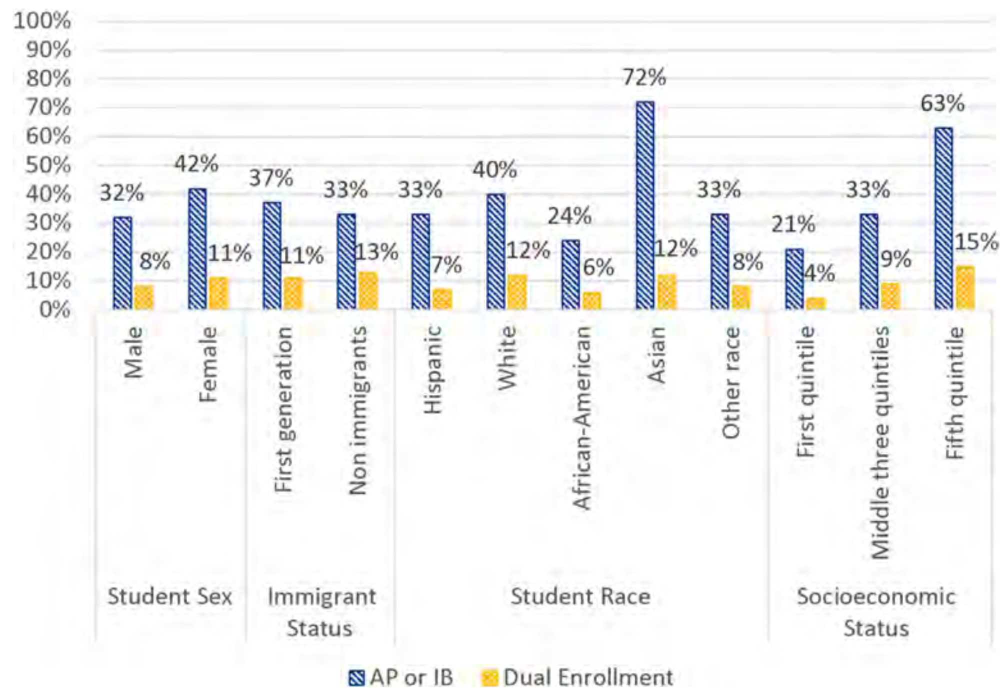

Figure 5 Proportion of students who took Advanced Placement or International Baccalaureate and dual enrollment courses by sex, immigrant status, race/ethnicity, and socioeconomic status. *Source*: U.S. Department of Education, National Center for Education Statistics, *High School Longitudinal Study of 2009 (HSLS:09) 2013 Update and High School Transcripts Restricted-Use Data File*.

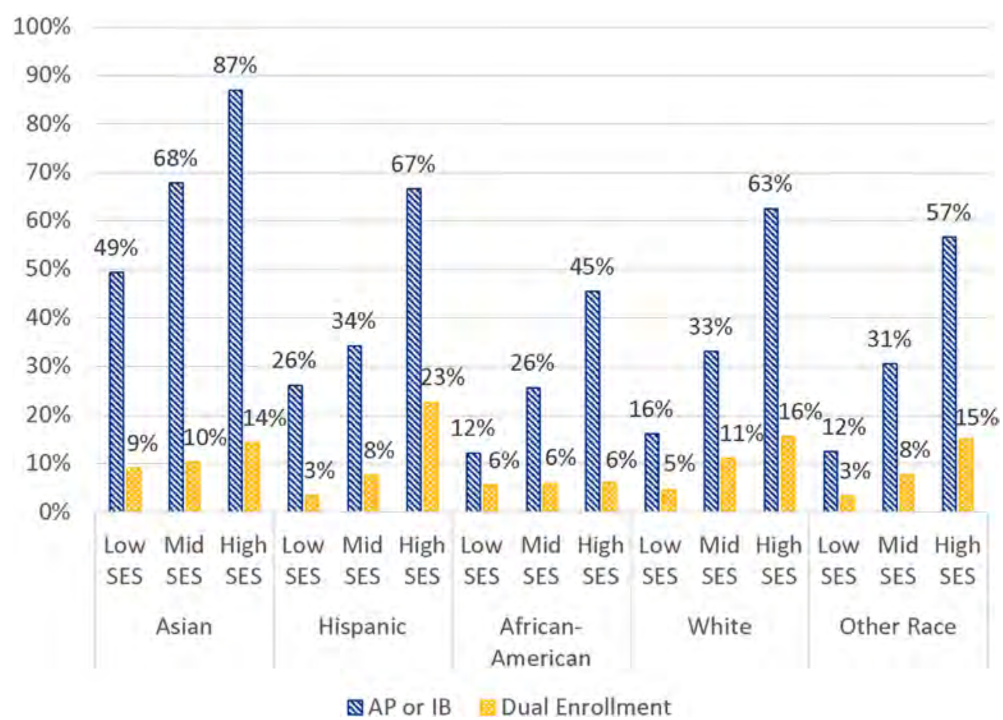

Figure 6 Proportion of students who took Advanced Placement or International Baccalaureate or dual enrollment courses, by socioeconomic status, within each racial or ethnic group. *Source*: U.S. Department of Education, National Center for Education Statistics, *High School Longitudinal Study of 2009 (HSLS:09) 2013 Update and High School Transcripts Restricted-Use Data File*.

Differences in Student, Family, and Peer Academic Influences and Skills Among Advanced Placement or International Baccalaureate and Dual Enrollment Course Takers

Our descriptive analyses also revealed that multiple student, family, and peer factors vary between AP or IB and dual enrollment course takers (see Table 3). Whereas ninth-grade math skills were higher among AP or IB and dual enrollment course takers than they were among the full student sample, they were highest among AP or IB course takers. More AP or IB and dual enrollment course takers also planned to attend college and to take college entrance examinations relative to the total student sample. Even more AP or IB course takers than dual enrollment course takers planned to take college entrance examinations. Compared to the full student sample, more AP or IB and dual enrollment course takers had involved parents and academically focused peers and talked to their friends, parents, and school staff about course taking and college plans. Each of these factors occurred more often among AP or IB course takers; the only exception was parent involvement in their child's school, which was more common among dual enrollment course takers than among AP or IB course takers.

Finally, we note that more White AP or IB and dual enrollment course takers had math teachers of the same racial background, whereas the opposite was true for the African American and Hispanic students. Whereas few Asian students had a math teacher of the same race, nearly twice as many Asian AP or IB course takers had Asian math teachers compared to Asian students overall.

Characteristics of the High Schools College-Level Course Takers Attend

This section briefly summarizes the differences in the characteristics of the high schools attended by students in the study who took AP or IB and dual enrollment courses (see Table 4).

Dual enrollment course takers came from schools with fewer students from disadvantaged backgrounds. Relative to all students in our sample, dual enrollment course takers more often attended schools with fewer than 20% of students qualifying for free or reduced-price lunch; this was the case even more often among AP or IB course takers. Proportionally more dual enrollment course takers than AP or IB course takers attended schools in which fewer than 20% of students identified as members of historically underrepresented racial groups or English language learners (ELLs).

School characteristics for AP or IB course takers did not vary much from those for dual enrollment course takers. Slightly more AP or IB course takers than dual enrollment course takers attended schools described as over capacity. The same was true for teacher qualifications: Slightly more AP or IB course takers attended schools in which at least 80% of teachers held at least a master's degree. Regarding location, more dual enrollment students than AP or IB students attended high schools in the midwestern or southern regions of the United States. In terms of our measures of school culture and school counselor views on the importance of course placement considerations, the data show few differences between schools attended by AP or IB and dual enrollment course takers.

In summary, descriptive analyses of the study data confirmed the trend that students and schools with lower levels of disadvantage are overrepresented in terms of college-level course taking. Consideration of SES and race together suggests differential patterns of course taking across demographic subgroups. Students who took dual enrollment looked somewhat different than those who took AP or IB, and they attended schools with somewhat different characteristics.

How Much Course Taking Variance is Explained by Student Versus School Factors?

Prior to specifying models to investigate factors that may predict college-level course taking in high school, we examined the extent to which variations in course taking rates are due to differences between students (e.g., Student A compared to Student B) or between the characteristics of the high schools that students attend (e.g., High School A compared to High School B). Multilevel modeling begins with such models, termed unconditional because they only include outcome variables, which estimate how much variance in an outcome is due to student characteristics and how much is due to school characteristics.

The unconditional model results indicate that most of the variance in students' likelihood of completing AP or IB college-level courses was due to differences between students (60%; see Table 5). In contrast, between-student (49%) and between-school (51%) differences accounted for nearly equal amounts of variance in the outcome of dual enrollment

Table 4 School-Level Characteristics of College-Level Course Takers: What Types of Schools Do They Attend?

Characteristic	Total		Took AP or IB courses		Took dual enrollment courses	
	N	Mean/%	*N*	Mean/%	*N*	Mean/%
Total	4,143,492	100.0	1,520,008	36.7	396,582	9.6
Percentage underrepresented minority						
0–19	1,646,625	39.8	608,120	40.0	188,507	47.5
20–39	798,178	19.3	319,570	21.0	99,519	25.1
40–59	721,967	17.4	256,875	16.9	55,953	14.1
60–79	489,604	11.8	176,657	11.6	32,352	8.2
80–100	486,080	11.7	158,366	10.4	20,251	5.1
Percentage ELL						
0–19	3,838,749	92.7	1,406,578	92.6	382,877	96.5
20–39	247,090	6.0	87,515	5.8	12,483	3.1
40–59	13,953	0.3	6,177	0.4	0	0.0
60–79	42,660	1.0	19,318	1.3	1,222	0.3
Percentage free/reduced-price lunch						
0–19	987,154	23.8	517,631	34.1	114,949	29.0
20–39	1,199,667	29.0	451,982	29.7	158,092	39.9
40–59	929,934	22.5	270,164	17.8	63,387	16.0
60–79	730,443	17.6	221,564	14.6	48,272	12.2
80–100	294,857	7.1	58,243	3.8	11,882	3.0
Percentage special education						
0–19	3,499,028	84.5	1,363,436	89.7	368,286	92.9
20–39	621,822	15.0	154,093	10.1	28,296	7.1
40–59	11,497	0.3	616	0.0	0	0.0
80–100	10,094	0.2	1,443	0.1	0	0.0
Percentage alumni enrolled in college[a]						
0–19	23,779	0.6	4,707	0.3	7,131	1.8
20–39	134,325	3.2	17,176	1.1	3,921	1.0
40–59	568,945	13.7	125,938	8.3	40,288	10.2
60–79	1,328,070	32.1	402,327	26.5	101,418	25.6
80–100	2,082,784	50.3	969,122	63.8	243,769	61.5
Percentage math teachers with master's degree or higher						
0–19	1,017,288	24.6	311,186	20.5	92,853	23.4
20–39	650,526	15.7	225,765	14.9	71,255	18.0
40–59	668,013	16.1	233,271	15.4	60,681	15.3
60–79	608,571	14.7	242,050	15.9	56,885	14.3
80–100	1,194,864	28.9	507,159	33.4	114,908	29.0
School over capacity[b]	575,473	15.5	263,058	17.3	61,659	15.5
Public school	3,846,197	92.8	1,365,795	89.9	365,034	92.0
School region						
West	947,822	22.9	341,905	22.5	75,747	19.1
Northeast	721,222	17.4	269,825	17.8	49,363	12.4
Midwest	919,021	22.2	317,913	20.9	97,488	24.6
South	1,555,426	37.5	590,365	38.8	173,984	43.9
School urbanicity						
Suburban	1,380,141	33.3	584,762	38.5	122,782	31.0
Urban	1,808,133	43.6	645,877	42.5	153,320	38.7
Rural	955,218	23.1	289,369	19.0	120,480	30.4

Table 4 Continued

Characteristic	Total		Took AP or IB courses		Took dual enrollment courses	
	N	Mean/%	*N*	Mean/%	*N*	Mean/%
School course offerings						
AP or IB or dual enrollment	4,141,775	99.4	1,519,082	100.0	396,563	100.0
AP or IB	3,776,804	91.2	1,497,001	98.5	357,830	90.2
Dual enrollment	3,586,679	86.6	1,277,014	84.0	387,743	97.8
School culture						
Lack of parent involvement[c]	4,143,116	2.5	1,519,811	2.3	396,582	2.3
Teacher culture/expectations[d]	4,138,682	1.8	1,519,005	1.8	396,582	1.9

Note. AP = advanced placement; ELL = English language learner; IB = International Baccalaureate. Data are from fall 2009 counselor, school administrator, and teacher surveys and spring 2012 counselor surveys and high school transcripts of the *High School Longitudinal Study of 2009 (HSLS:09) 2013 Update and High School Transcripts Restricted-Use Data File* (Publication No. 2015038), U.S. Department of Education, National Center for Education Statistics. [a]Measure of the percentage of alumni enrolled in college combining school administrator responses to survey items inquiring about the percentages of 2008–2009 seniors enrolling in 2-year or 4-year colleges. [b]An indicator of a school serving over 100% of the number of students for which the facility was designed based on an item on the school administrator survey asking for the percentage of capacity to which the school is filled. [c]Combines teacher, school administrator, and school counselor responses to a survey item inquiring about the extent to which a lack of parent involvement is problematic at the school. [d]Combines teacher survey items asking teachers to rate the extent to which teachers in the school set high standards for teaching and learning, believe all students can do well, have given up on some students, care only about smart students, expect little from students, and work hard to make sure all students learn.

Table 5 Fully Unconditional Models of Outcomes of Advanced Placement or International Baccalaureate and Dual Enrollment Course Taking and Number of Courses Taken

Outcome	Took AP or IB courses	Took DE courses	Took AP, IB, or DE courses	No. AP or IB courses taken	No. DE courses taken	No. AP or IB or DE courses taken
Between-classroom variance (σ^2)	1.000	1.000	1.000	3.981	2.613	4.837
Between-school variance (τ)	2.205	3.378	2.126	1.414	1.391	1.584
Total variance	3.205	4.378	3.126	5.394	4.004	6.421
Proportion of variance between students within schools[a]	0.599	0.493	0.607	0.774	0.653	0.753
Proportion of variance between schools (ICC)[b]	0.401	0.507	0.393	0.226	0.347	0.247

Note. AP = advanced placement; DE = dual enrollment; IB = International Baccalaureate; ICC = intraclass correlation. Data are from fall 2009 student, counselor, school administrator, and teacher surveys and spring 2012 counselor surveys and high school transcripts of the *High School Longitudinal Study of 2009 (HSLS:09) 2013 Update and High School Transcripts Restricted-Use Data File* (Publication No. 2015038), U.S. Department of Education, National Center for Education Statistics. [a]For linear models (no. of courses) $= 1 - (\tau/(\tau + \sigma^2))$; for logistic models (took courses) $= 1 - (\tau/\tau + (\pi^{2/3}))$. [b]ICC for linear models (no. of courses) $= \tau/(\tau + \sigma^2)$; ICC for logistic models (took courses) $= \tau/\tau + (\pi^{2/3})$.

course taking. These results reveal that taking AP or IB courses is driven to a larger extent by differences between students, whereas dual enrollment course taking is driven almost equally by differences between students and differences between schools.

Unconditional models of numbers of college-level courses taken, used in models restricted to subsamples of students who took each type of course or courses, suggest a slightly different story. The number of AP or IB courses completed by course takers appears to be mostly driven by student-level factors (77%), as does the number of dual enrollment courses completed by course takers (65%). In other words, the majority of the variance in the number of courses taken may be due to differences between students, and a lesser portion of the variance may be due to differences between schools.

