



# Long-term Consequences of Early Access to Educational Opportunity

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This paper examines the long-term consequences of tracking in middle school. Using longitudinal administrative data from a large, urban school district and regression and quasi-experimental matching methods, we find that students who had the opportunity to take advanced math earned higher math test scores, completed more rigorous high school coursework, and were more likely to attend a four-year college. These effects largely hold across student subgroups and are relatively robust to omitted confounders. We explore mechanisms underlying the short-term effects of taking advanced math and conclude that differences in classroom composition rather than differences in teachers help explain these effects. We conclude by discussing the implications of these results for efforts to improve educational equity.

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## **Long-term Consequences of Early Access to Educational Opportunity**

**Abstract:** This paper examines the long-term consequences of tracking in middle school. Using longitudinal administrative data from a large, urban school district and regression and quasi-experimental matching methods, we find that students who had the opportunity to take advanced math earned higher math test scores, completed more rigorous high school coursework, and were more likely to attend a four-year college. These effects largely hold across student subgroups and are relatively robust to omitted confounders. We explore mechanisms underlying the short-term effects of taking advanced math and conclude that differences in classroom composition rather than differences in teachers help explain these effects. We conclude by discussing the implications of these results for efforts to improve educational equity.

**Keywords:** academic tracking, advanced math, advanced courses, course access, college access

Educational outcomes in the U.S. continue to be highly stratified by social class and race/ethnicity (Duncan & Murnane, 2011; Kao & Thompson, 2003). For over a century, social scientists have studied the ways that educational institutions exacerbate or narrow these inequalities. Much of this literature has focused on how curriculum differentiation (i.e., tracking or ability grouping) affects academic stratification. Although curriculum differentiation has evolved over time, from a system of enrolling students in separate “tracks” of courses (e.g., academic or vocational) to an ostensibly more flexible system in which students can enroll in more or less advanced courses in different subject areas (Lucas, 1999), students from low-income families, and Latinx and Black students, are less likely to be enrolled in advanced courses than their higher-income and white and Asian American peers (Rees et al., 1996; Walston & McCarroll, 2010).

Social scientists’ interest in curricular differentiation stems largely from the concern that disparities in access to advanced coursework, both between and within schools, contribute to social stratification in adulthood (e.g., Persell, 1977; Rosenbaum, 1976). Policymakers have responded to this concern by taking two contrasting approaches to reducing disparities in advanced course-taking, particularly in math. One approach has been to expand access to advanced courses. Throughout the 1980s and 1990s, the percentages of students taking advanced math courses increased, which, in turn, reduced social class and ethnic disparities in advanced course-taking (Domina & Saldana, 2012). That trend continued during the first decade of the 2000s—with the percentage of U.S. eighth graders enrolled in Algebra I or higher increasing from less than a third in 2000 to nearly half by 2011 (Loveless, 2013).

Over the last decade, however, enrollment in advanced middle school math courses has declined by about 10 percentage points nationally and by over 40 percentage points in the Los

Angeles Unified School District (LAUSD), the focus of our study (see Appendix Table A1). These trends follow the adoption of new math standards in many states (known as the “Common Core”), which incorporated more algebra content throughout the grades and promoted a non-Algebra I eighth grade math course for all students (Loveless, 2016).

A longstanding literature has examined inequities in access to advanced courses, differences in students’ educational experiences in those courses, and the effects of course differentiation on students’ educational outcomes (for a review, see Gamoran, 2009). Yet little research has investigated these topics during this recent period of reduced access to advanced middle school math, when students who may have benefited from advanced math had fewer opportunities to take it. In addition, scholars know too little about the longer-term educational impacts of enrolling in advanced math, the effects of advanced coursework on behavioral and socioemotional outcomes, and why students may benefit from taking advanced math.

We investigate these topics by studying the effects of taking advanced seventh-grade math in a school district where the course is a prerequisite to taking Algebra I in eighth grade and where most students come from low-income families and are of Latinx heritage. In this majority-minority context, any advantages of taking advanced middle school math will accrue mostly to low-income students of color, and thus the results can inform scholarly and policy debates about how best to structure educational opportunity to achieve both equity and excellence.

Students are not randomly assigned to math courses, so the key methodological challenge in estimating the effect of advanced coursework is to approximate the causal effect using observational data. Moreover, because selection into advanced math is typically positive (i.e., students are more likely to take advanced math when they are higher achieving or have more involved parents), estimates that do not account for this selection process will be too large (i.e.,

what seem like effects of advanced math will instead, at least partially, reflect effects of the factors that lead some students to be more likely to take the course). Scholars generally take one of two approaches to approximating the causal effects of course taking. One approach compares students who took different math courses yet were otherwise similar on observed variables prior to course placement, using regression models, propensity score matching, or both (e.g., Domina, 2014; Hoffer, 1992; Simzar et al., 2016). A second approach uses natural experiments (e.g., Clotfelter et al., 2015; Dougherty et al., 2017; McEachin et al., 2020).

We use a variety of approaches that equate students on observables prior to course placement, including regression, weighting, and matching. We do this because our data include a very large set of observables measured prior to course placement and we lack a plausible natural experiment for most of the students in our sample. We do, however, incorporate two different types of natural experiments that apply to a subset of the schools or students in our sample. Specifically, we examine the middle school outcomes of students who differed in their course enrollment because their school did not always offer the advanced math course or who differed in their course enrollment yet lived in the same household. In addition, we assess how biased our estimated effects are likely to be, both by estimating effects of taking advanced seventh-grade math on outcomes that should not be affected by the course and by using robustness tests to estimate the likelihood that unobserved confounders would invalidate our results. Although we use causal language in our exposition, we caution readers to remain attuned to the potential for upward bias in our estimates, a point we return to in our discussion.

### **Background**

Scholarly research has focused on three main aspects of the link between curricular differentiation and educational inequality: 1) disparities in students' access to advanced

coursework; 2) disparities in students' experiences in advanced versus general courses; and 3) the impact of advanced versus general courses on students' academic outcomes.

### **Disparities in Access to Advanced Coursework**

Black and Latinx students, and students from families with low incomes and less education, tend to be less likely than their higher-income, white and Asian American peers to take advanced math courses (Attewell & Domina, 2008; Domina, 2014; Dougherty et al., 2015; Lucas, 1999). These disparities stem in part from differences in students' academic preparation. However, even among students with similar academic performance prior to course placement, studies tend to find small social class disparities in course placement. Among students who have similar social class backgrounds and academic performance prior to course placement, studies tend to find that Black and Latinx students are equally or more likely than white students to be enrolled in advanced courses, but that Asian American students are more likely than students from other ethnic backgrounds to be enrolled in advanced courses (e.g., Attewell & Domina, 2008; Dauber et al., 1996; Domina, 2014).

Course-taking disparities also arise because schools that serve large percentages of minoritized and socioeconomically disadvantaged students offer fewer advanced courses (Wolfe et al., 2023). In 2017-18, for example, about 50 percent of high schools that served large percentages of low-income students or students of color did not offer a calculus course (Leung et al., 2021). Because course offerings and course placement disparities vary across contexts (Hanselman et al., 2022; Kelly & Price, 2011; Lucas & Berends, 2007), we begin this paper by describing ethnic and social class stratification in advanced seventh-grade math in our sample.

### **Differences between Advanced and General Courses**

Advanced and general courses tend to differ in the students they enroll, their educational

practices, and their teaching quality (see Gamoran and Berends (1987) for a review). Because the rationale for offering both advanced and general math courses is that students need curricula and instruction tailored to their math skills, advanced math courses tend to serve higher achieving students, on average, than general math courses (Dougherty et al., 2017). And because students' math achievement tends to be correlated with their social background, effort in school, classroom behavior, and educational aspirations, students who take different math courses not only have classmates with higher math achievement but also tend to experience a different social environment in their math courses (Alexander et al., 1978; Carbonaro, 2005).