Overall, between-school factors explain less of the variance in whether students participate in college-level courses in high school and even less of the variance in the number of courses taken. School-level factors account for greater variation in overall course taking and the number of AP or IB courses taken; in contrast, dual enrollment course taking varies almost equally at the student and school levels of the model. T he substantial amount of between-school variance in the study outcomes confirms the need to employ multilevel modeling to examine college-level course taking with students nested within schools.

Factors Predicting Whether Students Take Advanced Placement or International Baccalaureate and Dual Enrollment Courses

In this section, we discuss the results of the final multilevel models predicting AP or IB and dual enrollment course taking in high school; these models included the full set of student- and school-level predictors (see Table 6), added in steps in previous models.[12] Readers interested in the results of all models of AP or IB and dual enrollment course taking should refer to Tables C1–C4. Finally, we note that because we are discussing only the results for the final models, they account for the influence of all other student- or school-level predictors in the models.

Table 6 Final Multilevel Models: Student- and School-Level Factors Predicting Advanced Placement or International Baccalaureate and Dual Enrollment Course Taking (Odds Ratios)

Factor	AP or IB courses	Dual enrollment
Student-level equation		
Intercept	0.012***	0.004***
First-generation immigrant	1.416**	1.218
Male	0.588***	0.669***
Race[a] (ref.: White)		
African American	0.638	0.687
Hispanic	0.915	1.206
Asian	1.763	1.046
Other race[b]	0.708	1.142
SES	1.291***	1.191
African American × SES	0.801	0.510*
Asian × SES	0.782	0.865
Hispanic × SES	1.088	1.343
Other Race × SES	0.863	1.176
Ninth-grade math test score	2.651***	1.808***
Student academic focus		
College access program participation	1.027	1.004
Plans to take college exams	1.663***	0.992
Plans to enroll in college	1.318**	1.501**
Parent involvement		
Parent supports academic focus	1.617**	1.373
Parent involvement in school	1.010	1.621
Peer academic focus		
Peers take college entrance exams	1.710***	1.372*
Peers plan to attend college	1.438***	0.983
Student discusses course taking		
Talks to friends about academics	0.861	1.130
Talks to parents about academics	1.921***	1.093
Talks to school staff about academics	1.142	1.086
Same-race math teacher		
White	1.015	1.328
African American	1.128	1.811
Hispanic	1.400	1.297
Asian	1.401	2.035

Table 6 Continued

Factor	AP or IB courses	Dual enrollment
School-level equation		
Percentage underrepresented minority	1.016***	1.000
Percentage ELL	1.003	1.016
Percentage free/reduced-price lunch	0.995	0.998
Percentage special education	0.973	0.971
Percentage alumni enrolled in college[c]	1.003	0.982*
School over capacity[d]	0.832	1.079
Percentage math teachers with master's degree or higher	1.214	1.382
Public school (ref.: Private school)	1.496	0.375
School region (ref.: West)		
Northeast	1.511	0.636
Midwest	1.305	0.866
South	1.691*	1.089
School urbanicity (ref.: suburban)		
Urban	1.000	0.977
Rural	0.654*	1.098
School culture		
Lack of parent involvement[e]	0.890	1.004
Teacher culture/expectations[f]	0.828	1.370
Random effects: Variance components: Intercept	0.862	3.404

Note. The table presents odds ratios; outcome variables are whether the student earned any Advanced Placement or International Baccalaureate course credits or any dual enrollment course credits during high school. Note that, the intercept values are not a focus of this study; however, for those interested in their interpretation, the intercept is the value when all continuous variables are equal to their average and the dichotomous (0 or 1) variables are 0, such that the reference group is modeled. Models also controlled for course access, specific to the college-level course type being modeled, but the confidence intervals were so wide that results could not be interpreted; thus, they are not included in this table. AP = Advanced Placement; ELL = English language learner; IB = International Baccalaureate; SES = socioeconomic status. Data are from fall 2009 student, school administrator, and teacher surveys and spring 2012 counselor surveys and high school transcripts of the *High School Longitudinal Study of 2009 (HSLS:09) 2013 Update and High School Transcripts Restricted-Use Data File* (Publication No. 2015038), U.S. Department of Education, National Center for Education Statistics.
[a] Race categories exclude Hispanic origin, unless otherwise specified. [b] Includes parents who self-identified as American Indian or Alaska Native, Native Hawaiian or Other Pacific Islander, or two or more races. [c] Combines school administrator responses to survey items on the percentages of 2008–2009 seniors enrolling in 2-year or 4-year colleges. [d] An indicator of a school serving over 100% of the number of students for which the facility was designed based on an item on the school administrator survey asking for the percentage of capacity to which the school is filled. [e] Combines teacher, school administrator, and school counselor responses to a survey item inquiring about the extent to which a lack of parent involvement is problematic at the school. [f] Combines teacher survey items asking teachers to rate the extent to which teachers in the school set high standards for teaching and learning, believe all students can do well, have given up on some students, care only about smart students, expect little from students, and work hard to make sure all students learn. $^{*}p < .05$. $^{**}p < .01$. $^{***}p < .001$.

Student- and School-Level Factors Predicting Advanced Placement or International Baccalaureate Course Taking

Student Demographics and Prior Math Achievement

Our results indicate that ninth-grade math skills, gender, and immigrant status may be stronger predictors of AP or IB course taking than family SES. Greater math skills, as measured by the HSLS:09 ninth-grade mathematics assessment, were associated with 165% higher odds of completing any AP or IB courses.[13] Male high school students had 41% lower odds than their female peers of taking AP or IB courses. Students whose parents were first-generation immigrants had 42% higher odds of taking AP or IB courses relative to students whose parents were born in the United States. Family SES was also significantly associated with AP or IB course taking, but to a lesser extent and only for White students. Whereas higher SES predicted 29% greater odds of AP or IB course taking for every 1 standard deviation [*SD*] increase in family SES for White students, there was no association between SES and AP or IB course taking for students of other racial backgrounds.

Student, Parent, and Peer Academic Focus and Support

Among the set of variables measuring the support and academic focus of parents, peers, and students themselves, family encouragement of math or science course taking was the strongest predictor of AP or IB course taking. Student and peer academic focus or plans were also significantly associated with AP or IB course taking, just to a lesser extent. In contrast, parent involvement in school activities was not a significant predictor of AP or IB course taking.

The measure of students talking with parents about course taking and college plans was associated with 93% higher odds of students taking AP or IB courses; in other words, students who talk with parents about courses and college are almost twice as likely to complete an AP or IB course. Parent encouragement of math or science course taking was associated with 61% higher odds of AP or IB course taking.

Students' own college plans, which could be expected to be related to their high school course choices, are also significantly associated with having taken AP or IB courses. Students with plans to take college entrance exams had 67% higher odds of taking AP or IB courses. Students having plans to attend college had 32% higher odds of taking AP or IB courses relative to students without such plans.

Peer academic behaviors also appear to predict students' AP or IB course taking; having friends who took college exams predicted 71% higher odds of taking AP or IB courses; having friends planning to go to college predicted 44% higher odds of taking AP or IB courses.

School Influences on Students' Advanced Placement or International Baccalaureate Course Taking

Three school-level factors significantly predicted whether 2009 ninth graders took AP or IB courses during their 4 years in high school. In the final model, students in schools in the southern region of the United States had 74% higher odds of taking AP or IB courses relative to students in the northeastern region of the United States. Students attending a rural high school had 34% lower odds of taking AP or IB courses compared to students attending a suburban high school. While a higher percentage of African American and Hispanic students in a high school student body was significantly associated with the odds of AP or IB course taking, the 2% greater likelihood was too small to be meaningful.

Student- and School-Level Factors Predicting Dual Enrollment Course Taking

In this section, we summarize the significant results of the final model predicting the odds of taking at least one dual enrollment course during the high school years (see Table 6).

Student Demographics and Prior Math Achievement

In general, fewer factors in our analysis models were significantly associated with dual enrollment course taking compared to the results of models predicting AP or IB course taking. Ninth-grade math skills predicted dual enrollment course taking to a lesser extent than they did for AP or IB course taking, yet they were still the strongest predictor in our models for both outcomes. Students with higher ninth-grade math test scores had 82% higher odds of taking dual enrollment courses.

The only demographic factors that predicted dual enrollment high school course taking were gender and family SES, and the latter only predicted dual enrollment course taking for African American students. Compared to their female peers, male students had 33% lower odds of taking dual enrollment courses. Similar to the models of AP and IB course taking, gender was more strongly associated with the odds of dual enrollment course taking than family SES. However, whereas SES predicted higher odds of AP or IB course taking for White students, it was not associated with the odds of White students taking dual enrollment courses (i.e., White students from lower- and higher-SES backgrounds were equally as likely to take dual enrollment courses). Also unlike the models of AP or IB course taking, higher family SES predicted lower odds of dual enrollment course taking for African American students. For each 1 *SD* increase in family SES, African American students had 29% lower odds of taking a dual enrollment course relative to a White student of the same SES background. In contrast, students of all other racial backgrounds were not more or less likely to take dual enrollment courses, regardless of family SES.

Student, Parent, and Peer Academic Focus and Support

Whereas six student, peer, and parent predictors were significantly associated with AP or IB course taking, only two significantly predicted dual enrollment course taking. Though parent involvement and conversations with parents about course taking and college predicted AP or IB course taking, neither significantly predicted dual enrollment course taking. The peer measure of having friends who planned to take college entrance examinations predicted 38% greater odds of a student taking a dual enrollment course. Unlike for AP or IB course taking, student academic focus, as measured by student plans to take college entrance exams, was not significant in any models. Student plans to enroll in college were associated with 49% higher odds of taking at least one dual enrollment course.

School Factors

School characteristics that predicted AP or IB course taking did not predict dual enrollment course taking in high school. In fact, in the final model, none of the many included school characteristics significantly predicted whether a student took a dual enrollment course.

Factors Predicting the Number of Courses Taken

In this section, we present the results of the final models examining (a) factors associated with the number of AP or IB courses taken by AP or IB students and (b) the number of dual enrollment courses taken by dual enrollment students

Table 7 Final Models: Student- and School-Level Predictors of Advanced Placement or International Baccalaureate and Dual Enrollment Students Taking More Advanced Placement or International Baccalaureate and Dual Enrollment Courses (Respectively)

Predictors	AP or IB courses	Dual enrollment
Student-level equation		
Intercept	0.896	0.014***
First-generation immigrant	1.015	1.389
Male	0.923**	0.863
Race[a] (ref.: White)		
African American	0.998	0.636
Hispanic	1.145	0.836
Asian	1.364**	0.870
Other race[b]	1.042	0.700
SES	1.080***	1.080
African American × SES	0.881*	1.041
Asian × SES	0.990	0.917
Hispanic × SES	1.002	1.270
Other Race × SES	1.048	1.029
Math test score	1.305***	1.400***
Student academic focus		
College access program participation	0.991	0.903
Plans to take college exams	1.197***	1.075
Plans to enroll in college	1.044	1.237
Parent involvement		
Parent supports academic focus	1.101**	1.318*
Parent involvement in school	1.076	1.246
Peer academic focus		
Peers take college entrance exams	1.108*	1.010
Peers plan to attend college	1.066	1.118
Student discusses course taking		
Talks to friends about academics	1.049	1.165
Talks to parents about academics	1.104	0.771
Talks to school staff about academics	1.027	1.040
Same-race math teacher		
White	1.050	0.902
African American	0.967	0.243
Hispanic	0.852	1.393
Asian	0.953	1.250

Table 7 Continued

Predictors	AP or IB courses	Dual enrollment
School-level equation		
Percentage underrepresented minority	1.003	1.004
Percentage ELL	1.002	1.003
Percentage free/reduced-price lunch	1.000	0.984
Percentage special education	1.003	1.011
Percentage alumni enrolled in college[c]	1.005*	0.977*
School over capacity[d]	1.128*	0.890
Percentage math teachers with master's degree or higher	1.265**	0.772
Public school (ref: Private school)	1.153	0.312*
School region (ref.: West)		
Northeast	0.976	0.564
Midwest	0.820*	0.611
South	1.073	0.936
School urbanicity (ref.: suburban)		
Urban	1.070	0.771
Rural	0.883	1.394
School culture		
Lack of parent involvement[e]	1.055	1.058
Teacher culture/expectations[f]	1.003	1.236
Random effects: Variance components: Intercept	0.093***	4.094***

Note. The table presents incident rate ratios from hierarchical generalized linear modeling with a Poisson distribution. Outcome variables are the number of AP or IB courses and the number of dual enrollment courses completed during high school. Models of the number of AP or IB courses taken were run on samples limited to AP or IB students, whereas models of the number of dual enrollment courses taken were run on samples limited to dual enrollment students. Note that the intercept values are not a focus of this study; however, for those interested in their interpretation, the intercept is the value when all continuous variables are equal to their average and the dichotomous (0 or 1) variables are 0, such that the reference group is modeled. Models also controlled for course access, specific to the college-level course type being modeled, but the confidence intervals were so wide that results could not be interpreted; thus, they are not included in this table. AP = Advanced Placement; ELL = English language learner; IB = International Baccalaureate; SES = socioeconomic status. Data are from fall 2009 student, school administrator, and teacher surveys and spring 2012 counselor surveys and high school transcripts of the *High School Longitudinal Study of 2009 (HSLS:09) 2013 Update and High School Transcripts Restricted-Use Data File* (Publication No. 2015038), U.S. Department of Education, National Center for Education Statistics. *$p < .05$. **$p < .01$. ***$p < .001$. [a]Race categories exclude Hispanic origin, unless otherwise specified. [b]Includes parents who self-identified as American Indian or Alaska Native, Native Hawaiian or Other Pacific Islander, or two or more races. [c]Combines school administrator responses to survey items inquiring about the percentages of 2008–2009 seniors enrolling in 2-year or 4-year colleges. [d]An indicator of a school serving over 100% of the number of students for which the facility was designed based on an item on the school administrator survey asking for the percentage of capacity to which the school is filled. [e]Combines teacher, school administrator, and school counselor responses to a survey item inquiring about the extent to which a lack of parent involvement is problematic at the school. [f]Combines teacher survey items asking teachers to rate the extent to which teachers in the school set high standards for teaching and learning, believe all students can do well, have given up on some students, care only about smart students, expect little from students, and work hard to make sure all students learn.

(Table 7). Variables were added in steps in prior models, beginning with student demographics in Model 1 and ending with all student and school variables in Model 10. Readers interested in all prior models of the number of AP or IB and dual enrollment courses taken by students who took each type of course should refer to Tables D1–D4.

To facilitate interpretation of the results, model coefficients have been exponentiated. This means that their values can be interpreted as incident rate ratios, which tell you how changes in a given factor affect the number of AP or IB and dual enrollment courses taken by those who took each type of course.

Student- and School-Level Factors Predicting the Number of Courses Taken

Student Demographics

Ninth-grade math skills proved to be a strong predictor of the number of AP or IB courses taken, as it did in models predicting whether students took any of these courses at all. Differences remained apparent by race, SES, and gender, even after accounting for the full set of factors included in our models.

Our results suggest that ninth-grade math skills may be the strongest predictor of the number of courses taken by AP or IB course takers. AP or IB students with higher ninth-grade math skills were predicted to take 30% more AP or IB courses. Race and SES were significant predictors, even after accounting for all other factors included in our study. Asian students who took AP or IB courses were predicted to take 36% more AP or IB courses than their White peers. Although we found that for each 1 *SD* increase in SES for White students who take AP or IB courses, they were predicted to take 8% more AP or IB courses, we found the opposite for African American students. For each 1 *SD* increase in SES for African American students who took AP or IB courses, they took 12% fewer AP or IB courses than their White peers of the same SES level.

Gender remained a significant predictor of the number of AP or IB courses taken by course takers, but the gender discrepancy in the number of courses taken was not as large as it was in models of whether students took AP or IB courses. Male students who took AP or IB courses were predicted to take only 8% fewer AP or IB courses than their female peers.

Student, Parent, and Peer Academic Focus and Support

In the final model, several measures of student and peer academic focus and parent involvement significantly predicted the number of AP or IB courses taken by AP or IB students. Student plans to take college entrance exams were associated with 20% more AP or IB courses taken. Family encouragement for math and science course taking predicted that AP or IB students would take 11% more courses. Students with peers who plan to take college entrance exams were predicted to take 11% more AP or IB courses as well.

School Factors

Four school characteristics were significantly associated with the number of AP or IB courses taken. Students in schools with a larger number of math teachers with advanced degrees were predicted to take 26% more AP or IB courses. AP or IB students in overcrowded schools were predicted to take 13% more AP or IB courses. Students attending schools in the midwestern region of the United States were predicted to take 18% fewer AP or IB courses relative to students in the Northeast. Although the measure of percentage of alumni enrolled in college was a significant predictor of students taking more AP or IB courses, the percentage increase was so small (0.5%) that it was not meaningful.

Student- and School-Level Factors Predicting the Number of Dual Enrollment Courses Taken by Dual Enrollment Students

We present only the results of the final model of factors associated with dual enrollment students choosing to take a greater or lesser number of dual enrollment courses in high school. As was the case for the results presented earlier, the results we discuss account for all other student- or school-level predictors in the final regression model (see Table 7).

Unlike the model predicting the number of AP or IB courses taken, only four factors—student math skills, family encouragement to take math and science courses, whether the student attended a public high school, and percentage of high school alumni enrolled in college—significantly predicted the number of dual enrollment courses completed by dual enrollment students. In the final model, dual enrollment students with higher ninth-grade math skills were predicted to complete 40% more dual enrollment courses than their peers with fewer math skills by ninth grade. Students with families that encouraged them to take math and science courses took 32% more dual enrollment courses. Dual enrollment students in public high schools took 69% fewer dual enrollment courses than their dual enrollment student peers attending private high schools. Although the measure of the percentage of high school alumni enrolled in college predicted 2% fewer dual enrollment courses taken, this difference is so small that it is not meaningful.

Study Limitations

This study contributes to the literature on college-level high school course taking through a rich examination of the influence of student, family, peer, and school factors on AP or IB and dual enrollment course taking and completion. As with any study, there are some limitations to our research. First, this study is exploratory in nature and thus does not support causal inferences in terms of relationships between student, family, peer, and school factors and college-level course taking patterns (Schneider et al., 2007). Although we included a large number of predictors in the models we tested, we acknowledge that there may be additional unobservable characteristics or measures of constructs not available in the HSLS:09 data set. Other, unaccounted-for factors at play in the course taking decisions of students may include planned career field, local employment prospects, and college enrollment prospects or proximity (Clotfelter et al., 2020).

This limitation is especially pertinent to our examination of dual enrollment course taking, as the set of factors included in our models was better able to explain AP or IB course taking compared to dual enrollment. This may be related to the vocational education component of dual enrollment—nearly 30% of dual enrollment students were enrolled in vocational or CTE courses in 2010–2011 (Thomas et al., 2013). We found that AP or IB and dual enrollment course taking and course completion patterns were explained by divergent sets of predictors, which not only informs recommendations for policies and practices to support more equitable course taking but also underscores the need for separate examinations of what influences AP or IB and dual enrollment course taking. In future related studies, the academic and CTE tracks of dual enrollment could be explored separately, given their differing aims and, accordingly, differing levels of focus on college preparation and academic rigor.

Moreover, the models may not have accounted for some school factors relevant to college-level course taking rates. One example is differences in school resources available to support the development and expansion of AP programs, and IB programs in particular, due to the requirement to offer the full IB Diploma Programme. In the case of dual enrollment, schools may face an additional challenge not accounted for in our models in terms of the need to partner with a local college or university. Such information may best be gathered through qualitative research, as is the case for other unaccounted-for factors, such as students' motivations for course taking decisions and the extent to which courses were truly available and accessible to them.

Although our models controlled for access to the type of college-level course being modeled, it was also the case that there was little variability in this measure across schools; the majority of high school counselors surveyed for the HSLS:09 study indicated that their schools offered AP or IB and/or dual enrollment college-level courses. However, we should note the limitation of this self-report survey item, which by its nature does not account for complex situations. For example, although some schools may indicate in a course catalog that they offer certain college-level courses, and thus qualify for a "yes" response to the HSLS:09 counselor survey item on this topic, the courses may be offered only every few years. Theokas and Saaris (2013) discussed how schools may be categorized as affording access to AP programs with only one student participating. Furthermore, given the saturation in "access" to most college-level course taking programs across U.S. schools, they suggested paying more attention to the size of the AP program, as this indicator may be more sensitive to marginalized students being left out of these opportunities despite being qualified. This may explain in part why higher-SES African American AP or IB students took fewer such courses than their White peers, leading us to conclude that future studies should include a measure of the number of college-level courses available at the school, not only whether the school offers such courses.

Finally, although we do account for prior academic achievement by including each student's score on the HSLS:09 ninth-grade mathematics assessment, our study was not able to account for the myriad differences in prior educational opportunities influencing these scores. It is well documented that there are inequities in the opportunities to learn due to variations in school and teaching quality and that these inequities may result in lower achievement rates for students from marginalized populations (Hanushek et al., 2016; Rivkin et al., 2005). We could not account in our statistical models for these inequities or for factors like tracking and its influence on levels of preparation for college-level high school courses.

Summary and Conclusions

We designed this study to investigate which student, parent, peer, and school factors predict college-level course taking during high school for the AP and IB programs combined and for dual enrollment courses. We included a large number of variables in our models to account for the many factors previously shown to be associated with high school course choices and academic trajectories. Given the large number of variables and the two types of outcomes (whether students took college-level courses and the number taken by those who did) and two focal programs (AP or IB and dual enrollment), we present in what follows a summary of the significant findings from all models (see Table 8) to highlight which factors predicted which of the four outcomes.

Across the results of all final models, only ninth-grade math skills consistently predicted greater odds of taking AP or IB and dual enrollment courses and the number of courses taken by course takers (see Table 8). Gender also had a relatively

Table 8 Summarizing Across Analyses: Student, Family, Peer, and School Factors Significantly Predicting Whether Students Earn Credits in Advanced Placement or International Baccalaureate and Dual Enrollment Courses and Number of Courses Taken by Course Takers

Factor	AP or IB Y/N	AP or IB No. courses	Dual enrollment Y/N	Dual enrollment No. courses
Student factors				
Student focus on academics	+	+	+	
Ninth-grade math skills (HSLS:09 math exam)	+	+	+	+
SES	+	+		
Asian × SES		+		
African American × SES		−	−	
Male	−	−	−	
First-generation immigrant	+			
Parent support for academic focus	+	+		+
Peer focus on academics	+	+	+	
School factors				
Ninth-grade math teachers with advanced degrees		+		
High school with higher percentage alumni attending college		+	−	−
High school over capacity		+		
High school region (Midwest)		−		
High school region (South)	+			
Rural high school	−			
Public high school				−

Note. Shading indicates associations with student course taking (yes/no outcome used in multilevel logistic regression models), whereas no shading indicates associations with the number of courses taken by course takers (count outcome used in multilevel Poisson regression models). AP = Advanced Placement; HSLS:09 = High School Longitudinal Study of 2009; IB = International Baccalaureate; SES = socioeconomic status; Y/N = yes/no. Data are from fall 2009 student, school administrator, and teacher surveys and from high school transcripts of the *High School Longitudinal Study of 2009 (HSLS:09) 2013 Update and High School Transcripts Restricted-Use Data File* (Publication No. 2015038), U.S. Department of Education, National Center for Education Statistics.

consistent association with AP or IB and dual enrollment course taking across the different models and outcomes; males had lower odds of taking AP or IB and dual enrollment courses, and among students who did take AP or IB courses, males were predicted to take fewer AP or IB courses than their female peers. Family SES subgroups were only associated with course taking for White, Asian, and African American students. Students' own focus on an academic, college-preparatory path positively predicted whether they took AP or IB courses and, for those who took them, the number of AP or IB courses they took. The extent to which their friends were focused on such a path was associated with students' own likelihood of taking AP or IB and dual enrollment courses. Whereas having friends focused on academics predicted more AP or IB courses taken by AP or IB students, the same association was not found between peer academic focus and the number of dual enrollment courses taken by dual enrollment students.

Relatively few school factors were associated with the likelihood of college-level high school course taking. High school characteristics, including the proportion of mathematics teachers with advanced degrees, predicted the number of AP or IB courses taken by AP or IB students. However, these factors did not predict whether students took AP or IB or dual enrollment courses or the number of dual enrollment courses completed by dual enrollment students. High school regional location and location in a rural area were found to be associated with the likelihood of students taking AP or IB, but not dual enrollment, courses. Compared to students attending high schools in the northeastern region of the United States, students attending high schools in the southern United States had higher odds of taking AP or IB courses. AP or IB students attending midwestern high schools were predicted to take fewer AP or IB courses than AP or IB students attending wesstern high schools. Students attending rural high schools had lower odds of taking any AP or IB courses compared to their peers in suburban high schools. Finally, the models predicted that dual enrollment students attending public high schools would take fewer dual enrollment courses than dual enrollment students attending private schools.

We contend that the study results extend the literature in several important ways. First, they suggest that there are similarities and differences in the factors that predict whether students take AP or IB and dual enrollment courses and in the number of courses taken by those who do take them. They also highlight that many factors other than race and

SES may more strongly predict whether students complete AP, IB, or dual enrollment courses and how many they end up completing. And, most importantly, the findings on which factors most strongly predict course taking have implications for how to design and refine intervention programs to increase equitable rates of college-level high school course taking.

In the following sections, we discuss the implications of our findings, given what else is known about each predictor of AP, IB, or dual enrollment course taking. We then end with suggestions for real-world actions based on our findings and other related research.

How Does Socioeconomic Status Factor Into Racial Disparities in College-Level High School Course Taking?

As we noted at the outset of the study, racial and income disparities in college-level high school course taking are well documented (College Board, 2014; Corra et al., 2011; Klugman, 2013; Kolluri, 2018; Musu-Gillette et al., 2017; Shivji & Wilson, 2019). Prior to estimating models of factors predicting college-level course taking, we conducted simple descriptive analyses of the AP, IB, and dual enrollment course taking rates of students from families with low-, middle-, and high-SES backgrounds identifying with often-used racial and ethnic group categories (i.e., African American, Hispanic, Asian, and White). As expected, we found that within racial groups, higher-SES high school students take college-level courses more often. This result aligns with extensive data highlighting the many advantages conveyed by growing up in a family with higher SES (Lam, 2014). However, this socioeconomic advantage does not appear to be consistent across racial and ethnic groups. Our analyses of the HSLS:09 data show that fewer than half of African American students from high-SES families take AP or IB courses in high school. Not only is this less than the proportion of White and Asian students from high-SES families that do so; it is also less than the proportion of Asian students from families with low SES who take AP or IB courses (see Figure 6).

In fact, the majority of Asian students with high SES, far more than any other subgroup, take AP or IB courses in high school. This finding aligns with studies showing that Asian students are generally some of the most high achieving in the United States as a group (Baker et al., 2016). When we looked at demographic trends among AP or IB course takers, we found that proportionally more Asian students of all family SES levels took AP or IB courses relative to students of all other racial backgrounds. Thus our findings seem to confirm that (a) the relative advantage of higher SES is lower for African American students than it is for White and Asian students and (b) more Asian students of all SES backgrounds are focused on high levels of academic achievement and college preparation.

Whereas our findings regarding the course taking patterns of African American and Asian students tend to align with previously identified achievement trends for these groups, our study findings regarding Hispanic students do not necessarily confirm previously documented trends of lower academic achievement. When we looked at demographic trends among AP or IB course takers, we found that Hispanic students at all family SES levels—low, middle, and high—took AP or IB courses at higher rates than White students from the same SES group. This may in part be due to the high rates at which Hispanic students take the AP English Language and Composition and AP Spanish Language and Culture courses; our calculations using 2019 AP data on completion rates for these courses seem to confirm this trend (College Board, 2019c). Our descriptive findings also reveal that Hispanic students with high SES had the highest rate of dual enrollment course taking of all racial and SES subgroups. This trend is likely not due to their greater participation in CTE dual enrollment courses, given that national data indicate that proportionally fewer Hispanic students take CTE courses compared with their White and African American peers (NCES, 2020). Thus Hispanic students may be taking college-preparatory, academically focused dual enrollment courses more often than their peers from other racial and ethnic backgrounds.

The results of our multilevel models, discussed next, help us to better understand the strength of associations between course taking, race, and SES in the context of a broad range of student, peer, family, and school factors. They also clarify to what extent each of these factors predict AP, IB, and DE course taking when all factors are analyzed together.

Which Student, Family, Peer, and School Factors Matter for College-Level High School Course Taking?

The results of the multilevel models present a complex picture of student, parent, peer, and school characteristics and factors that predict college-level high school course taking. Across all models, more student- than school-level factors were associated with course taking. In fact, the unconditional models (i.e., models of only the outcome) revealed that overall variation in taking AP or IB courses is driven to a larger extent by differences between students, whereas dual enrollment course taking is driven almost equally by differences between students and differences between schools.

Student Prior Achievement and Demographic Factors

Students' academic skills and their demographic backgrounds were significant predictors of AP or IB and dual enrollment course taking. In our models, the race × SES measures were weaker predictors of college-level high school course taking than math skills, gender, and—for AP or IB only—first-generation immigrant status.

Ninth-grade math skills, a proxy for prior academic achievement (Martin & Mullis, 2013) and, accordingly, prior educational experiences, more strongly predicted AP or IB and dual enrollment course taking than other factors in the final models. Among students who took each type of course, those with higher scores on the HSLS ninth-grade math test were predicted to take more AP or IB and dual enrollment courses, respectively. This finding may speak to the influence of and inequities in earlier academic experiences, including school and teacher quality (Goe, 2007), family support (Gottfried et al., 2017), and tracking practices (Kelly & Price, 2011). It also points to a potential opportunity to increase AP or IB and dual enrollment course taking through more early support for math and other academic skills.

Gender was also one of the most significant predictors of the odds of taking AP or IB and dual enrollment courses. Girls more often take AP, IB, or dual enrollment courses, and they take more of them compared to boys. This finding aligns with other research on the greater advanced course taking rates of girls more generally (Riegle-Crumb et al., 2006). It may also speak to the cultural shift toward more young women entering and completing college relative to their male counterparts (Flashman, 2013; Irwin et al., 2021). In either case, it suggests a need for additional supports and encouragement for high school boys to take rigorous courses and for more targeted supports for academically struggling middle and elementary school boys, including promising practices previously identified by researchers (Clark et al., 2008).

The race × SES variables in our regression analysis suggested that, compared to their White peers from lower-SES backgrounds, higher-SES White students were more likely to take AP or IB courses, and they took more of them when they took any at all. Asian students from families of average SES were predicted to take more AP or IB courses than their White peers from families of average SES. We found no such differences for the number of dual enrollment courses taken.