Advanced courses may also differ from general courses in their instructional quality. Early studies indicated that teachers of non-advanced courses taught a lower quality curriculum (Rosenbaum, 1976; Oakes, 1985) and were less satisfied with their jobs. More recent work from Wake County Public Schools finds that advanced middle school math courses are larger, by about five students, than general middle school math courses, but does not find statistically significant differences between advanced and general math courses in teachers' experience, contribution to student test score gains (i.e., "value added"), or demographics (Dougherty et al., 2017). Students' experiences in advanced and general courses may also differ because teachers' expectations for students (Kelly & Carbonaro, 2012; Oakes, 1982; Oakes, 1985), their instructional practices (e.g., Gamoran & Carbonaro, 2002; Mayer et al., 2018), and their responses to students' behavior (e.g., Musto, 2019) vary across advanced and general courses. We add to this literature by exploring the extent to which differences between general and advanced math students' end-of-seventh-grade math test scores and grades stem from differences in who teaches those courses, both in terms of aspects of teaching quality we can measure in our data, such as teachers' experience or math credentials, and overall. We do this by focusing a

subset of our analyses on a sample of seventh-grade students enrolled in either general or advanced math taught by the same teacher in the same year.

### **Effects of Advanced Courses**

Many scholars have estimated the impact of taking advanced courses on students' learning and educational attainment using nationally representative samples. For example, Gamoran (1987) found that students learned more math between 10<sup>th</sup> and 12<sup>th</sup> grade when they took more advanced math courses, and that this positive association held even for students with relatively weak math skills. Gamoran and Hannigan (2000) found similar results for 10<sup>th</sup>-grade math scores among students who took algebra in eighth grade, and Schneider et al. (1998) found that taking more advanced math courses in 12<sup>th</sup> grade improved students' math scores and college enrollment. Attewell and Domina (2008) showed that taking more math courses (and more advanced math courses) in high school improved students' chances of completing college.

Studies of the effects of middle school math course-taking are less common, and those using nationally-representative data have been limited to looking at short-term effects on test scores. These studies find positive effects on middle school math test scores ranging in size from around half a standard deviation in the late 1980s (Hoffer, 1992) to about a tenth of a standard deviation in the mid-2000s (Domina, 2014).

To our knowledge, Simzar et al. (2016) is the only study to estimate the impact of advanced math course-taking in middle school on students' behavioral or socioemotional outcomes. Studying a sample of middle schools from an urban district in California, they found that eighth graders enrolled in Algebra I reported lower self-efficacy in math by the end of the year (by about a quarter of a standard deviation) than otherwise similar eighth graders enrolled in general math, and that these effects were most pronounced among lower-achieving students.

Several studies have examined the longer-term effects of middle school math placement using data from specific school districts or states. Perhaps because of these contextual differences, these studies have yielded conflicting results. Clotfelter et al. (2015) studied the impact of school districts expanding access to eighth-grade algebra in the early 2000s in North Carolina. They found negative or null effects of eighth-grade algebra on students' end-of-course algebra test scores, negative effects on passing geometry by the end of 11<sup>th</sup> grade, and negative or null effects on passing Algebra II by the end of 12<sup>th</sup> grade. Their results suggest that the effects of taking algebra in eighth grade are especially negative for low-achieving students. In contrast, McEachin et al. (2020) estimated the impact of taking algebra in eighth grade using a sample of students who were in middle school in California between 2007 and 2011. They found that enrolling in eighth-grade algebra improved math scores in 10<sup>th</sup> grade slightly and boosted enrollment in advanced high school math courses considerably.

Dougherty et al. (2017) is the most similar study to ours because they examine the impact of taking advanced math in seventh grade on both middle school and high school outcomes. Using a longitudinal sample of students from Wake County, NC who were in seventh grade in 2011-2013, they found null effects of enrollment in advanced seventh grade math on math and reading test scores at the end of seventh grade (their results are imprecise, however, so they are unable to rule out positive effects on math as large as .25 standard deviations) and they found large positive effects on high school course taking. Students who took advanced math in seventh grade were 33 percentage points more likely to pass geometry in ninth grade, 18 percentage points more likely to pass Algebra II in 10<sup>th</sup> grade, and possibly more likely to pass precalculus in 11<sup>th</sup> grade (their point estimate is positive but imprecise). They also found positive effects on the 10<sup>th</sup> grade PLAN ACT test (a composite of math, science, English, and reading), imprecise

but positive estimates for the math ACT, and large positive effects, approximately 25 percentage points, on 10<sup>th</sup> graders' plans to attend a four-year college. Their effects were largest for girls and for students from higher-income families. We add to this literature by using a recent, large, longitudinal sample to estimate the effects of taking advanced seventh-grade math on short and long-term academic, behavioral, socioemotional, and college readiness outcomes, including college enrollment.

### **Data and Sample**

Our primary data source is an administrative data set that includes the universe of students enrolled in the Los Angeles Unified School District during the 2009–10 through 2020–21 academic years. These data include measures of students' demographic characteristics, academic achievement, school-related behavior, and course-taking. We link these administrative data to students' responses to the district's annual school climate survey, National Student Clearinghouse (NSC) data on their college enrollment, and district human resources data about their math teachers' demographic characteristics, educational background, and teaching credentials.

We construct longitudinal cohorts of students who were first-time seventh graders in 2015-16, 2016-17, 2017-18, or 2018-19. From these cohorts, we then create several analytic samples for each of our data sources and years. Our largest analytic sample includes all the first-time seventh graders who had not taken an advanced math course in sixth grade (only 3% of seventh graders took advanced math in sixth grade), took a full year of general or advanced math in seventh grade, had non-missing data for key predictors (including standardized test scores, academic grades, academic program (e.g., classified as gifted), gender, ethnicity, and English language learner status), and had non-missing data for key administrative outcomes from the end

of seventh grade (including standardized test scores, grades, and attendance). This sample includes 108,413 seventh graders from 126 schools and 5,083 math classrooms. Most of these students were Latinx (78%), low income (89%), multilingual (64%), and scored below grade level on their sixth-grade standardized math test (74%).

Our other analytic samples are subsets of this sample. Those analytical samples are smaller, either because they follow students over a longer time period, use outcome measures derived from surveys (which are subject to non-response), or include only those cohorts that have aged enough for us to measure particular outcomes. We use these different samples to maximize statistical power and so that our results for the shorter-term outcomes are more generalizable (i.e., less affected by sample attrition that occurs as students progress through middle and high school). Appendix Table A2 shows the cohorts we include in each of the analytic samples and their Ns. Appendix Table A3 shows descriptive statistics for each analytic sample and indicates that our samples are somewhat more positively selected as students age.

## **Measures**

### **Student Characteristics**

We measure a large set of student characteristics prior to seventh-grade math course placement because our analytic approaches require that we account for as many important predictors of both math course placement and the outcomes as possible. These predictors include demographic characteristics (e.g., age, gender, and ethnicity); family background characteristics (e.g., eligibility for subsidized meals, parents' education, and school mobility); academic program, including receiving special education services, being identified as gifted and talented, and English-language learner status; academic performance as measured by two years of standardized test scores and fifth and sixth grade grades; sixth grade course-taking; school-

related behavior including attendance, suspension, teacher-reported work effort, and student-reported work effort and classroom behavior; and students' reports of their growth mindset, academic self-efficacy, and educational expectations (see Appendix Table A4 for more details).

### **Outcomes**

We measure a number of middle school and high school academic outcomes, including students' middle school standardized test scores, 10<sup>th</sup> grade PSAT scores, and likelihood of passing an Advanced Placement (AP) exam; students' middle and high school math and overall grades; students' high school course-taking, including whether they passed or earned a "B" or better in Algebra I by the end of ninth grade, took calculus or another higher-level math course in high school, and the number of semesters of honors, AP, International Baccalaureate (IB), or "advanced" academic, math, and science courses they passed in high school (see Long et al., 2012). We also measure students' academic self-efficacy and school-related behavior, including their annual attendance rate, teacher-reported behavior grades, and self-reported behavior. Finally, we measure college-related outcomes including educational expectations, reports of receiving college-access support from school staff, four-year college eligibility, college math course eligibility, and college enrollment (see Appendix Table A4 for more details).