These findings were not unexpected. However, we did not expect to find that, even after accounting for the many other factors in our models, higher-SES African American students may be less likely to take dual enrollment courses, and those who take AP or IB courses may take fewer of them than their higher-SES peers of other races.

The fact that racial and SES inequities were still predicted even given the broad range of factors in our models compels us to briefly discuss the broader context of inequities in educational outcomes. In addition to cultural and parenting differences (Kim & Wong, 2002; Pong et al., 2005), the persistent racial differences we identified are likely related to structural inequalities in society more broadly (Ayscue & Orfield, 2015; Klugman, 2013; Orfield & Lee, 2005). These inequalities may be the result of long-standing racial biases and stigmas that have translated into educational inequality (Steele, 1997; Tatum, 2017). Differences in college-level high school course taking rates by SES clearly highlight the advantages associated with middle and upper social class membership. These advantages include parental education (Beverly et al., 2012) and the associated experience with college preparation it connotes (Nuñez & Kim, 2012), as well as time and money for involvement in a child's education (Lareau, 2011). There is also evidence that these persistent inequities are influenced by schooling experiences, such as subtle messages around expectations (Saunders & Maloney, 2005; Tyson & Darity, 2005) and within-school segregation (Clotfelter et al., 2020).

Parent and Peer Factors Associated With College-Level High School Course Taking

Our results suggest that both parent and peer factors predict college-level course taking, but in different ways for AP or IB and dual enrollment course taking and the number of courses completed by course takers. Our findings on factors predicting AP or IB course taking align with prior research documenting that when parents and peers convey positive attitudes toward preparing for college, students are more likely to take these courses (Alvarado & An, 2015; Barber & Wasson, 2015; Filer & Chang, 2008; Gottfried et al., 2017; Valadez, 2002). We found that students were more likely to take AP or IB courses when they reported: (a) having discussions with parents about academics, (b) receiving encouragement from parents to take rigorous, college-preparatory courses, and (c) having friends who are preparing for college themselves. In prior studies the extent of communication with parents did not always predict the number of courses taken (Hyde et al., 2017; Perna & Titus, 2005; Valadez, 2002), but parents providing direct cues to take rigorous courses did (Filer & Chang, 2008). Our findings on the importance of peers confirms research documenting that students tend to have friends with similar aspirations who reinforce students' own beliefs about the importance of participating in college-level courses to improve odds of college enrollment (Alvarado & An, 2015; Barber & Wasson, 2015; Zietz & Joshi, 2005). In fact, peer academic focus more strongly predicted AP or IB course taking than students' own academic focus; this finding aligns with prior studies finding that peers academic focus may matter more than a student's own focus (Davis et al., 2013; Hanushek et al., 2003; Juvonen et al., 2012).

At the same time, our findings suggest that parent and peer factors are more strongly associated with the odds of a student taking a college-level course than they are with the number of such courses taken. Parent encouragement to take math and science courses emerged as the only factor that predicts both college-level high school course taking *and* the number of courses taken. None of the peer behaviors included in our models were associated with the number of courses taken, suggesting that factors such as student prior achievement and a focus on college preparation play a greater role in decisions around how many college-level courses students take once they begin taking them.

Parent factors were also not found to significantly predict students' decisions to take dual enrollment courses. However, at the same time, more parent encouragement for math and science course taking was associated with dual enrollment students taking more dual enrollment courses during high school. Despite more students taking dual enrollment courses in recent years, perhaps parents view dual enrollment as less prestigious or helpful for college readiness. This view could have been influenced by efforts made by state lawmakers to enroll students with lower academic achievement levels in dual enrollment courses (Fink et al., 2017; Thomson, 2017). Alternatively, parents may be more familiar with the potential of AP or IB courses to improve college readiness and admission prospects than they are with the potential positive impacts of dual enrollment course taking. Parents' views of dual enrollment may also be influenced by messages they receive from K–12 schools, which less often see dual enrollment course completion as reflective of college readiness compared to college and university staff (Kilgore & Wagner, 2017). Like K–12 school staff, parents may also be concerned about challenges to dual enrollment course taking, including the high cost (in cases where schools and districts do not cover fees) and concern about course credit transferring to their preferred colleges (Kilgore & Wagner, 2017).

Moreover, the fact that dual enrollment programs often include vocational or CTE tracks in addition to college-preparatory courses may also confuse some parents or undermine their perception of the value of dual enrollment for college preparation. Collectively, these concerns could translate into lower parent encouragement and support for dual enrollment course taking. At the same time, parent involvement in course taking decisions could lead to more dual enrollment courses being taken by the children of parents who are familiar with the benefits of dual enrollment, including college preparation and the potential for college tuition savings when their children need fewer credits to earn a bachelor's degree.

The only peer factor that predicted dual enrollment course taking—having peers who take college entrance exams—may reflect the heightened salience of like-minded peers in the absence of strong, positive family support for dual enrollment (Barber & Wasson, 2015). The expanded focus of dual enrollment to include students at all levels of academic achievement, or multiple high school tracks, may complicate parents' perceptions of its rigor but be acceptable or understandable among peers (Thomson, 2017).

School Factors That Influence College-Level Course Taking and the Number of Courses Completed

In our study, high school demographics and practices were weaker predictors than student, parent, and peer factors, as is generally the case in studies of educational phenomena (Coleman et al., 1966; Lee & Smith, 1996). Similar to patterns that emerged for student, parent, and peer factors, we found that school factors that predicted any college-level course taking (e.g., school location) differed from those that predicted the number of courses completed (e.g., math teachers with master's degrees). Additionally, different school factors predicted AP or IB and dual enrollment course taking. In this section, we discuss only the factors that were significantly associated with course taking *and* had effect sizes large enough to be meaningful in practice.[14]

High School Factors Associated With Students Taking Any College-Level Courses

In our final model of dual enrollment course taking, only one of the school-level factors—percentage of high school alumni enrolled in college—significantly predicted whether students would take any dual enrollment courses. However, the effect size is so small that is not meaningful in practice.

In the final model predicting whether students took AP or IB courses, one significant factor was school location in the southern region of the United States. This result suggests that, after accounting for all other factors in the models, compared to students in high schools in the western United States, students attending schools in the South were more likely to take AP or IB courses. This stands in contrast to national statistics on the frequency of AP or IB course taking by regional location, which is highest in terms of simple percentages in the western United States (NCES, 2012) and next highest in the southern states, followed by the Northeast and the Midwest. It is possible that the regional variation indicated by our results reflects state policies requiring high schools to offer AP or IB courses or any type of college-level high school courses. According to the ECS (2020), such policies are in place in 11 of the 17 states (65%) included in the southern region of the United States and in only 2 of the 9 states (22%) in the northeastern region of the United States.[15] Thus, we could simply be seeing that these policies do, in fact, work as intended.

In addition to U.S. region, we found that, after accounting for all other factors, attending a rural high school was associated with lower odds of taking AP or IB courses. The good news is that although rural high school students may be less likely to take AP or IB classes, those rural students who do take AP or IB courses do not take fewer of them than their suburban counterparts.

Access to college-level high school courses is often cited as an impediment for rural students who express interest in enrolling in AP or IB courses (ECS, 2017; Shivji & Wilson, 2019). However, our results show that students in rural areas are less likely to take AP or IB courses than their peers in suburban high schools, *even after controlling for access to courses through the high school*. This is also notable because this relationship already accounts for student focus on academics and college preparation, as well as family and peer focus on academics and college. One possible explanation is that students are less interested in virtual or off-site AP or IB courses, which are more common options in rural schools (ECS, 2017). Further research could explore whether AP or IB course taking rates might increase as onsite offerings increase.

School Factors That Influence the Number of College-Level Courses Taken

Different school factors predicted the number of college-level high school courses completed by course takers, indicating that some policies and practices may influence whether students take any such courses and other, different policies and practices may influence the number of such courses students take. Notably, our analyses showed that college-level course takers in southern high schools did not take any more or fewer courses than their peers in the Northeast. At the same time, we found that AP/IB students in midwestern schools were predicted to take fewer AP/IB courses than their peers in schools in the western United States; this result does not seem to be influenced by regional differences in the percentages of states mandating that schools offer AP or IB courses.[16]

Other school factors—including master's-level teachers in schools and schools being over capacity in number of students served—emerged as salient for the number of courses taken among those enrolled in AP or IB courses. It is possible that schools with a higher number of teachers with advanced education would not only be more well equipped to offer AP or IB courses, they may also provide more mentoring and encouragement to take such courses. Prior research has shown that teachers with master's degrees may have a greater influence on academic achievement (Gándara & Contreras, 2009), although different conclusions have been drawn about the influence of teacher qualifications, specifically on college-level course taking (Conger et al., 2009). The findings of our study highlight that teacher preparation may predict college-level course taking and that this is the case after accounting for many other factors.

The other school factor that may influence the number of AP or IB courses taken by high school students, school overcrowding, may have a complicated and indirect influence on course taking decisions. Overcrowding could be viewed as an obstacle to college-level high school course taking, as it could increase competition for seats in AP or IB courses. Given that larger schools tend both to be more often overcrowded and to offer a wider range of advanced courses (Handwerk et al., 2008; NCES, 1999), the associations between overcrowding, school size, and school resources lead us to suggest that this result may be driven by the greater number of course offerings in larger public high schools.

Similarities and Differences in Factors Predicting Advanced Placement or International Baccalaureate and Dual Enrollment Course Taking

As we noted at the outset of the study, there are multiple differences between dual enrollment, AP, and IB programs. We analyzed the data together for AP and IB courses, as other researchers have, because these programs are similar and the IB program serves a relatively small number of U.S. students. We analyzed data separately for dual enrollment programs, which, unlike AP and IB courses, may take different forms and are more often developed by schools and districts. Our models explored the relevance of the same set of factors for AP or IB and dual enrollment course taking and courses completed, and as we noted, many more of the factors included in our models were associated with AP or IB course taking than dual enrollment course taking. There were also clear differences in which factors predicted dual enrollment course taking. For example, higher-SES African American students were less likely than their peers to take any dual enrollment courses, and dual enrollment students attending private schools were likely to take more dual enrollment courses than their dually enrolled counterparts in public high schools. The same patterns were not found among AP or IB students.

There are likely several explanations for this difference. There are likely other factors influencing dual enrollment course taking that we could not measure; for example, dual enrollment students may face logistical challenges in additional time required and the cost of travel to take dual enrollment courses at a college campus. This difference may also be related to the vocational education component of dual enrollment—nearly 30% of dual enrollment students were enrolled in vocational or CTE courses in 2010–2011 (Thomas et al., 2013). In future related studies, the academic and CTE tracks of dual enrollment could be explored separately, given their differing aims and, accordingly, differing levels of focus on college preparation. Our findings seem to indicate that different policies and practices will support more equitable dual enrollment course taking.

Conclusions, Implications, and Recommendations

Our findings highlight that multiple factors should be the focus of efforts to increase college-level high school course taking rates or to make them more equitable. These findings may be particularly informative for those seeking to reduce inequities in rates of AP, IB, and dual enrollment course taking between students from more and less marginalized groups, given the lower college enrollment and completion rates among African American and Hispanic students and students living in poverty. In this final section, we provide recommendations for shifts in policies and practices that hold the promise of increasing AP, IB, and/or dual enrollment course taking rates, especially for students from historically underrepresented backgrounds.

Recommendation 1: Support Students' Math Skills Early, and Especially in Middle School

One of our strongest and most consistent findings was that students' prior math skills, represented as HSLS ninth-grade math assessment scores, were an important predictor of college-level course taking. This finding highlights the importance of programs and policies focused on supporting the development of student math skills and increasing completion of rigorous math courses, which have been a consistent focus of programs aimed at fostering college readiness (Finkelstein et al., 2012; Silva et al., 1990). Some education stakeholders emphasize the eighth-grade year as a pivotal time frame for understanding whether students need to master more basic math skills before moving on to required courses, such as Algebra, or more advanced courses later in high school (Finkelstein et al., 2012; Loveless, 2008). In general, a focus on students' math skills and achievement prior to high school appears to be a well-supported way to increase rates of college-level course taking in high school. Math may be a particularly important focus for students from families with low incomes, African American students, and students attending rural high schools, based on our findings.

Recommendation 2: Support Parent Encouragement of College-Level High School Course Taking

Our findings also highlight the role of interactions with academically focused and encouraging family members in high school students' college-level course taking decisions. Thus, our recommendation is to select or expand evidence-based programs that help parents to better support their child's selection of high school courses and pathways. One such example is provided in research documenting that high school students were more likely to take at least one additional semester of STEM coursework following their parents' participation in a brief informational intervention emphasizing the utility and importance of STEM learning (Harackiewicz et al., 2012).

Recommendation 3: Create Opportunities for Peer-to-Peer Interactions That Promote Advanced Course Taking

Our findings suggest that the influence of peers is an important factor in high school students' decisions to take AP, IB, or dual enrollment courses. These findings highlight the potential impact of programs enabling peer mentoring, such as those that have been shown to positively impact high school students' college-preparation behaviors (Castleman & Page, 2015). Even better, high school students who advise their peers on how to improve their academic achievement even see benefits themselves in the form of higher grades (Eskreis-Winkler et al., 2019).

Recommendation 4: Review Policies and Practices With an Eye Toward Increasing Equitable College-Level Course Taking Rates

Our findings suggest a need for schools to review and revise processes for course placement to ensure that students move on to a course that is appropriate for their current skills and knowledge (Finkelstein et al., 2012; Loveless, 2008). Furthermore, given high rates of access to college-level courses, such as AP, but inequitable patterns of participation by racial and socioeconomic backgrounds, policies aimed at increasing equity are needed. For example, schools can adopt opt-out rather than opt-in policies to ensure that all qualified students have the opportunity to participate in college-level courses based on prior academic performance; such policies can address competition for seats in AP, IB, or dual enrollment courses in schools that have "small" or limited programs (Theokas & Saaris, 2013). Schools can also partner with local businesses to create greater incentives for teachers and students to invest in the AP, IB, or dual enrollment curriculum and hire more AP, IB, or dual enrollment teachers to increase opportunities to engage students around taking college-level courses and enable more students to participate overall (Klopfenstein, 2004). Reviewing data on student performance in high school coursework, as well as data illustrating who gets into college-level courses, is another way to improve approaches to tracking and student course taking and to prevent gaps (Kelly & Price, 2011; Theokas & Saaris, 2013). Given that our findings highlight that even higher-SES African American students take fewer AP, IB, and dual enrollment courses, and take fewer of them than their White and Asian peers with high SES, districts and schools serving students from different family income levels may want to focus specifically on supporting enrollment and completion of such courses by African American students.

Finally, students and families of all backgrounds, particularly those from historically marginalized groups, families of lower incomes, and families in which parents have not themselves attended college, may benefit from additional information provided by schools about college-level high school courses and their potential benefits for student college access, success, and affordability. A variety of prior research, outside the scope of this study, has provided insights into effective parent and community outreach strategies that school staff could add to their tool kits.

In closing, we highlight the importance of our findings in light of the conclusions of a recent study by the Education Trust. The authors concluded that if all groups of students attending AP schools were served equally, more than 640,000 additional students from low-income and historically underrepresented racial backgrounds would benefit (Theokas & Saaris, 2013). If students from historically underrepresented racial backgrounds were served equally, more than 79,000 African American students, 37,000 Hispanic students, and nearly 6,000 American Indian students would benefit (Theokas & Saaris, 2013). Our findings could be used to help close these gaps in college-level high school course taking, which could help to improve the odds of college and career success and enhance life outcomes for students and their families for generations.