### **Potential Mechanisms for the Effects on Seventh-Grade Outcomes**

We also measure peer and teacher characteristics of students' seventh-grade math courses that may contribute to the effect of taking advanced math. We construct classroom-level measures of seventh-grade class size and classmate characteristics, including means and standard deviations of classmates' sixth-grade standardized test scores, math GPAs, and self-reported sixth-grade classroom behavior, and the percentages of classmates who, in sixth grade, expected to earn a bachelor's degree or higher.

For seventh-grade teachers, we construct indicators for whether they were novices (i.e., had two or fewer years of teaching experience), long-term substitutes, or National Board Certified; the type of math credential they held (i.e., a multisubject credential, which licenses them to teach general middle school math; a foundational math credential, which licenses them to teach math through Algebra II; or a full math credential, which licenses them to teach all secondary math courses (California Commission on Teacher Credentialing, n.d.)); and the type of math courses they taught in the prior year (i.e., elementary school; general sixth, seventh, or eighth grade; advanced sixth, seventh, or eighth grade; or Algebra I or higher).

### **Middle School Math Course Taking in the Los Angeles Unified School District**

During the period of our study, 2014-15 through 2020-21, most L.A. Unified students (75%) took general math throughout middle school, with the expectation that they would take Algebra I in ninth grade. Approximately one in six students (17%) took general math in sixth grade and advanced math in seventh grade, with the expectation that they would take Algebra I in eighth grade. A small percentage of students (3%) took an advanced math course in sixth grade, with the expectation that they would take Algebra I in seventh grade, and Geometry in eighth grade. An additional five percent of students followed an alternative course sequence.<sup>1</sup> We focus on the opportunity to take advanced math in seventh grade, because that particular course served as students' primary pathway to taking Algebra I in eighth grade and was the most common entry point into an advanced math curriculum (i.e., most students who took an advanced middle or high school math course took their first advanced course in seventh grade).

To be eligible to enroll in advanced seventh-grade math, district policy advised schools that students should have earned an "A" or "B" in the spring term of their sixth-grade math course and have met or exceeded grade-level standards on their sixth-grade math SBAC.<sup>2</sup> Table

1 shows that the students in our analytic sample who took advanced math in seventh grade had considerably higher average grades and test scores at the end of sixth grade than their peers in general math. For example, 85 percent of the students who took advanced math earned at least a “B” average in sixth grade math compared to 35 percent of general math students. And nearly three-quarters (73%) of advanced math students scored in the top quartile of the district’s sixth grade standardized math test score distribution (on the Smarter Balanced test, or SBAC), compared to 13 percent of general math students.

[TABLE 1]

Students in advanced math were also in somewhat larger classes than their general-math counterparts. In addition, students’ classmates in advanced courses began those courses with substantially higher work effort grades, self-reported behavior, and educational expectations than classmates in general math classrooms. The typical advanced math student was also more likely than the typical general math student to have a teacher with a full math credential and with recent experience teaching an advanced course (see Table 1).

Sixty-five percent of students in our analytic sample who were eligible to enroll in advanced math took the course. Of the eligible students who did not take the course, 31 percent attended a school that did not offer the course during their seventh-grade year and 41 percent attended a school that did not offer enough sections of the course to accommodate all eligible students. Note that we classified schools as not offering advanced math if no students were enrolled in the course in a given academic year. We classified schools as not offering enough sections if the number of eligible students at the school exceeded the space in the course(s) calculated based on the maximum class size allowed by district policy. Eligible students who did not take the course yet attended schools that offered enough sections may not have taken the

course because their parents did not sign the permission form, they were not interested in taking it, or it conflicted with another course they were interested in taking.

During the period of our study, schools that did not offer an advanced seventh-grade math course enrolled relatively few eligible students (9 percent of their seventh graders, on average) (see Appendix Table A5). Compared to the other schools in our sample, these schools enrolled fewer students who were white or Asian American, whose parents had completed at least some college, or who were eligible for subsidized meals. Schools that did not offer enough sections of the course to accommodate all eligible students were demographically similar to schools that offered enough sections but had slightly higher achieving students—and thus a larger share of eligible students.<sup>3</sup>

Among students who took advanced math, 65 percent met the district's course eligibility criteria and 35 percent did not (Appendix Table A6 describes these students). A large percentage (93%) of the ineligible students who enrolled in advanced math attended schools that had room in the course for additional students. Ineligible students who enrolled in the course may also have had sixth grade teachers who recommended them for advanced math or had parents who requested they take it (see Useem, 1992). Because the cohorts we study include substantial percentages of students who were eligible for advanced seventh-grade math but did not take it and students who were ineligible but did take it, our sample contains many students who were similar academically at the start of seventh grade but took different math courses.

### **Analytic Approach**

#### **Estimating Enrollment Inequities in Advanced Seventh-Grade Math**

We begin by examining whether students from different demographic backgrounds who were similar on other observed variables measured prior to seventh grade enrolled in advanced

math at different rates. We do this by estimating logistic regression models—adjusting the standard errors to account for students being clustered in schools—where  $y_{it}$  is the math placement (general 7<sup>th</sup>-grade math=0, advanced 7<sup>th</sup>-grade math=1) of student  $i$  in cohort  $t$ ,  $DEMO_{it}$  is the demographic characteristic of interest for student  $i$  in cohort  $t$ ,  $\mathbf{X}_{it}$  is a vector of students' characteristics that includes all the control variables in Appendix Table A3,  $\alpha_t$  is a cohort fixed effect, and  $\varepsilon_{it}$  is an error term.

$$\text{Prob}(y_{it} = 1) = [1 + \exp(\beta_0 + \beta_1 DEMO_{it} + \mathbf{X}_{it}\beta_2 + \alpha_t + \varepsilon_{it})]^{-1} \quad (1)$$

We address missing data using dummy variable adjustment (Allison, 2010) but also estimate some of our models using multiple imputation methods and obtain qualitatively similar results.<sup>4</sup> We obtain predicted probabilities of taking advanced math for each student subgroup by computing the average marginal effects (AME) (Williams, 2012).

### **Estimating The Impact of Taking Advanced Seventh-Grade Math**

Our second set of analyses aims to approximate the impact of taking advanced math. We use several different empirical strategies to compare the outcomes of advanced and general math students who were similar on a large set of characteristics prior to seventh grade.<sup>5</sup> We first estimate linear and logistic mixed effects (ME) models that nest students in schools (level 3) and classrooms (level 2). Our models for continuous outcomes take the following form, where  $y_{ijkt}$  is the outcome for student  $i$  in classroom  $j$ , school  $k$ , and cohort  $t$ ;  $ADVMATH_{ijkt}$  is a binary indicator of students' enrollment in advanced math;  $\mathbf{X}_{ijkt}$  is a vector of the student-level predictors in Appendix Table A3;  $\alpha_t$  is a cohort-fixed effect;  $\zeta_{jk}^{(2)}$  is a random intercept for classroom  $j$  in school  $k$ ;  $\zeta_k^{(3)}$  is a random intercept for school  $k$ ; and  $\varepsilon_{ijkt}$  is the error term. (We refer to this model as the “mixed effects” model in our tables.)

$$y_{ijkt} = \beta_0 + \beta_1 ADVMATH_{ijkt} + \mathbf{X}_{ijkt}\beta_2 + \alpha_t + \zeta_{jk}^{(2)} + \zeta_k^{(3)} + \varepsilon_{ijkt} \quad (2)$$

While the ME model includes a large set of controls, it is possible that it does not adequately equate students because of differences in the distribution of general and advanced math students' pre-placement characteristics. To address this possibility, we estimate models using entropy balancing (EB) weights (Hainmueller, 2012). Entropy balancing reweights the data so that the means and variances of the covariates are equal, effectively making the average general math student equivalent to the average advanced math student on the covariates. Weights, unlike the other data preprocessing methods we use, have the advantage of retaining the full sample and balancing the distribution of covariates in addition to their means.

We then run a weighted OLS or logistic regression model—adjusting the standard errors to account for students being clustered in schools. (We refer to this model as the “entropy balancing weights” model in our tables.) Our models for continuous outcomes take the following form, where  $y_{it}$  is the outcome for student  $i$  in cohort  $t$ ,  $ADVMATH_{it}$  is a binary indicator of students' enrollment in advanced math,  $X_{it}$  is a vector of student-level predictors,  $\alpha_t$  is a cohort fixed effect, and  $\varepsilon_{it}$  is the error term.

$$y_{it} = \beta_0 + \beta_1 ADVMATH_{it} + \mathbf{X}_{it}\beta_2 + \alpha_t + \varepsilon_{it} \quad (3)$$

While the EB weights model achieves covariate balance on students' observed characteristics, it does not account for schools' potential role in students' math course placements. Thus, we also estimate linear and logistic regression models that include school fixed effects (FE). (We refer to this model as the “school fixed effects” model in our tables.)

$$y_{ikt} = \beta_0 + \beta_1 ADVMATH_{ikt} + \mathbf{X}_{ikt}\beta_2 + \mu_k + \alpha_t + \varepsilon_{ikt} \quad (4)$$

These unweighted models extend the EB weights model (equation 3) by adding a school fixed effect ( $\mu_k$ ), and are limited to schools that offered general and advanced math concurrently.

Because the school FE model, like the ME model, may not adequately equate students, we use two different propensity score matching (PSM) approaches. We first estimate students' propensity for taking advanced math, conditional on their pre-placement characteristics, cohort, and school.<sup>6</sup> We then match treated (i.e., advanced math) students to up to five other un-treated (i.e., general math) students who attended the same school using caliper matching (Rosenbaum & Rubin, 1985) and estimate the school FE model (equation 4) with our matched samples (the “school fixed effects + PSM” models in our tables).<sup>7</sup>

We then estimate an additional set of propensity score models that takes advantage of a subset of schools' delayed adoption of advanced math in the years immediately following the district's transition to Common Core. These models address the potential concern that students who attend the same school and have similar propensities for taking advanced math but ultimately take different courses may differ in ways we cannot observe. If we assume that some proportion of seventh graders would opt to take advanced math if given the opportunity, then general math students who attended a school that did not offer the course may be a better pool of students to use as counterfactuals for advanced math students than those who had the possibility of taking advanced math but did not.

We implement this approach by matching treated students (i.e., advanced math) to up to five un-treated students (i.e., general math) who attended the same school, but in a year when advanced math was not offered. For example, school  $k$  was in operation from 2015–16 through 2017–18, which we can denote as  $T_1$ ,  $T_2$ , and  $T_3$ . In 2015–16 ( $T_1$ ), school  $k$  only offered general math ( $GM$ ). In 2016–17 and 2017–18 ( $T_2$  and  $T_3$ ), school  $k$  offered general ( $GM$ ) and advanced math ( $AM$ ). For school  $k$ , our treatment group is composed of 2016–17 and 2017–18 advanced math students ( $AM_{T_2T_3}$ ) whom we match to a control group of 2015–16 general math students

( $GM_{T_1}$ ). We prioritize matching students in adjacent cohorts (62% of matches are between students who attended the same school in consecutive years).

After matching, we estimate the school FE model (equation 4) with our matched samples, excluding the cohort fixed effect (we refer to this model as the “late adopters (fixed effects + PSM)” models in our tables).<sup>8</sup> Due to sample size limitations, we only estimate the late adopters model for our middle school outcomes.

While the late adopters model partially addresses concerns about unobserved differences in general and advanced math students, it cannot address the possibility that our results may be driven, in part, by unmeasured differences among students’ families, such as how much homework help families provide to their children or how much they encourage them to take advanced math. We address this concern by extending the school FE model (equation 4) by adding a household fixed effect (which we refer to as the “household fixed effects” model in our tables). These models compare children who lived in the same household and attended the same school but took different seventh-grade math courses. Due to relatively small sample sizes, we only estimate these models only for the middle school outcomes.

Finally, we replicate the main analyses using our smallest analytic sample—the students we can follow into college—to show which of the results hold for students who remained in the school district through high school graduation (see Appendix Table A7).

### **Heterogeneous Effects**

After estimating average effects, we examine whether the impact of taking advanced math varies by students’ gender, ethnicity, socioeconomic status, language background, sixth-grade math skills (i.e., SBAC score quartile), or eligibility to take advanced math. We do this by estimating the ME, EB weights, school FE, and school FE with PSM models for each subgroup.<sup>9</sup>

Our sample sizes for the late adopters and household FE models are too small to estimate subgroup specific models.

### **Potential Mechanisms During Seventh Grade**

We then examine potential mechanisms for the effect of seventh-grade math, focusing on students' seventh-grade math test scores and grades as the outcomes. We do this by adding a random coefficient for our advanced math indicator (*ADVMATH*) to the ME model, allowing the coefficient on advanced math to vary across schools.<sup>10</sup> And then add vectors of peer and teacher characteristics measured at the classroom level. We limit this mechanism analysis to seventh-grade outcomes because once students move into eighth grade and beyond, it becomes difficult to accurately attribute effects on longer-term outcomes to mechanisms that span multiple grades, courses, and teachers.

Because it is not possible to measure and adjust for all differences among teachers of general and advanced math courses, we also estimate an additional set of models that estimates the effect of taking advanced seventh-grade math for the subset of students whose teacher concurrently taught general seventh-grade math and advanced seventh-grade math. These models extend the ME, EB weight, school FE, and school FE with PSM models by including a teacher fixed effect ( $\tau_c$ ) and interacting the teacher fixed effects with the cohort fixed effects ( $\alpha_t \times \tau_c$ ), so that we are comparing outcomes among students who had the same teacher in the same year. For example, the school FE model with teacher fixed effects takes the following form:

$$y_{iktc} = \beta_0 + \beta_1 ADVMATH_{iktc} + \mathbf{X}_{iktc} \beta_2 + \mu_k + \tau_c + \alpha_t + (\alpha_t \times \tau_c) + \varepsilon_{iktc} \quad (5)$$

For the school FE with PSM model, we match students within teacher and cohort.

## **Findings**

### **Disparities in Academic Preparation and Advanced Math Course Taking**

## [TABLE 2]

Table 2 shows that by the end of sixth grade, boys, Latinx and Black students, students whose parents did not graduate from college, students eligible for subsidized meals, and students with fewer English language skills scored lower on the math SBAC and earned lower grades than their peers (see the first four columns). Given these academic disparities, it is not surprising that there are large disparities in which students enrolled in advanced seventh-grade math (see the “unconditional disparities” columns).

Among students who had the same measured characteristics at the end of sixth grade, disparities in advanced seventh-grade math enrollment were much smaller but did not disappear (see the two rightmost columns). These results show that Asian American students were slightly more likely to enroll in advanced math than otherwise similar white, Latinx, and Filipinx peers, as were students whose parents attended graduate school.<sup>11</sup>

**The Impact of Taking Advanced Math in Seventh Grade**

Next, we estimate the impact of taking advanced math in seventh grade. We find positive effects on students’ middle school and high school test scores; negative effects on students’ middle school math grades; inconsistent, mixed effects on students’ self-perceptions and behavior; and consistent positive effects on high school course-taking, college readiness, and four-year college enrollment.

## [TABLE 3]

***Test Scores***

Our smallest point estimates suggest that students who took advanced math scored .13, .15, and .15 standard deviations higher on their seventh-grade math SBAC, eighth-grade math SBAC, and tenth-grade math PSAT, respectively, than otherwise similar students who took

general math (see Table 3).<sup>12</sup> The seventh-grade estimate is substantially smaller than Hoffer's (1992) estimate, but within the confidence interval of Dougherty et al.'s (2017) null effect. The eighth-grade estimate is slightly larger than Domina's (2014) estimate for taking advanced math in eighth grade, perhaps in part because the ECLS-K eighth-grade exam may not measure advanced middle school mathematics well enough (Domina, 2014). The tenth-grade estimate is three times as large as McEachin et al.'s (2020) estimate of taking advanced math in eighth grade on a tenth-grade high school exit exam, probably because the PSAT measures more advanced math. Note that the effect of taking advanced seventh-grade math on test scores in eighth and tenth grade may be attributable to learning gains that persist after seventh grade, to additional advanced math course taking in later grades, or both.