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Notes

1 The College Board, administrator of the AP examinations and developer of course materials, tracks and publishes data on AP exam takers and not on actual AP course takers (College Board, n.d.-b). Because not all AP course takers take exams, the increase in the number of students taking exams may underestimate the actual increase in AP course completion rates.
2 We define college readiness as being academically prepared to complete a degree at a 2-year and 4-year college or university.
3 Based on the 22,678 high schools offering AP courses in 2018–2019 (College Board, 2020) and the 35,465 high schools in the United States that year (NCES, 2019b).

4 Advanced Placement began as a scholarship program for four universities (Chicago, Columbia, Wisconsin, and Yale) that was funded by the Ford Foundation's Fund for the Advancement of Education. It spread to other schools in 1954 and was adopted by the College Board in 1955 (Valentine, 1987).

5 Based on the 950 IB diploma program schools listed on the IBO website as of March 2020 (IBO, n.d.-c) out of the 35,465 high schools in the United States that year (NCES, 2019b).

6 Authors' calculations are based on the 88,205 students who completed requirements for the IB in 2018 (IBO, 2019a, 2019b) and the 16,978,000 high school students in the United States as of the 2019–2020 school year (NCES, 2017).

7 Less than 1% of high schools in the HSLS:09 sample were considered alternative or vocational/technical high schools and thus would not offer AP or IB courses.

8 Note that "occupational prestige" is a sociological concept that denotes the relative social-class positions people may achieve based on the ways in which others view their chosen occupations (Nakao & Treas, 1994). Rating scales are used to quantify occupational prestige for the purposes of research that seeks to account for socioeconomic status, which is a more comprehensive measure than income because it accounts for education and occupational prestige.

9 Sampling weights are used to produce nationally representative estimates such that each respondent in the sample represents a specific number of individuals relative to their representation in the population.

10 Note that the measure of credits with postsecondary credit potential does not include AP or IB courses and only includes dual enrollment courses.

11 We combined AP and IB courses because of the small size of the IB program nationally, as the NCES does in its studies of these programs (e.g., Thomas et al., 2013); however, we recognize that there are clear distinctions between the AP and IB programs and courses. Given the similarity of the results for the outcome of taking any AP or IB or dual enrollment course and the outcome of taking any AP or IB course, and our interest in a comparison between AP or IB and dual enrollment, we opted to focus our study on AP or IB and dual enrollment course taking.

12 To facilitate interpretation of the results, the multilevel logistic regression coefficients have been exponentiated so that their values can be interpreted as odds ratios. An odds ratio is a measure of association between a predictor and an outcome. It represents the odds that an outcome will occur given a particular value of the predictor compared to the odds of the outcome occurring for the opposing value of the predictor. Odds ratios higher than 1 indicate a positive relationship between covariates and the outcome variable, whereas odds ratios lower than 1 indicate that this relationship is negative (Szumilas, 2010).

13 Note that the precise interpretation of this result is that for every 1 standard deviation increase in a student's score on the HSLS:09 ninth-grade math assessment, their odds of having completed AP or IB courses are 165% higher.

14 We examined many school factors but want to focus our attention on significant predictors that hold the most practical meaning for research and practice. For example, the measures of underrepresented minority students and special education students within the student body were significant in the models predicting course taking; yet, because the odds ratios were too small to be practically meaningful, we will not be discussing them further.

15 Of the states and districts in the South (U.S. Census Bureau, 2020), 65% (Arkansas, District of Columbia, Florida, Kentucky, Louisiana, Mississippi, North Carolina, South Carolina, Texas, Virginia, and West Virginia) require high schools to offer advanced courses, whereas 35% (Alabama, Delaware, Georgia, Maryland, Oklahoma, and Tennessee) do not. Of the states in the Northeast, 22% (Connecticut and Maine) have such policies in place, whereas 78% (Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont) do not (ECS, 2020).

16 Of the states in the midwestern region of the United States (U.S. Census Bureau, 2020), 30% (Indiana, Iowa, and Ohio) require high schools to offer advanced courses, whereas 70% (Illinois, Kansas, Michigan, Minnesota, Missouri, Nebraska, and South Dakota) do not.

17 Note that all unweighted *N*s are rounded to the nearest 10 to comply with IES reporting requirements for restricted-use data.

18 The number of students with data for the 2009, 2011, and 2013 surveys who also have high school transcript data totaled 15,190. However, the use of multiple imputation to address missing data resulted in a final sample of 15,120 cases with data for all study variables, because some data could not be imputed. The multilevel analyses could only include cases with data for all study variables.

19 Note that the measure of credits with postsecondary credit potential does not include AP or IB courses and only includes dual enrollment courses.

20 Note that we acknowledge the limitation of our measures of parent involvement because they do not account for parent involvement at home, which may be more common in families with lower income due to time constraints and barriers to communication with teachers and school staff (Epstein, 2010).

21 The "other race" category includes students who self-identified as American Indian or Alaska Native, Native Hawaiian or other Pacific Islander, or two or more races.

22 Because the HSLS:09 study was designed to focus on mathematics and science, teacher background data were collected only for teachers of these subjects. Given their similar levels of preparation, we opted to focus only on mathematics teachers for our measure of teacher degrees.
23 Items with a negative focus were reverse-coded prior to the creation of the composite variable.
24 Note that the Grade 9 survey item on dual enrollment program offerings may have included various types of dual enrollment programs. In addition to differing in the location in which courses were offered, dual enrollment programs included in this item may have enabled students to earn college credit or a certificate or associate's degree; in some cases, students may have had to be accepted into the partner college to enroll in the dual enrollment program. Moreover, dual enrollment courses may have had an academic or career, technical, or vocational focus. It was not possible to parse out these distinctions using school counselor survey responses.
25 We opted for grand mean centering of the Level 1 predictors because we are interested in their estimates across schools, not within schools. Also, we did not find a substantial amount of variation between clusters (schools).
26 As shown in the multilevel model results tables in Appendix C, models with all student-level variables included 28 student-level variables. The equation presented here is a simplified version of the full student-level model; for the sake of brevity, race is depicted rather than all race dummy variables other than the White omitted dummy variable, and Race × SES is depicted rather than the five interaction terms (White × SES, African American × SES, etc.).
27 As shown in the multilevel model results tables in Appendix C, models with all school-level variables included 15 school-level variables. The equation presented here is a simplified version of the full school-level model, for the sake of brevity.
28 We used the MICE module of Stata Version 15, which uses a chained equation routine and produces 10 imputed data sets for analysis. The MICE routine is appropriate when imputing binary, continuous, and count variables, among others. Constraints were included to ensure consistent variance before and after imputation.
29 Note that multiple imputation is sound even for large percentages of missing values because the application of Rubin's rules preserves confidence intervals and Type I error rates (Rubin, 1987). The amount of missing data is not as important as the convergence of imputation models (Dong & Peng, 2013).

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Supporting Information

Additional supporting information can be found online in the Supporting Information section of this paper.
Executive summary for *Equity Levers: What Predicts Enrollment in and Number of College-level Courses Taken in High School?*

Appendix A

Methods

To address the study research questions, we used nationally representative, longitudinal data on the cohort of high school students entering ninth grade in 2009, collected for the NCES's HSLS:2009 study. We used multilevel models to estimate the influence of student, family, and peer behaviors; student and family demographics; and school demographics, experiences, and practices on college-level course taking and the intensity of said course taking. Models of the dichotomous outcome of course taking used HGLM, an extension of the generalized linear model that provides estimates of how various factors influence the likelihood of an outcome. Models of the count outcome of the number of courses taken used multilevel Poisson regression models. These models were restricted to students who had completed college-level high school coursework to allow for explorations of factors that might increase the number of courses taken among those who had taken at least one (a) AP or IB or (b) dual enrollment only course.

Data

The HSLS:09 data were collected by the NCES in a national probability sample of U.S. high schools (Ingels et al., 2011). Data collection included student surveys in fall 2009 (ninth-grade entry), spring 2012 (end of 11th grade), and fall 2013 (post high school), at which point high school transcripts were also collected. Parents were also surveyed in fall 2009 and spring 2012, when student mathematics and science cognitive assessments were conducted. In this study, we used data from fall 2009 student, counselor, school administrator, and math teacher surveys; spring 2012 counselor surveys; and high school transcripts, as well as fall 2009 HSLS:09 mathematics assessment scores.

Sample

For the models of college-level high school course taking, our longitudinal sample of 15,120[17] students, out of 21,440 in the full HSLS:09 sample, included respondents with data for the 2009, 2011, and 2013 surveys who also had high school transcript data.[18] The students in our analytic sample were randomly selected by the NCES from 940 U.S. high schools, which were selected randomly within a stratified sample of primary sampling units selected to be representative of the United States as a whole. The use of student and school weights (W3W1W2STU for students and W1SCHOOL for schools) to compensate for the stratified sampling design of the study resulted in hierarchical linear modeling estimates representing 4,123,063 U.S. students in Grade 9 in 22,815 high schools in 2009–2010.

The two subsamples of course takers used for the models of number of courses taken included students who had taken either (a) AP or IB courses or (b) dual enrollment courses. The AP or IB course taker sample included 6,260 students; when weighted, this sample represented 1,512,315 students. The dual enrollment course taker sample included 1,510 students; when weighted, this sample represented 396,018 students.

Measures

Outcomes

The indicators of course taking models were designed to investigate factors associated with student college-level course taking, whereas the number of courses models were designed to explore factors associated with the number of courses taken. Courses were standardized by the NCES to Carnegie units, which are each equivalent to a 1-year academic course taken one period a day, 5 days a week (Ingels et al., 2015). This means that each course credit represents a completed college-level high school course of its respective type.

We used two sets of outcomes measures. The first set of outcomes, used in multilevel logistic regression models, included indicators of having taken (a) any AP or IB course or (b) any dual enrollment course, based on the number of AP or IB and dual enrollment courses on student high school transcripts. The second set of outcomes, used in multilevel linear regression models, included continuous measures of (a) the number of AP or IB courses taken and (b) the number of dual enrollment courses taken. We used the HSLS:09 transcript data composite variables on "number of AP or IB credits earned" and "number of credits earned with potential postsecondary credit" to generate the two dichotomous indicators (TookAP_IB = 1 if a student earned at least one credit in AP or IB, otherwise 0; TookDE = 1 if a student earned at least one credit in a dual enrollment course, otherwise 0); the original variables were also used as outcomes, after being standardized to $m = 0$ and $SD = 1$.[19]

Whereas the HGLM models of course taking were run on the full study sample, the HGLM Poisson models of number of courses taken were run on a subsample limited to students who took the type of college-level high school courses measured by the outcome (i.e., AP or IB and dual enrollment).

Student-Level Predictors

In addition to measures of student demographics like race, SES, and the overlap between them, student-level predictors of college-level high school course taking included measures of student focus on academics, parent involvement in and encouragement of advanced course taking, peer focus on academics, student conversations with others about course taking, and exposure to a ninth-grade math teacher of the same race.

Student Academic Focus and Experiences

Measures of student academic focus included variables representing student plans to take college entrance exams and to enroll in college as well as a derived dichotomous indicator of participation in one of five national college access programs (Talent Search, Upward Bound, Gear Up, AVID, or MESA) during high school (CollegeAccessProgPart = 1 if students had participated in one or more of the five programs, otherwise 0). The measure of student plans to attend college was also derived as a dichotomous indicator (= 1 if students responded "yes" to survey items asking if they planned to enroll in an associate's or bachelor's degree program after high school). The measure of plans to take college entrance exams is a composite created as an average of variables representing plans to take the *PSAT*® test, the SAT, or ACT (α = .79). Measures of whether students spoke with parents, friends, or school staff about academics, including which courses to take and planning for college, were derived as composite average measures of relevant student survey items (α = .87, .78, and .78, respectively).

Indicators of having a same-race math teacher in ninth grade were generated in the student-level data set using HSLS variables on student and teacher race and ethnicity contained in the full student-level HSLS data set. Dichotomous variables were created to indicate whether White students had a White math teacher, African American students had an African American math teacher, Hispanic students had a Hispanic math teacher, and Asian students had an Asian math teacher, to explore the potential positive association of having a same-race teacher with student academic outcomes, demonstrated in prior studies noted earlier.

Family and Peer Academic Support and Focus

In addition to the measure of students speaking with parents about course taking and college plans, we include in our models measures of family encouragement of math and science course taking and parent involvement in school. The measure of family encouragement of math and science course taking was derived by averaging responses to four survey items on students taking or planning to take math and science courses because of parent encouragement to do so (α = .75). The measure of parent involvement in school was derived by averaging responses to eight fall 2009 parent survey items on their participation in school meetings; meetings with school counselors; PTO meetings, parent–teacher conferences, school events, and school fundraisers; volunteer service; and attendance at a school science fair (α = .67).[20]

An indicator of peers' plans to attend college was also derived as a dichotomous indicator (= 1 if students responded "yes" to survey items on peer plans to enroll in an associate's or bachelor's degree program after high school). An indicator of peer plans to take college entrance exams was recoded into a dichotomous indicator variable (= 1 if a student responded that half or more than half of their friends planned to take the PSAT, SAT, PLAN, or ACT college entrance examination).

Student Demographics

Analytic models included measures of student demographic characteristics, including gender, race, SES (Silva et al., 1990), and whether students were first-generation immigrants to the United States. A ninth-grade (fall 2009) student survey item on gender was recoded as a dichotomous variable indicating identification as a male (male = 1, female = 0), for comparison with females, to account for the higher rates of college-level course taking among high school girls (Dalton et al., 2018). A dichotomous variable indicating status as a first-generation immigrant was included to account for variations in achievement between immigrants and nonimmigrants (Pivovarova & Powers, 2019). Moreover, the education system is seeing an increased presence of immigrants and ELLs (Gándara & Contreras, 2009), and placement in English as a second language classes is associated with lower levels of placement in advanced courses (Callahan et al., 2010).

Race and SES, a primary focus of the study, were represented by separate and interacted measures. A set of dummy variables was created from a ninth-grade student survey item on race and ethnicity to represent the categories of White, Hispanic, African American, Asian, and other race.[21] The measure of family SES is a continuous variable computed by the NCES as an average composite of five measures: father/male guardian's education and occupation, mother/female guardian's education and occupation, and household income (Ingels et al., 2011). In the analytic models, the SES variable was used in its continuous form after being standardized to a mean of 0 and standard deviation of 1, both on its own and in interaction with the race dummy variables. For descriptive analyses, the categorical HSLS:09 SES quintiles variable computed by the NCES was recoded into three dichotomous (yes = 1, no = 0) variables representing low, middle, and high family SES. In this way, we were able to retain the greater variability of the continuous SES measure for the multilevel models, while also presenting the percentages of students from families with low, middle, and high SES within each racial group and taking each type of college-level course. Interaction terms, creating by multiplying each dichotomous race or ethnicity variable by the standardized, continuous SES measure, were included in analytic models to account for the overlap between race and SES in influence on college-level course taking (Klopfenstein, 2004). In other words, we sought to explore how being a member of various racial and SES subgroups, such as African American, Hispanic, White, or Asian groups, with low or high SES, is related to college-level course taking and the intensity of course taking.