In addition to scoring higher in math, we find suggestive evidence that advanced math students also scored higher on the English language art (ELA) SBAC and the verbal PSAT, though these coefficients are much smaller than for math. These results resemble McEachin et al.'s (2020) findings and may arise because advanced math students were more likely to take honors English courses in the seventh through tenth grades than similar peers, including those who took the same English and social sciences classes in sixth grade. It is also possible that these results indicate bias from unobserved heterogeneity, a point to which we return in our sensitivity analyses. Table 3 also shows that students who took advanced seventh-grade math were more likely to pass at least one AP exam in high school than similar peers who took general math (by as much as 6.4 percentage points). Note that we show odds ratios rather than predicted probabilities in the tables because we are not able to estimate average marginal effects (AME) for all of our model specifications. The percentage point estimates we report in the text are from the school fixed effect model with propensity score matching.

## [TABLE 4]

***Grades***

Although taking advanced math improved students' test scores, it reduced their middle school math grades, especially in seventh grade (see Table 4). The point estimates vary across models, with smaller negative effects from the models that use balancing weights or matching, but all the models for seventh grade suggest that otherwise similar students got lower grades in advanced math than in general math (the estimates imply a difference between an "A" in a general course and an "A" minus or "B" plus in an advanced course). It is not surprising that relatively high achieving students would earn better grades in a general math course than in an advanced math course where more of the students are also high achieving (see also Nomi & Allensworth, 2009).

We do not find consistent negative effects of taking advanced seventh-grade math on students' overall GPAs in seventh or eighth grade, however, which suggests that higher grades in other subjects may offset lower math grades. In addition, the negative effects on middle school math grades do not seem to persist into high school (the estimates' signs vary across models and the estimates are rarely statistically significant). We also find suggestive evidence that taking advanced math in seventh grade may improve students' overall high school GPAs slightly.

## [TABLE 5]

***Self-Perceptions and Behavior***

We find suggestive, but inconsistent, evidence that students who took advanced seventh-grade math may have received slightly lower work effort grades from their math teachers than they would have had they taken general seventh-grade math (see Table 5). Students who took advanced seventh-grade math also reported slightly lower academic self-efficacy in seventh

grade, and possibly in eighth grade as well (though the coefficients are not consistently statistically significant nor consistently negative). In contrast, students who took advanced seventh-grade math received slightly higher cooperation grades from their middle school math teachers and may have had slightly better attendance in seventh grade. We find no consistent evidence that taking advanced seventh-grade math affected students' perceptions of their own behavior or educational expectations. Nor do we find consistent positive or negative effects on students' behavior or self-perceptions during high school (see Appendix Table A8).

[TABLE 6]

### ***Course Taking***

Like Dougherty et al. (2017) and McEachin et al. (2020), we find consistently positive effects, across most models, of taking advanced math in middle school on students' advanced course-taking in high school (see Table 6). Students who took advanced seventh-grade math were 3.6 percentage points more likely to pass Algebra I by the end of ninth grade and may have been more likely to earn at least a "B" in the course. Students who took advanced seventh-grade math also passed an additional semester of rigorous math and were about 10 percentage points more likely to take calculus or a higher-level math course in high school than otherwise similar peers who took general math. We also find positive effects on taking rigorous science courses and rigorous academic courses overall. These results strongly suggest that having the opportunity to take advanced math in seventh grade gave students an enduring positional advantage in the high school academic opportunity structure (see Schneider et al., 1998).

### ***College Access Support, Readiness, and Enrollment***

Table 6 suggests that this positional advantage may also benefit students in terms of the college-access supports they receive at school, particularly in 11<sup>th</sup> grade (the 12<sup>th</sup>-grade estimates

are imprecise), and in their likelihood of meeting the minimum eligibility requirements for admission to public four-year universities in California. In addition, students who took advanced seventh-grade math were about 7 percentage points more likely to meet the California State University (CSU) system's math course placement requirements for non-STEM and STEM majors. Students who meet those requirements move directly into courses that fulfill degree and major requirements, allowing them to make more timely progress toward their degrees.

Finally, students who took advanced math in seventh grade were as much as 6 percentage points more likely to enroll in a four-year college than otherwise similar peers who took general math. Note, however, that we only have outcomes for the year following high school graduation for our earliest cohort. The Covid-19 pandemic disrupted the spring of those students' junior year in high school and their entire senior year. We do not know whether the effects of taking advanced seventh-grade math on four-year college enrollment would be larger or smaller in non-pandemic times. Future research should assess whether these seemingly positive effects replicate in other contexts and in non-pandemic years.

### **Results for Student Subgroups**

We show subgroup results for two key outcomes, seventh-grade math scores and taking more rigorous math courses in high school, though the results generally hold for other outcomes. Figure 1 shows that all subgroups of advanced seventh-grade math students improved their math test scores relative to general math students, even ineligible students and students who began seventh grade with relatively low math test scores. These results resemble Rickles's (2013) findings of fairly homogeneous effects of eighth-grade algebra on subsequent test scores.

[FIGURE 1]

Figure 2 indicates that students from most subgroups also experienced a substantial positive

impact of advanced seventh-grade math on the number of semesters of rigorous math they passed in high school, with the exception of Black students and students in the bottom quartile of the end-of-sixth grade math test score distribution (their point estimates are positive but not statistically distinguishable from zero). These findings about ethnic disparities in advanced course pathway persistence resemble Irizarry's (2021) results from a nationally-representative sample of ninth graders.

[FIGURE 2]

### **Mechanisms that Contribute to the Impact of Taking Advanced Math on Seventh-Grade Outcomes**

In Appendix Tables A9 and Appendix Table A10, we explore the relative importance of peer and teacher characteristics in helping to explain the effects of being placed in advanced seventh-grade math on seventh-grade math test scores and math grades, respectively. The results show that measured classmate characteristics account for nearly two-thirds of the positive impact of taking an advanced math course on seventh-grade math test scores and nearly all of the negative impact on seventh-grade math grades.<sup>13</sup> Appendix Table A11, which shows how much each of the potential mediators, taken singly, reduces the size of the coefficient on taking advanced seventh-grade math, indicates that the most important mediator of both effects is classmates' math test scores from the spring of the prior year, followed by their sixth-grade math grades. Note, however, that if having higher achieving peers in a class contributed directly to student achievement through mechanisms of peer encouragement, role modeling, or assistance, we would expect to see a positive association of peer achievement with both test score and grade outcomes. Instead, the results show that peer achievement is positively associated with test scores but negatively associated with grades. These results imply that classmates' achievement

may instead serve as a proxy for differences in how teachers tailor their instruction and grading practices to classrooms with different student compositions. Research suggests that teachers expose students to more rigorous curricular content in advanced courses (e.g., Gamoran & Carbonaro, 2002) but administrative data like ours lack information on what students are taught in their math courses. Thus, we are unable to explore the role of differential curricular exposure in producing learning differences across courses. Classmate characteristics may also proxy for differences in teachers' expectations for students (Kelly & Carbonaro, 2012) or differences in responses to their behavior (Musto, 2019), neither of which we can measure in our data.

Although differences in classmate characteristics seem to account for much of the effect of advanced seventh-grade math on test scores and grades, the teacher characteristics we measure explain only 16 or 25 percent of the impact of taking an advanced math course on test scores or grades, respectively. Nonetheless, these characteristics are associated with students' test scores and grades in both advanced and general math classrooms. The models imply that students improve their math test scores when their teachers have more than two years of experience, are national board certified (see also Cowan and Goldhaber, 2016), or have recently taught advanced math. They also imply that more experienced teachers and teachers who have recently taught advanced math grade students more stringently. Because research suggests that commonly-measured teacher characteristics like those in our models usually do not explain differences in student learning from classroom to classroom (Goldhaber & Brewer, 1997), and because teachers may self-select into teaching advanced courses in ways we cannot measure, we also estimate these models for a sample of teachers who concurrently taught both general math and advanced math, without and with teacher fixed effects (see Appendix Table A12). These estimates are somewhat smaller than those in Tables 3 and 4, suggesting that advanced and general courses

differ less when taught by teachers who teach both types of courses. But these estimates are also not insubstantial, and are statistically significant, indicating that the positive test score effects, and negative grade effects, of advanced seventh-grade math compared to general seventh-grade math arise even in classes taught by the same teachers.