Given the powerful influence of prior achievement, perhaps influenced by variations in early childhood, elementary, and middle school educational experiences, we also included a measure of student mathematics achievement at the outset of Grade 9 (fall 2009). HSLS:09 student cognitive mathematics assessment scores were standardized to $M = 0$ and $SD = 1$ to enable interpretation in units of effect size.

School-Level Predictors

Multiple school-level factors were included in analytic models to explore the extent to which various school characteristics and practices predicted the likelihood and intensity of college-level high school course taking. Given the prior literature highlighting the importance of particular school factors, we included in our models measures of school demographic characteristics, school climate and culture, mathematics course placement practices, and college-level course access.

School Demographic Context

To account for and explore the influence of variations in the student populations served, we included various measures based on school administrator survey items. The percentage of students eligible for free or reduced-price lunch was included as a measure of school poverty, albeit a less-than-ideal one (Domina et al., 2018). The percentage of underrepresented minority students, also an indicator of the poverty level of the student population, was calculated using survey items asking administrators to report percentages of the student body reported to be Hispanic, African American, or other American Indian. A measure of the percentage of ELLs in the student body was also included in the study. These measures accounted for the fact that schools that serve higher percentages of students from minority and low-income families offer college-level courses less often, tend to be less resourced, and may provide instruction of lower quality than schools serving more affluent, White, and Asian students (GAO, 2018). Moreover, underrepresented minority and ELL students more often attend schools with more students with low achievement, high student–teacher ratios, high student enrollments, and high levels of students living in or near poverty (Fry, 2008).

Other school-level variables, provided in the HSLS:09 data set as composite measures of 2009–2010 school characteristics developed by the NCES, included measures of school type (i.e., public or private), geographical region, and urbanicity to explore the importance of these factors for student course taking and the intensity of college-level high school course taking. As we noted earlier, students may take more college-level high school courses in private schools, and course taking rates are lower in smaller schools and rural areas (NCES, 2012, 2019a). Students in rural schools take fewer math courses, and have less access to AP math courses in particular, than their peers in urban or suburban schools (Anderson & Chang, 2011). Thus we opted to include in our models a dichotomous variable indicating whether a given school was public (yes = 1; no = 0); a set of dummy variables indicating U.S. regional location, with the western region as the omitted category; and another set of dummy variables representing rural, urban, and suburban schools, with the suburban category omitted in analytic models.

School Resources

A survey item on the percentage of special education students was also included in statistical models to account for the influence of these needs on the larger student population. The school over capacity measure, a dichotomous indicator (yes = 1, no = 0) of schools serving over 100% of the number of students for which the facilities were designed, was derived from an administrator survey item on the percentage of capacity to which their school is filled (range responses to original item, 20%–150%); it was included as a further measure of the extent to which school resources may be overtaxed, given that prior research has found that overcrowding has negative impacts on student learning (Oakes, 2003).

A continuous measure of the percentage of mathematics teachers[22] possessing a master's degree or higher was derived from a fall 2009 teacher survey variable on highest degree taken to further explore the importance of teacher qualifications for college-level high school course taking. It is unclear to what extent teacher qualifications may predict specifically for college-level course taking (Conger et al., 2009), but it is clear that the professional development and education of a school's teacher workforce can play a large role in the achievement of its students (Bryk, 2010).

School Culture

To explore the importance of a college-going culture, we combined the percentages of 2008 – 2009 graduates who enrolled, respectively, in associate's and bachelor's degree-granting programs. Other aspects of school culture were explored through the inclusion of measures of lack of parent involvement in the school and teacher perceptions of the school culture and, relatedly, expectations for students. The lack of parent involvement measure averages teacher and school administrator responses to the same survey item inquiring about the extent to which a lack of parent involvement is problematic at the school ($\alpha = .86$). The "teacher culture" measure averages responses to seven school counselor survey items asking teachers to rate the extent to which teachers in the school set high standards for teaching and learning, believe all students can do well, have given up on some students, care only about smart students, expect little from students, and work hard to make sure all students learn ($\alpha = .81$).[23]

College-Level High School Course Access

Given the potential importance of schools offering college-level courses, either on campus, in the case of all three types of courses, or at a local college, in the case of dual enrollment only, we opted to include indicators of schools offering the type of courses serving as the outcome in a given analytic model (AP or IB, dual enrollment, or any of the three). These three indicators were created as dichotomous variables representing responses to Grade 11 school counselor survey items inquiring whether each type of program was offered at the school at the time of the survey.[24]

Sample Characteristics

The study sample was similar to the full nationally representative HSLS:09 sample across demographic characteristics, including family SES and most racial and ethnic categories, and across school characteristics, including school type, region, and urbanicity (see Table A1). Differences included fewer first-generation immigrants and slightly more White students in the study sample relative to the full HSLS:09 sample. Moreover, the average HSLS:09 ninth-grade math test score was slightly higher in the analytic sample than in the full sample.

Analyses

As we previously noted, we used indicators of course taking in college-level high school courses and counts of number of courses taken in each type of course or combination of course types as outcome measures in multilevel logistic and Poisson regression models. Prior to the multilevel modeling, to document frequencies and means of study variables for students taking AP or IB, dual enrollment, or AP or IB/dual enrollment, we conducted descriptive analyses using the yes/no indicators of course taking.

Multilevel modeling is ideal for studies of educational phenomena because it enables researchers to address nested data by simultaneously accounting for variations at each level (Raudenbush & Bryk, 2002). We used the software program Hierarchical Linear Modeling, Version 7.01 (Raudenbush et al., 2010), to specify multilevel models with students nested under teachers. After specifying unconditional models to partition the variance in the four outcome measures, using a one-way random effects analysis of variance, we specified a series of two-level intercepts-as-outcomes models in which student- and school-level variables were added in steps to base models. The model steps are shown in the multilevel model results tables in Appendix C.

In all linear multilevel models, continuous variables were standardized to $M = 0$ and $SD = 1$, and categorical variables were coded as dichotomous indicators, as described previously, so that slope coefficients were in units of effect size, using the metric of standard deviation units. Variables were used in the same format in the multilevel logistic regression models

Table A1 Student and School Demographic Characteristics of Full High School Longitudinal Study of 2009 Student Sample and Study Analytic Sample

	Base HSLS:09 student sample[a]		Analytic sample[b]	
Characteristic	*N*	%	*N*	%
Student demographics				
Race				
Hispanic	4,000	17.2	2,310	15.2
White	12,260	52.8	8,650	56.9
African American	2,650	11.4	1,510	9.9
Asian	3,000	9.1	1,230	8.1
Other race	2,230	9.6	1,490	9.8
SES quintile				
First	3,620	16.5	2,200	14.5
Middle three	12,820	58.3	8,550	56.3
Fifth	5,560	25.3	4,440	29.2
Female	12,290	48.9	7,640	50.3
First-generation immigrant	3,420	21.1	2,470	16.3
Ninth-grade math skills	21,440	0.035	15,190	0.146
School demographics				
Control				
Public	20,660	82.0	12,320	81.1
Private	4,550	18.1	2,870	18.9
Locale				
City or town	10,150	40.2	6,160	40.6
Suburb	9,200	36.5	5,340	35.1
Rural	5,860	23.3	3,700	24.3
U.S. geographic region				
Northeast	3,980	15.8	2,350	15.5
Midwest	6,670	26.5	4,150	27.3
South	10,210	40.5	6,130	40.3
West	4,350	17.2	2,570	16.9

Note. HSLS:09 = High School Longitudinal Study of 2009. Data are from fall 2009 student and administrator surveys of the *High School Longitudinal Study of 2009 (HSLS:09) 2013 Update and High School Transcripts Restricted-Use Data File* (Publication No. 2015038), U.S. Department of Education, National Center for Education Statistics. [a]*N* = 25,210. [b]*N* = 15,190.

used to predict college-level high school course taking, with outcomes presented as odds ratios representing the likelihood of completing courses.

Dichotomous indicator variables were entered into analytic models uncentered. Continuous measures of prior math achievement, SES, and race × SES interactions were entered uncentered because they were standardized to a mean of 0 and standard deviation of 1; thus they had a meaningful zero value. Student-level measures of parent involvement and talking with others about academics were grand mean centered[25] such that they represented average levels of these constructs; moreover, continuous school-level measures of school demographics, school culture, and ninth-grade mathematics course placement considerations were also grand mean centered.

The final within-school model for the four study outcomes (two addressing course taking and two addressing number of courses taken), respectively (Y_{ij}), of the ith student of the jth school, was[26]

$$
\begin{aligned}
Y_{ij} = {} & \beta_{0j} + \beta_{1j}\left(\text{Race}_{ij}\right) + \beta_{2j}\left(\text{SES}_{ij}\right) + \beta_{3j}\left(\text{Gender}_{ij}\right) + \beta_{4j}\left(\text{Ninth} - \text{Grade Math Skills}_{ij}\right) \\
& + \beta_{5j}\left(\text{First} - \text{Generation Immigrant}_{ij}\right) + \beta_{6j}\left(\text{Student Academic Focus}_{ij}\right) + \beta_{7j}\left(\text{Parent Involvement}_{ij}\right) \\
& + \beta_{8j}\left(\text{Talk Peers, Parents, Teachers About Academics}_{ij}\right) + \beta_{9j}\left(\text{Peer Academic Focus}_{ij}\right) \\
& + \beta_{10j}\left(\text{Race} \times \text{SES}_{ij}\right) + \beta_{11j}\left(\text{Same} - \text{Race Teacher}_{ij}\right) + e_{ij},
\end{aligned}
$$

where β_{0j} is the intercept, β_{1-11j} are slopes, and e_{ij} is the student-specific random error. The student-level equation intercept was allowed to vary freely from student to student to model within-teacher variation. All other student-level slopes were constrained to represent average student-level variable estimates.

The final between-school model, for all four outcomes, representing the within-school intercept, is

$$\beta_{0j} = \gamma_{00} + \gamma_{01}(\text{School Demographics}) + \gamma_{02}\left(\text{School Culture}_j\right) + \gamma_{03}\left(\text{Ninth} - \text{Grade Math Course Placement Preferences}_j\right) + \gamma_{04}\left(\text{School Type}_j\right) + \gamma_{05}\left(\text{School Region}_j\right) + \gamma_{06}\left(\text{School Urbanicity}_j\right) + \gamma_{07}\left(\text{College} - \text{Level Course Access}_j\right) + u_{0j},$$

where γ_{00} is the intercept, γ_{01-07} are slopes, and u_{0j} is the school-level random error.[27]

Missing data on outcome measures and covariates were addressed using multiple imputation via the multiple imputation chained equation (MICE) routine in Stata.[28] Multiple imputation reduces bias caused by missing data through a missing values prediction process that preserves important parts of, and connections within, the data distribution (Allison, 2001; Schafer & Olsen, 1998). In data sets with imputed values, the observed values are the same, but the missing values are filled in with a distribution of imputations that reflect the uncertainty about the missing data (Honaker & King, 2010). In most cases, it can be assumed that data are not missing completely at random but instead are missing at random (MAR); that is, missing data on particular measures are conditionally independent in the fully specified model (Rubin, 1987). Auxiliary variables are chosen because they are correlated with variables with missing data to support the MAR assumption. For this study, auxiliary variables included measures of the number of certified full-time mathematics teachers, parent race or ethnicity, level of parent education, whether math teachers completed an alternative form of teacher certification, and the school counselor's perception of the teacher workforce.

As noted, the number of students with data for the 2009, 2011, and 2013 surveys who also had high school transcript data totaled 15,190. However, the use of multiple imputation to address missing data resulted in a final sample of 15,120 cases with data for all study variables, because some data could not be imputed and the multilevel analyses could only include cases with data for all study variables. Thus multiple imputation was successfully used to predict and fill in missing values, bringing missing value rates down to 0%–0.04% prior to data analyses. Prior to imputation, rates of missing data among variables with missing values had ranged from 2% of data on measures of same-race teacher, student academic focus, and student talking to others about academics to 28%–30% of data on the percentage of math teachers with a master's degree or higher and ninth-grade math placement practices used by high schools.[29] The imputation converged within 100 iterations. Imputation resulted in the creation of 10 imputed data sets; the results presented in Appendix B to Appendix D and in the main body of the report were the result of aggregating estimates analyzed across five data sets containing imputed values.

Appendix B

Table B1 Patterns of College-level High School Course Taking, by Demographic Subgroups (Row Percentages)

		Took AP or IB courses		Took DE courses		Took AP or IB or DE courses	
	Total	*N*	%	*N*	%	*N*	%
Total	4,143,492	1,520,008	36.7	396,582	9.6	1,672,380	40.4
Student demographics							
Sex							
Male	2,084,953	664,659	31.9	174,732	8.4	740,646	35.5
Female	2,058,539	855,349	41.6	221,850	10.8	931,734	45.3
Immigrant status[a]							
First-generation	1,266,845	468,548	37.0	142,183	11.2	533,862	42.1
Other	2,875,140	938,426	32.6	381,901	13.3	1,122,513	39.0
Race[b]							
Hispanic	902,880	300,537	33.3	63,533	7.0	320,436	35.5
White	2,148,829	853,843	39.7	252,975	11.8	952,047	44.3
African American	567,947	136,458	24.0	32,758	5.8	155,205	27.3
Asian	146,718	105,769	72.1	16,973	11.6	108,515	74.0
Other[c]	377,120	123,401	32.7	30,342	8.0	136,177	36.1

Table B1 Continued

	Total	Took AP or IB courses		Took DE courses		Took AP or IB or DE courses	
		N	%	*N*	%	*N*	%
SES quintile							
First	805,605	169,417	21.0	34,686	4.3	188,163	23.4
Middle three	2,485,094	815,257	32.8	230,851	9.3	914,975	36.8
Fifth	852,792	535,334	62.8	131,044	15.4	569,242	66.8
Race by SES							
Asian							
Low	19,697	9,724	49.4	1,784	9.1	9,822	49.9
Middle	75,486	51,198	67.8	7,799	10.3	52,148	69.1
High	51,535	44,846	87.0	7,390	14.3	46,546	90.3
Hispanic							
Low	377,774	98,728	26.1	13,079	3.5	106,315	28.1
Middle	456,896	156,360	34.2	34,962	7.7	166,734	36.5
High	68,210	45,449	66.6	15,492	22.7	47,386	69.5
African American							
Low	150,574	18,410	12.2	8,320	5.5	22,912	15.2
Middle	361,847	92,818	25.7	21,064	5.8	106,414	29.4
High	55,527	25,230	45.4	3,374	6.1	25,879	46.6
White							
Low	208,131	33,652	16.2	9,660	4.6	38,805	18.6
Middle	1,332,382	439,823	33.0	148,195	11.1	506,501	38.0
High	608,315	380,369	62.5	95,120	15.6	406,741	66.9
Other race							
Low	55,073	6,868	12.5	1,842	3.3	8,275	15.0
Middle	237,407	72,460	30.5	18,268	7.7	80,525	33.9
High	64,210	36,379	56.7	9,668	15.1	39,629	61.7

[a] Immigration status data were missing for 1,508 students out of the weighted sample of 4,143,492. [b] Race categories exclude Hispanic origin unless otherwise specified. [c] Includes students who self-identified as American Indian or Alaska Native, Native Hawaiian or Other Pacific Islander, or two or more races.

Appendix C

Results Tables for Multilevel Models Predicting Whether Students Took Advanced Placement or International Baccalaureate and Dual Enrollment Courses

Table C1 Student-Level Predictors of Completion of Any Advanced Placement or International Baccalaureate Courses in High School

Predictor	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Fixed effects							
Student-level equation							
Intercept	0.401***	0.390***	0.178***	0.185***	0.103***	0.109***	0.125***
First-generation immigrant	1.422**	1.506***	1.517***	1.517***	1.528***	1.546***	1.546***
Male	0.602***	0.521***	0.556***	0.566***	0.582***	0.576***	0.576***
Race[a] (ref.: White)							
African American	0.524***	0.821	0.789	0.804	0.795	0.835	0.698
Hispanic	0.856	0.987	0.985	1.003	1.032	1.089	0.925
Asian	2.766***	1.968*	2.006*	1.929	1.851	2.003*	1.646
Other race[b]	0.674*	0.751	0.756	0.752	0.781	0.796	0.689
White × SES	2.036***	1.566***	1.501***	1.451***	1.381***	1.359***	1.356***
African American × SES	0.752	0.741	0.732	0.744	0.763	0.765	0.777
Asian × SES	0.761	0.756	0.776	0.778	0.798	0.787	0.785
Hispanic × SES	0.906	1.014	1.025	1.044	1.064	1.035	1.033
Other Race × SES	0.972	0.826	0.854	0.846	0.837	0.855	0.855
Ninth-grade math skills		3.276***	3.022***	2.912***	2.745***	2.728***	2.730***

Table C1 Continued

Predictor	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Student academic focus							
College access program participation[c]			1.118	1.098	1.100	1.090	1.089
Plans to take college exams			1.872***	1.830***	1.756***	1.717***	1.720***
Plans to enroll in college			1.485***	1.427***	1.376***	1.301**	1.299**
Parent involvement							
Family supports academic focus				1.950***	1.916***	1.575**	1.575**
Parent involvement in school				1.089	1.028	0.932	0.936
Peer academic focus							
Peers take college entrance exams					1.723***	1.735***	1.736***
Peers plan to attend college					1.527***	1.509***	1.515***
Student discusses course taking							
Talks to friends about academics						0.845	0.844
Talks to parents about academics						2.070***	2.071***
Talks to school staff about academics						1.157	1.161
Same-race math teacher							
White							0.856
African American							1.353
Hispanic							1.318
Asian							1.688
Random effects: Intercept	1.952***	2.177***	2.148***	2.16463***	2.150***	2.131***	2.114***

Note. The table presents odds ratios; the outcome variable is whether a student took any Advanced Placement or International Baccalaureate courses during high school. The intercept values are not a focus of this study; however, for those interested in their interpretation, the intercept is the value when all continuous variables are equal to their average and the dichotomous (0 or 1) variables are 0, such that the reference group is modeled. SES = socioeconomic status. Data are from fall 2009 student, counselor, school administrator, and teacher surveys and spring 2012 counselor surveys and high school transcripts of the *High School Longitudinal Study of 2009 (HSLS:09) 2013 Update and High School Transcripts Restricted-Use Data File* (Publication No. 2015038), U.S. Department of Education, National Center for Education Statistics. [a]Race categories exclude Hispanic origin, unless otherwise specified; note that in models with race × SES interaction terms, race dummy variables indicate students of a specific race from families of average SES. [b]Includes students who self-identified as American Indian or Alaska Native, Native Hawaiian or Other Pacific Islander, or two or more races. [c]Measure is a derived indicator of participation in one of five national college access programs (Talent Search, Upward Bound, Gear Up, AVID, or MESA) during high school. *$p < .05$. **$p < .01$. ***$p < .001$.

Table C2 Student- and School-Level Predictors of Completion of Any Advanced Placement or International Baccalaureate Courses in High School

Predictor	Model 8	Model 9	Model 10
Fixed effects			
Student-level equation			
Intercept	0.071***	0.013***	0.012***
First-generation immigrant	1.390**	1.415**	1.416**
Male	0.586***	0.588***	0.588***
Race[a] (ref.: White)			
African American	0.605	0.637	0.638
Hispanic	0.867	0.909	0.915
Asian	1.629	1.751	1.763
Other race[b]	0.698	0.705	0.708
SES	1.294***	1.296***	1.291***
African American × SES	0.821	0.798	0.801
Asian × SES	0.811	0.782	0.782
Hispanic × SES	1.095	1.083	1.088
Other Race × SES	0.882	0.862	0.863
Ninth-grade math skills	2.689***	2.652***	2.651***
Student academic focus			

Table C2 Continued

Predictor	Model 8	Model 9	Model 10
College access program participation[c]	1.069	1.029	1.027
Plans to take college exams	1.649***	1.666***	1.663***
Plans to enroll in college	1.330***	1.322***	1.318**
Parent involvement			
Parents support academic focus	1.605**	1.617**	1.617**
Parent involvement in school	0.979	1.014	1.010
Peer academic focus			
Peers take college entrance exams	1.700***	1.711***	1.710***
Peers plan to attend college	1.481***	1.443***	1.438***
Student discusses course taking			
Talks to friends about academics	0.845	0.861	0.861
Talks to parents about academics	2.030***	1.922***	1.921***
Talks to school staff about academics	1.158	1.139	1.142
Same-race math teacher			
White	0.963	1.003	1.015
African American	1.285	1.148	1.128
Hispanic	1.198	1.408	1.400
Asian	1.532	1.410	1.401
School-level equation			
Percentage underrepresented minority	1.022***	1.016***	1.016***
Percentage ELL	1.018	1.002	1.003
Percentage free/reduced-price lunch	0.988	0.994	0.995
Percentage special education	0.977	0.971*	0.973
Percentage alumni enrolled in college[d]	1.012	1.005	1.003
School over capacity[e]	1.153	0.830	0.832
Percentage math teachers with master's degree or higher	1.369	1.211	1.214
Public school (ref.: Private school)	2.111	1.391	1.496
School region (ref.: West)			
Northeast	1.945	1.487	1.511
Midwest	1.221	1.325	1.305
South	2.176**	1.724*	1.691*
School urbanicity (ref.: suburban)			
Urban	0.899	1.000	1.000
Rural	0.490**	0.674*	0.654*
AP or IB course access		11.809***	12.086***
School culture			
Lack of parent involvement[f]			0.890
Teacher culture/expectations[g]			0.828
Random effects: Intercept	1.563***	0.867***	0.862***

Note. The table presents odds ratios; the outcome variable is whether the student took any Advanced Placement or International Baccalaureate courses during high school. The intercept values are not a focus of this study; however, for those interested in their interpretation, the intercept is the value when all continuous variables are equal to their average and the dichotomous (0 or 1) variables are 0, such that the reference group is modeled. AP = Advanced Placement; ELL = English language learner; IB = International Baccalaureate; SES = socioeconomic status. Data are from fall 2009 student, counselor, school administrator, and teacher surveys and spring 2012 counselor surveys and high school transcripts of the *High School Longitudinal Study of 2009 (HSLS:09) 2013 Update and High School Transcripts Restricted-Use Data File* (Publication No. 2015038), U.S. Department of Education, National Center for Education Statistics. [a]Race categories exclude Hispanic origin, unless otherwise specified; note that in models with race × SES interaction terms, race dummy variables indicate students of a specific race from families of average SES. [b]Includes students who self-identified as American Indian or Alaska Native, Native Hawaiian or Other Pacific Islander, or two or more races. [c]Measure is a derived indicator of participation in one of five national college access programs (Talent Search, Upward Bound, Gear Up, AVID, or MESA) during high school. [d]Combines school administrator responses to survey items on the percentages of 2008–2009 seniors enrolling in 2-year or 4-year colleges. [e]An indicator of a school serving over 100% of the number of students for which the facility was designed based on an item on the school administrator survey asking for the percentage of capacity to which the school is filled. [f]Combines teacher, school administrator, and school counselor responses to a survey item inquiring about the extent to which a lack of parent involvement is problematic at the school. [g]Combines teacher survey items asking teachers to rate the extent to which teachers in the school set high standards for teaching and learning, believe all students can do well, have given up on some students, care only about smart students, expect little from students, and work hard to make sure all students learn. $^{*}p < .05$. $^{**}p < .01$. $^{***}p < .001$.

Table C3 Student-Level Predictors of Completion of Any Dual Enrollment Courses in High School

Predictor	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Fixed effects							
Student-level equation							
Intercept	0.051***	0.047***	0.032***	0.032***	0.027***	0.028***	0.021***
First-generation immigrant	1.189	1.182	1.201	1.216	1.217	1.208	1.229
Male	0.625***	0.615***	0.643***	0.655***	0.659***	0.668***	0.668***
Race[a] (ref.: White)							
African American	0.485**	0.588*	0.560*	0.560*	0.586*	0.594*	0.675
Hispanic	0.849	0.973	0.944	0.943	0.965	0.975	1.208
Asian	1.118	0.851	0.855	0.844	0.829	0.833	1.040
Other race[b]	0.831	0.885	0.895	0.882	0.877	0.882	1.147
SES	1.613***	1.309**	1.275*	1.211	1.191	1.191	1.180
African American × SES	0.501*	0.482*	0.472*	0.482*	0.503*	0.499*	0.512*
Asian × SES	0.748	0.785	0.794	0.802	0.813	0.819	0.810
Hispanic × SES	1.244	1.296	1.308	1.334	1.316	1.313	1.333
Other Race × SES	1.187	1.100	1.120	1.153	1.163	1.164	1.168
Ninth-grade math skills		1.971***	1.877***	1.820***	1.779***	1.770***	1.785***
Student academic focus							
College access program participation[c]			1.060	1.039	1.026	1.023	1.008
Plans to take college exams			1.066	1.033	1.010	0.995	0.992
Plans to enroll in college			1.584**	1.529**	1.528**	1.497**	1.493**
Parent involvement							
Parent supports academic focus				1.457	1.463	1.364	1.358
Parent involvement in school				1.728*	1.668	1.628	1.681
Peer academic focus							
Peers take college entrance exams					1.375*	1.366*	1.348*
Peers plan to attend college					0.966	0.961	0.976
Student discusses course taking							
Talks to friends about academics						1.122	1.130
Talks to parents about academics						1.103	1.093
Talks to school staff about academics						1.092	1.093
Same-race math teacher							
White							1.322
African American							1.961
Hispanic							1.495
Asian							1.659
Random effects: Intercept	3.536***	3.724***	3.760***	3.78401***	3.821***	3.819***	3.834***

Note. T he table presents odds ratios; the outcome variable is whether the student took any dual enrollment courses during high school. T he intercept values are not a focus of this study; however, for those interested in their interpretation, the intercept is the value when all continuous variables are equal to their average and the dichotomous (0 or 1) variables are 0, such that the reference group is modeled. SES = socioeconomic status. Data are from fall 2009 student, counselor, school administrator, and teacher surveys and spring 2012 counselor surveys and high school transcripts of the *High School Longitudinal Study of 2009 (HSLS:09) 2013 Update and High School Transcripts Restricted-Use Data File* (Publication No. 2015038), U.S. Department of Education, National Center for Education Statistics. $^{*}p < .05$. $^{**}p < .01$. $^{***}p < .001$. [a] Race categories exclude Hispanic origin, unless otherwise specified; note that in models with race × SES interaction terms, race dummy variables indicate students of a specific race from families of average SES. [b] Includes students who self-identified as American Indian or Alaska Native, Native Hawaiian or Other Pacific Islander, or two or more races. [c] Measure is a derived indicator of participation in one of five national college access programs (Talent Search, Upward Bound, Gear Up, AVID, or MESA) during high school.

Table C4 Student- and School-Level Predictors of Completion of any Dual Enrollment Courses in High School

Predictor	Model 8	Model 9	Model 10
Fixed effects			
Student-level equation			
Intercept	0.031***	0.004***	0.004***
First-generation immigrant	1.226	1.217	1.218
Male	0.670***	0.670***	0.669***
Race[a] (ref.: White)			
African American	0.693	0.681	0.687
Hispanic	1.234	1.207	1.206
Asian	1.063	1.046	1.046
Other race[b]	1.177	1.140	1.142
White × SES	1.175	1.191	1.191
African American × SES	0.520*	0.510*	0.510*
Asian × SES	0.833	0.863	0.865
Hispanic × SES	1.355	1.339	1.343
Other Race × SES	1.186	1.176	1.176
Ninth-grade math skills	1.791***	1.806***	1.808***
Student academic focus			

Table C4 Continued

Predictor	Model 8	Model 9	Model 10
College access program participation[c]	0.994	1.001	1.004
Plans to take college exams	0.990	0.993	0.992
Plans to enroll in college	1.491**	1.498**	1.501**
Parent involvement			
Parent supports academic focus	1.375	1.376	1.373
Parent involvement in school	1.615	1.620	1.621
Peer academic focus			
Peers take college entrance exams	1.357*	1.373*	1.372*
Peers plan to attend college	0.983	0.984	0.983
Student discusses course taking			
Talks to friends about academics	1.132	1.128	1.130
Talks to parents about academics	1.104	1.095	1.093
Talks to school staff about academics	1.110	1.088	1.086
Same-race math teacher			
White	1.390	1.329	1.328
African American	1.822	1.802	1.811
Hispanic	1.307	1.305	1.297
Asian	1.648	2.017	2.035
School-level equation			
Percentage underrepresented minority	0.998	1.000	1.000
Percentage ELL	1.023	1.017	1.016
Percentage free/reduced-price lunch	1.000	0.998	0.998
Percentage special education	0.970	0.973	0.971
Percentage alumni enrolled in college[d]	0.979*	0.981*	0.982*
School over capacity[e]	0.746	1.101	1.079
Percentage math teachers with master's degree or higher	1.190	1.370	1.382
Public school (ref.: Private school)	0.631	0.392	0.375
School region (ref.: West)			
Northeast	0.636	0.626	0.636
Midwest	0.872	0.844	0.866
South	1.206	1.043	1.089
School urbanicity (ref.: suburban)			
Urban	0.989	0.949	0.977
Rural	1.014	1.054	1.098
Dual enrollment course access		14.876***	14.784***
School culture			
Lack of parent involvement[f]			1.004
Teacher culture/expectations[g]			1.370
Random effects: Intercept	3.727***	3.425***	3.404***

Note. The table presents odds ratios; the outcome variable is whether the student took any dual enrollment courses during high school. The intercept values are not a focus of this study; however, for those interested in their interpretation, the intercept is the value when all continuous variables are equal to their average and the dichotomous (0 or 1) variables are 0, such that the reference group is modeled. ELL = English language learner; SES = socioeconomic status. Data are from fall 2009 student, counselor, school administrator, and teacher surveys and spring 2012 counselor surveys and high school transcripts of the *High School Longitudinal Study of 2009 (HSLS:09) 2013 Update and High School Transcripts Restricted-Use Data File* (Publication No. 2015038), U.S. Department of Education, National Center for Education Statistics. $^{*}p < .05$. $^{**}p < .01$. $^{***}p < .001$. [a]Race categories exclude Hispanic origin, unless otherwise specified; note that in models with race × SES interaction terms, race dummy variables indicate students of a specific race from families of average SES. [b]Includes students who self-identified as American Indian or Alaska Native, Native Hawaiian or Other Pacific Islander, or two or more races. [c]Measure is a derived indicator of participation in one of five national college access programs (Talent Search, Upward Bound, Gear Up, AVID, or MESA) during high school. [d]Combines school administrator responses to survey items on the percentages of 2008–2009 seniors enrolling in 2-year or 4-year colleges. [e]An indicator of a school serving over 100% of the number of students for which the facility was designed based on an item on the school administrator survey asking for the percentage of capacity to which the school is filled. [f]Combines teacher, school administrator, and school counselor responses to a survey item inquiring about the extent to which a lack of parent involvement is problematic at the school. [g]Combines teacher survey items asking teachers to rate the extent to which teachers in the school set high standards for teaching and learning, believe all students can do well, have given up on some students, care only about smart students, expect little from students, and work hard to make sure all students learn.