### **Sensitivity Analyses**

#### ***Unobserved Confounders***

Although we match students on a large set of student characteristics prior to their seventh-grade math placement, and control for those characteristics in our models, our estimates may still be biased upward by unobserved variables related to students' math placements and outcomes. We conduct two sensitivity analyses to examine the extent of this bias.

***Placebo Outcomes.*** First, we estimate the effect of taking advanced math on outcomes it cannot affect—third graders' math standardized test scores and math achievement and work effort grades. We use these outcomes to examine possible bias from unmeasured academic and behavioral selection into advanced math courses. Appendix Table A13 shows that nearly all of these estimates are statistically insignificant and most are close to zero, which increases our confidence that we have adequately accounted for selection into advanced math (Imbens, 2004).

***Robustness Estimates.*** To assess whether bias from unmeasured confounders would invalidate our conclusions about the positive impact of taking advanced math, we also estimate how strong an unobserved confounder would have to be relative to a set of benchmark variables to either reduce our point estimates to zero or to cause our estimates to lose statistical significance (Cinelli & Hazlett, 2020).<sup>14</sup> We use a large set of academic benchmark variables that are highly correlated with taking advanced math and students' outcomes. These variables include two prior years of students' standardized test scores, fifth- and sixth-grade math and ELA GPAs,

sixth-grade math and overall work effort grades, type of sixth-grade math course the student took, whether students were classified as gifted and talented as of the end of sixth grade, and whether students were eligible to take advanced math according to district policy.

Our results suggest that unobserved confounders would need to be relatively strong to invalidate most of our findings for the academic outcomes (see Appendix Table A14). For example, for the estimates of the effects on students' seventh-grade math scores or four-year college enrollment to lose statistical significance, we would need to have omitted a variable nearly a quarter as strong as all the benchmark variables taken together. The estimates for course-taking are even more robust. For example, an omitted variable would need to be nearly three quarters as strong as all the benchmark variables taken together to reduce the point estimate for additional semesters of rigorous math to statistical insignificance and *more* than three quarters as strong to reduce the estimate to zero. Our findings for students' self-perceptions and school-related behavior are far less robust than for the academic outcomes. For example, for the seventh-grade, teacher-reported math work effort grades and academic self-efficacy estimates to lose statistical significance, we would need to have omitted a variable slightly more than a tenth as strong as all of the benchmark variables taken together.

### ***Censoring***

Although we replicate our main analyses using our smallest analytic sample—students we can follow into college—and find that our results largely hold (see Appendix Table A7), it is possible that our estimates may be biased due to attrition. To assess the extent of this bias, we estimate our school fixed effects models using stabilized Inverse Probability Censoring Weights (IPCW) (Fewell et al., 2004; Willems et al., 2018). IPCWs give extra weight to students who remain in the sample (i.e., are uncensored) but who are demographically and academically

similar to students who left the sample before we could observe their outcomes (i.e., were censored). The estimates from the models with censoring weights are not substantively different than the unweighted estimates, though the magnitude of the estimates varies slightly (see Appendix Table A15).<sup>15</sup> These results suggest that the estimates are robust to censoring.

### **Discussion**

The results in this paper indicate that the students in the large, urban school district we study experienced both short- and long-term educational advantages when they had the opportunity to take advanced math in seventh grade. Although students received slightly lower middle school math grades when they took advanced seventh-grade math, taking this advanced course improved their test scores and set them on an academic path that exposed them to greater academic rigor in their high school courses, increased their college readiness, and improved their likelihood of enrolling in a four-year college. We find much smaller effects of taking advanced math on students' self-perceptions and school-related behavior, with small negative effects on students' seventh-grade work effort grades and middle school academic self-efficacy and small positive effects on seventh-grade attendance and middle school cooperation grades.

Although our impact estimates are probably somewhat overstated, due to unobserved or poorly measured confounders, our robustness tests indicate that it is very unlikely that there is no positive impact of taking advanced math on students' educational outcomes. This conclusion is bolstered by recent studies that use different causal designs and samples but also show substantial positive effects of taking advanced middle school math on students' math course-taking in high school (Dougherty et al., 2017; McEachin et al., 2020).

Our results also suggest that the short-term effects of taking advanced seventh-grade math may arise from being taught alongside relatively high achieving classmates (see also

Imberman et al., 2012). Our teacher fixed effects models imply that the same teacher teaches and grades differently when their class has stronger math achievement. Although our data provide limited insight into differences in advanced and general math students' classroom experiences, other research suggests that teachers of advanced courses have more positive perceptions of students' abilities (Kelly & Carbonaro, 2012; Oakes, 1982; Oakes, 1985), cover more rigorous material (Gamoran & Carbonaro, 2002), and respond more positively (Mayer et al., 2018), or with alternative ways of teaching, when "advanced" students do not understand new concepts. Additional research describing differences in teachers' perceptions, instruction, and classroom climate between advanced and general middle school math courses is essential for understanding why students' test scores improve more on average in advanced courses and what types of instructional changes might enhance students' learning in general math courses.

Because advanced math courses exacerbate academic inequality in the school district we study, one strategy for reducing inequality would be to eliminate math course differentiation in middle school, as some school districts have done (Blume, 2021). But our results suggest that eliminating advanced seventh-grade math courses would exacerbate societal inequities by reducing social mobility for low-income students of color. In the school district we study, well over half of the students who take advanced seventh-grade math are Latinx, nearly two-thirds are eligible for subsidized school meals, and a third have parents who never attended college. In this context, eliminating advanced seventh-grade math would reduce opportunities for historically marginalized students to improve their math test scores, complete a rigorous high school program, and attend a four-year college.

An alternative strategy would be to offer advanced seventh-grade math to all or most students, an approach that appeals to principles of both equity and excellence and that Mehan et

al. (1996) refer to as “untracking.” Our subgroup results provide some support for this strategy, showing that ineligible students (i.e., those who did not meet the achievement criteria for taking the course) improve their test scores more when they take advanced seventh-grade math than when they take general seventh-grade math, suggesting that the eligibility threshold for the course could potentially be lowered. However, our data cannot speak to the question of whether the very lowest achieving students in this school district would benefit from taking advanced seventh-grade math because very few students who scored far below standards on their sixth-grade math test took the course. And other studies suggest that advanced middle school math may only benefit higher-achieving students (Clotfelter et al., 2015), or students in schools that set higher achievement thresholds for eligibility to take advanced math (McEachin et al., 2020).

Enrolling all or most students in advanced seventh-grade math raises other concerns as well. First, school districts would need many more teachers to teach advanced math, and our results suggest that teachers who are not currently teaching advanced math may initially be less effective at improving students’ math scores than those with current advanced-math teaching experience (see Table 7). More importantly, a potentially important mechanism for the positive effect of advanced math on students’ test scores is the much higher average level of math achievement in advanced classrooms. Thus, adding large numbers of low-achieving students to advanced math courses could potentially reduce the course’s effectiveness (see also Nomi, 2012; Nomi et al., 2021). Therefore, it is possible that neither high- nor low-achieving students would experience the same benefits from advanced seventh-grade math that we describe in this paper if all students took the course.

A promising strategy in the school district we study would be to enroll all eligible students, regardless of the school they attend, in advanced seventh-grade math. Schools could

offer enough sections of the course for all eligible students, and schools with too few eligible students to fill a class could allow nearly-eligible students at that school to take the course. Offering enough courses to meet the needs of eligible students would begin to reverse the steep historical decline in advanced-math enrollment described in the introduction. District policymakers could also explore extending enrollment in advanced math to lower-achieving students, possibly with additional academic support (see Taylor, 2014). Over the longer-term, in the urban district we study and others like it, scholars, policymakers, and educators should also build more knowledge about effective ways to bolster lower-achieving students' math achievement *before* they enter middle school, so that more students can enroll in, and benefit from, advanced math in middle school and thus realize the long-lasting academic advantages that follow from early access to educational opportunity.

### Notes

<sup>1</sup> These statistics include 2014-15 - 2018-19 6<sup>th</sup> graders with non-missing course-taking data who were enrolled in the district for their 6<sup>th</sup>, 7<sup>th</sup>, and 8<sup>th</sup> grade years (N=123,195). We define advanced 7<sup>th</sup>-grade math as enrollment in "Accelerated Math 7." Examples of alternative course sequences include alternate curriculum courses, repeating a course, or skipping a course.

<sup>2</sup> Approximately 15% of students attended elementary schools for 6<sup>th</sup> grade. During the years of our study, elementary and middle school 6<sup>th</sup> graders were subject to different advanced math placement policies. Elementary school 6<sup>th</sup> graders were required to earn a "4" (the highest elementary school academic achievement mark) in the spring term of their math course and meet or exceed grade-level standards on their 6<sup>th</sup>-grade math SBAC to be placed in advanced 7<sup>th</sup>-grade math. Students in the 2016 and 2017 cohorts were also required to receive a score of "proficient" on the district's 6<sup>th</sup>-Grade Mathematics Placement Assessment (LAUSD, 2016).

<sup>3</sup> Across the years that we study, 36% of schools, on average, did not offer the course and 13% of schools, on average, did not offer enough sections of the course to accommodate all eligible students. The percentage of schools that did not offer the course decreased from 42% in 2015-16 to 30% in 2018-19.

<sup>4</sup> We require students to be non-missing on the key variables described in the text, so only impute values for the other predictors. We impute these missing values with the mean for continuous variables and with zero for binary variables. We then include a dummy variable in the model that indicates the variable is missing. This approach assumes that the values are missing completely at random. It also reduces the variance of the variables (Allison, 2010). Thus, we also run models using multiple imputation methods. Due to computational limitations, we only estimated our preferred models—regression models with school fixed effects—using 100 imputed datasets. Results from those models are similar and available upon request.

<sup>5</sup> Because the district's advanced math eligibility requirements were based on test score and grade cut-offs, but these requirements imperfectly predicted whether students enrolled in the course, we considered using a fuzzy multivariate regression-discontinuity design (MRDD) to estimate the causal effect of taking advanced math (Wong et al., 2013). However, we found that being above or below the test score eligibility cut-off was insufficiently predictive of taking advanced math for an RDD approach to yield valid inferences (i.e., our assignment variable did not have a high enough F statistic in the first stage (What Works Clearinghouse (2022))).

<sup>6</sup> Our propensity score model extends equation 1 by adding a school fixed effect (see Arpino & Mealli, 2011).

<sup>7</sup> Before matching, we drop students whose propensity scores are below the first or above the 99<sup>th</sup> percentile. Across our samples, we adjust our trimming to improve balance. In our most

restrictive models, we trim students below the fifth and above the 95<sup>th</sup> percentiles. We use calipers of .02 to .20 to achieve adequate balance.

<sup>8</sup> This approach resembles difference-in-difference matching (e.g., Smith & Todd, 2005).

However, due to changes in testing and math placement policies (i.e., California did not administer standardized math tests in 2014 and most 7th graders enrolled in pre-algebra prior to 2015), we cannot examine trends prior to the adoption of advanced 7th-grade math.

<sup>9</sup> Because some student groups are small, we use “preferential within-cluster” matching (Arpino & Cannas, 2016). We look for matches within school, and if we cannot find a match, we look for matches who attended a different school.

<sup>10</sup> During the period of our study, most schools only offered one section of advanced math, so we allow this coefficient to vary across schools rather than classrooms.

<sup>11</sup> We also explored the extent to which these small disparities in course taking among similar students could be attributed to differences in schools’ course offerings. These analyses (not shown) suggest that disparities among similar students whose schools offered the course are smaller than those in Table 2, disparities among similar students who were eligible for the course but whose schools offered too few sections are larger than those in Table 2 for some student groups but are largely not statistically significant, and that disparities among similar students who were ineligible for the course but whose schools had room for additional students in the course are much smaller than in Table 2 and largely not statistically significant.

<sup>12</sup> Note that these positive results for math test scores hold for our smallest analytic sample (the students we can follow to college), as do many of the other results (see Appendix Table A7).

<sup>13</sup> It is possible that classmate characteristics might appear to mediate the effects but instead indicate a hidden interaction between student achievement and course placement. To investigate

this possibility, we ran these models separately for students in the bottom half of the 6th-grade math achievement distribution and found similar mediation results.

<sup>14</sup> Several recent education papers use a benchmarking procedure developed by Cinelli and Hazlett (2020) to test their estimates' sensitivity to an unobserved confounder (e.g., Huntington-Klien & Gill, 2020; Wang et al., 2022.) We also use this method to assess how strong, relative to an observed covariate, an unobserved confounder would have to be to reduce the point estimate to zero or cause the estimate to lose statistical significance. Cinelli and Hazlett (2020) take a slightly more conservative approach than other authors (e.g., Frank, 2000) because they adjust the benchmark variables to account for their possible relationship with the unobserved confounder. Because this method relies on OLS regression, we estimate OLS models with school and cohort fixed effects.

<sup>15</sup> To construct the weights, we estimate a model that includes all the pre-placement characteristics in Appendix Table A3. We also include time-varying measures of students' math grade point average and standardized math test scores (per Fewell et al., 2004).

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**Table 1.** General and Advanced Math Student, Classroom, and Teacher Characteristics

	General 7th-Grade Math			Advanced 7th-Grade Math		
	N	Mean	SD	N	Mean	SD
<b>Student Characteristics</b>						
6th-Grade Math GPA (SD Units)	90,153	-0.16	0.94	18,260	0.87	0.63
Earned At Least a "B" Average in 6th-Grade Math	90,153	0.35	0.48	18,260	0.85	0.36
6th-Grade Math SBAC Score (SD units)	90,153	-0.20	0.85	18,260	1.03	0.64
6th-Grade Math SBAC Score: Quartile 1 (Bottom)	90,153	0.28	0.45	18,260	0.01	0.12
6th-Grade Math SBAC Score: Quartile 2	90,153	0.30	0.46	18,260	0.05	0.22
6th-Grade Math SBAC Score: Quartile 3	90,153	0.28	0.45	18,260	0.21	0.40
6th-Grade Math SBAC Score: Quartile 4 (Top)	90,153	0.13	0.34	18,260	0.73	0.45
<b>Classroom Characteristics</b>						
Class Size	90,153	29.94	7.01	18,260	32.43	5.43
Mean 6th-Grade SBAC Scores (SD Units)	90,153	-0.21	0.55	18,260	1.02	0.40
Standard Deviation of Class SBAC Scores (SD Units)	90,084	0.66	0.13	18,257	0.51	0.13
Mean 6th-Grade Math Grades (SD Units)	90,153	-0.17	0.44	18,260	0.86	0.31
Standard Deviation of Class Math Grades (SD Units)	90,094	0.85	0.16	18,257	0.54	0.20
Mean 6th-Grade Math Work Effort (SD Units)	89,827	-0.14	0.45	18,162	0.69	0.31
Mean 6th-Grade Student-Reported Behavior (SD Units)	89,466	0.06	0.71	18,157	0.88	0.48
% Expected to Earn a Bachelor's Degree or Higher	88,511	52.24	17.61	17,998	70.27	12.25
<b>Teacher Characteristics</b>						
Novice (<=2 Years of Experience)	90,153	0.10	0.40	18,260	0.07	0.34
Long-Term Substitute	90,153	0.03	0.18	18,260	0.03	0.16
National Board Certified	90,153	0.04	0.20	18,260	0.07	0.25
Multisubject Credential	90,153	0.26	0.44	18,260	0.26	0.44
Foundational Math Credential	90,153	0.28	0.45	18,260	0.27	0.44
Full Math Credential	90,153	0.35	0.48	18,260	0.41	0.49
Other Math Credential	90,153	0.08	0.27	18,260	0.03	0.18
Math Credential is Missing	90,153	0.03	0.18	18,260	0.03	0.16
Taught Elementary School (K-5) Math in the Prior Year	90,153	0.01	0.11	18,260	0.01	0.09
Taught General 6th-Grade Math in the Prior Year	90,153	0.11	0.32	18,260	0.10	0.30
Taught Advanced 6th-Grade Math in the Prior Year	90,153	0.01	0.07	18,260	0.02	0.15
Taught General 7th-Grade Math in the Prior Year	90,153	0.73	0.45	18,260	0.68	0.47
Taught Advanced 7th-Grade Math in the Prior Year	90,153	0.24	0.43	18,260	0.64	0.48
Taught 8th-Grade Math in the Prior Year	90,153	0.29	0.45	18,260	0.31	0.46
Taught Algebra I or Higher in the Prior Year	90,153	0.12	0.33	18,260	0.32	0.47
Course Taught in the Prior Year is Missing	90,153	0.10	0.30	18,260	0.03	0.18