Appendix D

Results Tables for Multilevel Models Predicting the Number of Advanced Placement or International Baccalaureate and Dual Enrollment Courses Taken by Students Who Took Advanced Placement or International Baccalaureate and Dual Enrollment Courses

Table D1 Student-Level Predictors of Number of Advanced Placement or International Baccalaureate Courses Completed in High School (Part 1: Models 1–7)

Predictor	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Fixed effects							
Student-level equation							
Intercept	2.393***	2.124***	1.676***	1.708***	1.506***	1.538***	1.508**
First-generation immigrant	1.017	1.015	1.016	1.021	1.021	1.019	1.021
Male	0.966	0.895***	0.909**	0.915**	0.915**	0.919**	0.919**
Race[a] (ref.: White)							
African American	0.877	0.973	0.970	0.978	0.981	0.987	0.998
Hispanic	1.076	1.102	1.101	1.109	1.113	1.127*	1.161
Asian	1.394***	1.339***	1.345***	1.337***	1.326***	1.339***	1.363**
Other race[b]	0.980	1.008	1.011	1.007	1.016	1.017	1.037
SES	1.158***	1.108***	1.103***	1.092***	1.083***	1.084***	1.084***
African American × SES	0.904	0.889	0.882	0.887	0.893	0.891	0.888
Asian × SES	0.998	0.980	0.979	0.976	0.983	0.981	0.982
Hispanic × SES	1.002	0.996	0.991	0.994	0.994	0.987	0.989
Other Race × SES	1.102*	1.047	1.041	1.045	1.038	1.043	1.044
Math test score		1.358***	1.337***	1.326***	1.314***	1.311***	1.310***
Student academic focus							
College access program participation			1.022	1.010	1.006	0.999	0.998
Plans to take college exams			1.241***	1.229***	1.219***	1.208***	1.209***
Plans to enroll in college			1.061	1.049	1.045	1.034	1.033
Parent involvement							
Parent supports academic focus				1.148***	1.146***	1.099**	1.099**
Parent involvement in school				1.080	1.075	1.053	1.054
Peer academic focus							
Peers take college entrance exams					1.118*	1.115*	1.115*
Peers plan to attend college					1.077	1.073	1.074
Student discusses course taking							
Talks to friends about academics						1.052	1.054
Talks to parents about academics						1.099	1.100
Talks to school staff about academics						1.034	1.028
Same-race math teacher							
White							1.021
African American							1.000
Hispanic							0.848
Asian							1.000
Random effects: Intercept	0.155***	0.154***	0.152***	0.154***	0.151***	0.151***	0.151***

Note. The table presents incident rate ratios from hierarchical generalized linear modeling with a Poisson distribution; the outcome variable is the number of Advanced Placement or International Baccalaureate courses completed during high school. The intercept values are not a focus of this study; however, for those interested in their interpretation, the intercept is the value when all continuous variables are equal to their average and the dichotomous (0 or 1) variables are 0, such that the reference group is modeled. SES = socioeconomic status. Data are from fall 2009 student, counselor, school administrator, and teacher surveys and high school transcripts of the *High School Longitudinal Study of 2009 (HSLS:09) 2013 Update and High School Transcripts Restricted-Use Data File* (Publication No. 2015038), U.S. Department of Education, National Center for Education Statistics.

[a] Race categories exclude Hispanic origin, unless otherwise specified. [b] Includes parents who self-identified as American Indian or Alaska Native, Native Hawaiian or Other Pacific Islander, or two or more races.

*$p < .05$. **$p < .01$. ***$p < .001$.

Table D2 Student- and School-Level Predictors of Number of Advanced Placement or International Baccalaureate Courses Completed in High School (Part 2: Models 8 – 10)

Predictor	Model 8	Model 9	Model 10
Fixed effects			
Student-level equation			
Intercept	1.361	0.882	0.896
First-generation immigrant	1.009	1.016	1.015
Male	0.921**	0.923**	0.923**
Race[a] (ref.: White)			
African American	0.977	0.998	0.998
Hispanic	1.142	1.145	1.145
Asian	1.366**	1.363**	1.364**
Other race[b]	1.048	1.043	1.042
SES	1.081***	1.078***	1.080***
African American × SES	0.897	0.883	0.881*
Asian × SES	0.992	0.992	0.990
Hispanic × SES	1.000	1.003	1.002
Other Race × SES	1.048	1.049	1.048
Math test score	1.305***	1.304***	1.305***
Student academic focus			
College access program participation	0.997	0.990	0.991
Plans to take college exams	1.189***	1.196***	1.197***
Plans to enroll in college	1.038	1.044	1.044
Parent involvement			
Parent supports academic focus	1.095*	1.102**	1.101**
Parent involvement in school	1.071	1.076	1.076
Peer academic focus			
Peers take college entrance exams	1.108*	1.107*	1.108*
Peers plan to attend college	1.066	1.065	1.066
Student discusses course taking			
Talks to friends about academics	1.052*	1.050	1.049
Talks to parents about academics	1.100	1.104	1.104
Talks to school staff about academics	1.028	1.028	1.027
Same-race math teacher			
White	1.050	1.053	1.050
African American	0.991	0.962	0.967
Hispanic	0.840	0.847	0.852
Asian	0.958	0.953	0.953
School-level equation			
Percentage underrepresented minority	1.003*	1.003	1.003
Percentage ELL	1.002	1.002	1.002
Percentage free/reduced-price lunch	1.000	1.000	1.000
Percentage special education	1.006	1.004	1.003
Percentage alumni enrolled in college[c]	1.006**	1.005*	1.005*
School over capacity[d]	1.169**	1.134*	1.128*
Percentage math teachers with master's degree or higher	1.291**	1.270**	1.265**
Public school (ref.: Private school)	1.203	1.178	1.153
School region (ref.: West)			
Northeast	1.008	0.984	0.976
Midwest	0.819*	0.817**	0.820*
South	1.082	1.069	1.073
School urbanicity (ref.: suburban)			
Urban	1.060	1.074	1.070
Rural	0.874	0.881	0.883
AP or IB course access		1.617**	1.621**

Table D2 Continued

Predictor	Model 8	Model 9	Model 10
School culture			
Lack of parent involvement[e]			1.055
Teacher culture/expectations[f]			1.003
Random effects: Intercept	0.103***	0.093***	0.093***

Note. The table presents incident rate ratios from hierarchical generalized linear modeling with a Poisson distribution; the outcome variable is number of Advanced Placement or International Baccalaureate courses completed during high school. The intercept values are not a focus of this study; however, for those interested in their interpretation, the intercept is the value when all continuous variables are equal to their average and the dichotomous (0 or 1) variables are 0, such that the reference group is modeled. AP = Advanced Placement; ELL = English language learner; IB = International Baccalaureate; SES = socioeconomic status. Data are from fall 2009 student, counselor, school administrator, and teacher surveys and high school transcripts of the *High School Longitudinal Study of 2009 (HSLS:09) 2013 Update and High School Transcripts Restricted-Use Data File* (Publication No. 2015038), U.S. Department of Education, National Center for Education Statistics.

[a]Race categories exclude Hispanic origin, unless otherwise specified. [b]Includes parents who self-identified as American Indian or Alaska Native, Native Hawaiian or Other Pacific Islander, or two or more races. [c]Combines school administrator responses to survey items on the percentages of 2008–2009 seniors enrolling in 2-year or 4-year colleges. [d]An indicator of a school serving over 100% of the number of students for which the facility was designed based on an item on the school administrator survey asking for the percentage of capacity to which the school is filled. [e]Combines teacher, school administrator, and school counselor responses to a survey item inquiring about the extent to which a lack of parent involvement is problematic at the school. [f]Combines teacher survey items asking teachers to rate the extent to which teachers in the school set high standards for teaching and learning, believe all students can do well, have given up on some students, care only about smart students, expect little from students, and work hard to make sure all students learn.

$^{*}p < .05$. $^{**}p < .01$. $^{***}p < .001$.

Table D3 Student-Level Predictors of Number of Dual Enrollment Courses Completed in High School (Part 1: Models 1–7)

Predictor	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Fixed effects							
Student-level equation							
Intercept	0.077***	0.062***	0.049***	0.050***	0.047***	0.045***	0.049***
First-generation immigrant	1.373	1.425	1.446	1.443	1.433	1.423	1.399
Male	0.828	0.807*	0.828*	0.853	0.853	0.868	0.865
Race[a] (ref.: White)							
African American	0.525*	0.614	0.617	0.628	0.626	0.639	0.637
Hispanic	0.859	0.933	0.911	0.928	0.939	0.948	0.832
Asian	0.989	0.909	0.939	0.919	0.926	0.925	0.864
Other race[b]	0.783	0.789	0.789	0.771	0.773	0.770	0.706
SES	1.151*	1.091	1.077	1.060	1.056	1.076	1.079
African American × SES	1.022	0.977	1.003	1.003	1.013	1.011	1.036
Asian × SES	0.943	0.939	0.936	0.947	0.939	0.943	0.909
Hispanic × SES	1.286	1.279	1.289	1.289	1.282	1.280	1.279
Other Race × SES	1.090	1.022	1.034	1.042	1.031	1.031	1.025
Math test score		1.445***	1.423***	1.395***	1.395***	1.394***	1.393***
Student academic focus							
College access program participation			0.903	0.897	0.900	0.892	0.901
Plans to take college exams			1.073	1.060	1.058	1.069	1.078
Plans to enroll in college			1.253*	1.221	1.213	1.232	1.237
Parent involvement							
Parent supports academic focus				1.284	1.275	1.316	1.322*
Parent involvement in school				1.205	1.205	1.243	1.257
Peer academic focus							
Peers take college entrance exams					0.998	0.999	1.004
Peers plan to attend college					1.123	1.118	1.108

Table D3 Continued

Predictor	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Student discusses course taking							
Talks to friends about academics						1.169	1.169
Talks to parents about academics						0.776	0.772
Talks to school staff about academics						1.029	1.041
Same-race math teacher							
White							0.905
African American							0.271
Hispanic							1.417
Asian							1.192
Random effects: Intercept	4.743***	4.868***	4.830***	4.811***	4.830***	4.878***	4.848***

Note. The table presents incident rate ratios from hierarchical generalized linear modeling with a Poisson distribution; the outcome variable is number of dual enrollment courses completed during high school. The intercept values are not a focus of this study; however, for those interested in their interpretation, the intercept is the value when all continuous variables are equal to their average and the dichotomous (0 or 1) variables are 0, such that the reference group is modeled. SES = socioeconomic status. Data are from fall 2009 student, counselor, school administrator, and teacher surveys and high school transcripts of the *High School Longitudinal Study of 2009 (HSLS:09) 2013 Update and High School Transcripts Restricted-Use Data File* (Publication No. 2015038), U.S. Department of Education, National Center for Education Statistics.

[a] Race categories exclude Hispanic origin, unless otherwise specified. [b] Includes parents who self-identified as American Indian or Alaska Native, Native Hawaiian or Other Pacific Islander, or two or more races.

*$p < .05$. **$p < .01$. ***$p < .001$.

Table D4 Student- and School-Level Predictors of Number of Dual Enrollment Courses Completed in High School (Part 2: Models 8–10)

Predictor	Model 8	Model 9	Model 10
Fixed effects			
Student-level equation			
Intercept	0.104***	0.014***	0.014***
First-generation immigrant	1.397	1.390	1.389
Male	0.864	0.863	0.863
Race[a] (ref.: White)			
African American	0.635	0.634	0.636
Hispanic	0.839	0.837	0.836
Asian	0.868	0.870	0.870
Other race[b]	0.703	0.700	0.700
SES	1.077	1.079	1.080
African American × SES	1.057	1.047	1.041
Asian × SES	0.915	0.917	0.917
Hispanic × SES	1.274	1.270	1.270
Other Race × SES	1.031	1.030	1.029
Math test score	1.396***	1.400***	1.400***
Student academic focus			
College access program participation	0.899	0.903	0.903
Plans to take college exams	1.076	1.075	1.075
Plans to enroll in college	1.233	1.237	1.237
Parent involvement			
Parent supports academic focus	1.320*	1.318*	1.318*
Parent involvement in school	1.243	1.246	1.246
Peer academic focus			
Peers take college entrance exams	1.006	1.010	1.010
Peers plan to attend college	1.115	1.117	1.118
Student discusses course taking			
Talks to friends about academics	1.167	1.165	1.165
Talks to parents about academics	0.774	0.771	0.771
Talks to school staff about academics	1.041	1.039	1.040
Same-race math teacher			
White	0.910	0.903	0.902
African American	0.244	0.241	0.243
Hispanic	1.385	1.392	1.393
Asian	1.195	1.248	1.250

Table D4 Continued

Predictor	Model 8	Model 9	Model 10
School-level equation			
Percentage underrepresented minority	1.002	1.003	1.004
Percentage ELL	1.010	1.004	1.003
Percentage free/reduced-price lunch	0.987	0.985	0.984
Percentage special education	1.003	1.013	1.011
Percentage alumni enrolled in college[c]	0.971*	0.976*	0.977*
School over capacity[d]	0.582	0.896	0.890
Percentage math teachers with master's degree or higher	0.575	0.772	0.772
Public school (ref: Private school)	0.516	0.331*	0.312*
School region (ref.: West)			
Northeast	0.575	0.575	0.564
Midwest	0.683	0.613	0.611
South	1.030	0.924	0.936
School urbanicity (ref.: suburban)			
Urban	0.766	0.762	0.771
Rural	1.221	1.345	1.394
Dual enrollment course access		15.548***	15.160***
School culture			
Lack of parent involvement[e]			1.058
Teacher culture/expectations[f]			1.236
Random effects: Intercept	4.588***	4.107***	4.094***

Note. The table presents incident rate ratios from hierarchical generalized linear modeling with a Poisson distribution; the outcome variable is number of dual enrollment courses completed during high school. The intercept values are not a focus of this study; however, for those interested in their interpretation, the intercept is the value when all continuous variables are equal to their average and the dichotomous (0 or 1) variables are 0, such that the reference group is modeled. ELL = English language learner; SES, socioeconomic status. Data are from fall 2009 student, counselor, school administrator, and teacher surveys and high school transcripts of the *High School Longitudinal Study of 2009 (HSLS:09) 2013 Update and High School Transcripts Restricted-Use Data File* (Publication No. 2015038), U.S. Department of Education, National Center for Education Statistics.

[a] Race categories exclude Hispanic origin, unless otherwise specified. [b] Includes parents who self-identified as American Indian or Alaska Native, Native Hawaiian or Other Pacific Islander, or two or more races. [c] Combines school administrator responses to survey items on the percentages of 2008–2009 seniors enrolling in 2-year or 4-year colleges. [d] An indicator of a school serving over 100% of the number of students for which the facility was designed based on an item on the school administrator survey asking for the percentage of capacity to which the school is filled. [e] Combines teacher, school administrator, and school counselor responses to a survey item inquiring about the extent to which a lack of parent involvement is problematic at the school. [f] Combines teacher survey items asking teachers to rate the extent to which teachers in the school set high standards for teaching and learning, believe all students can do well, have given up on some students, care only about smart students, expect little from students, and work hard to make sure all students learn.

$^{*}p < .05$. $^{**}p < .01$. $^{***}p < .001$.

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