The table includes students in our seventh-grade analytic sample. See Appendix Table A4 and the text for details on the measures in this table.

**Table 2.** Disparities in 6th-Grade Math Achievement and 7th-Grade Advanced Math Course Taking, by Student Group

	Difference in...				Unconditional Disparities: Advanced Math Enrollment		Disparities Conditional on Prior Characteristics: Advanced Math Enrollment	
	6th-Grade Math Standardized Test Scores (SD Units)	6th-Grade Math GPA (SD Units)	Percentage of Students Met/Exceeded Standards on 6th-Grade Math Test (Percentage Points)	Percentage of Students with a B or Better 6th- Grade Math GPA (Percentage Points)	Difference in Predicted Probability	SE	Difference in Predicted Probability	SE
<b>Gender</b>								
Female vs. Male	0.111***	0.297***	2.190***	12.045***	0.029***	0.004	-0.005	0.003
<b>Ethnicity</b>								
Latinx vs. White	-0.672***	-0.460***	-30.148***	-22.274***	-0.218***	0.024	-0.016	0.010
Black vs. White	-0.809***	-0.641***	-32.488***	-29.138***	-0.194***	0.026	0.014	0.018
Filipinx vs. White	0.110***	0.160***	5.034***	6.355***	0.028	0.028	-0.006	0.012
Asian American vs. White	0.272***	0.265***	11.805***	11.962***	0.145***	0.030	0.022*	0.011
Latinx vs. Asian American	-0.944***	-0.725***	-41.953***	-34.236***	-0.362***	0.029	-0.038***	0.012
Black vs. Asian American	-1.081***	-0.906***	-44.292***	-41.100***	-0.339***	0.031	-0.008	0.019
Filipinx vs. Asian American	-0.162***	-0.105***	-6.770***	-5.607***	-0.116***	0.027	-0.028*	0.012
<b>Parents' Educational Attainment</b>								
Less than HS vs. Graduate School	-0.855***	-0.623***	-37.786***	-29.633***	-0.303***	0.024	-0.022**	0.007
HS Graduate vs. Graduate School	-0.699***	-0.518***	-33.137***	-25.010***	-0.270***	0.022	-0.019**	0.006
Some College vs. Graduate School	-0.501***	-0.413***	-25.152***	-20.287***	-0.216***	0.019	-0.016*	0.006
Bachelor's Degree vs. Graduate School	-0.126***	-0.094***	-7.614***	-4.989***	-0.074***	0.012	-0.010**	0.004
<b>Subsidized Meal Eligibility</b>								
Eligible vs. Not Eligible	-0.675***	-0.496***	-30.063***	-23.660***	-0.229***	0.018	-0.004	0.006
<b>English Language Learner Status</b>								
Initial Fluent Eng. Prof. vs. Eng. Only	0.297***	0.225***	10.245***	9.987***	0.061***	0.011	0.005	0.004
Reclassified Fluent Eng. Prof. vs. Eng. Only	-0.046***	0.042***	-7.774***	0.242	-0.064***	0.013	-0.003	0.005
Limited Eng. Prof. vs. Eng. Only	-1.176***	-0.613***	-31.427***	-27.235***	-0.206***	0.016	-0.032**	0.011

The table includes students in our seventh-grade analytic sample (note that some cases are dropped from models in which covariates perfectly predict the outcome). N=108,016. Estimates are average marginal effects. The conditional disparities models include all of the pre-placement characteristics in Appendix Table A3. See Appendix Table A4 for information about how we constructed the measures.

**Table 3.** The Impact of Taking Advanced 7th-Grade Math on Students' Test Scores

	Mixed Effects		Entropy Balancing Weights		School Fixed Effects		School Fixed Effects + PSM		Late Adopters (Fixed Effects + PSM)		Household Fixed Effects	
	N	B (SE)	N	B (SE)	N	B (SE)	N	B (SE)	N	B (SE)	N	B (SE)
Standardized Math Test Scores (SD Units)												
7th-Grade SBAC	108,413	0.177*** (0.008)	108,413	0.127*** (0.014)	86,158	0.143*** (0.014)	29,302	0.161*** (0.014)	3,465	0.140*** (0.030)	2,674	0.130*** (0.038)
8th-Grade SBAC	76,029	0.214*** (0.010)	76,029	0.147*** (0.021)	59,455	0.204*** (0.017)	19,656	0.209*** (0.016)	1,561	0.145** (0.040)	1,871	0.183 (0.096)
10th-Grade PSAT	35,029	0.169*** (0.015)	35,029	0.159*** (0.027)	26,276	0.154*** (0.024)	7,456	0.168*** (0.023)	--	--	--	--
Standardized ELA Test Scores (SD Units)												
7th-Grade SBAC	108,413	0.069*** (0.008)	108,413	0.029** (0.011)	86,158	0.050*** (0.008)	29,302	0.053*** (0.012)	3,465	0.063 (0.033)	2,674	-0.015 (0.040)
8th-Grade SBAC	76,029	0.054*** (0.009)	76,029	0.005 (0.013)	59,455	0.047*** (0.011)	19,656	0.045*** (0.012)	1,561	0.114** (0.035)	1,871	0.010 (0.092)
10th-Grade PSAT	35,029	0.064*** (0.013)	35,029	0.044 (0.023)	26,276	0.052** (0.018)	7,456	0.058* (0.026)	--	--	--	--
Passed At Least One AP Exam <sup>1</sup>												
9th-12th Grade	14,982	1.370*** (0.103)	14,982	1.338*** (0.114)	11,005	1.347*** (0.100)	2,956	1.439*** (0.129)	--	--	--	--

<sup>1</sup> Estimates are odds ratios

-- indicates that the sample size was too small to estimate the model. The models include all of the pre-placement characteristics in Appendix Table A3. See Appendix Table A4 for information about how we constructed the measures. Sample sizes differ across grades mainly because samples with outcomes measured later in high school contain fewer longitudinal cohorts than those with outcomes measured earlier. Note that some cases are dropped from models in which covariates perfectly predict the outcome. See text and Appendix Tables A2 and A3 for more details.

**Table 4.** The Impact of Taking Advanced 7th-Grade Math on Students' Grades

	Mixed Effects		Entropy Balancing Weights		School Fixed Effects		School Fixed Effects + PSM		Late Adopters (Fixed Effects + PSM)		Household Fixed Effects	
	N	B (SE)	N	B (SE)	N	B (SE)	N	B (SE)	N	B (SE)	N	B (SE)
<b>Math Grade Point Average</b>												
7th Grade	108,413	-0.435*** (0.032)	108,413	-0.188*** (0.031)	86,158	-0.268*** (0.029)	29,302	-0.263*** (0.024)	3,459	-0.178** (0.064)	2,674	-0.328** (0.101)
8th Grade	76,029	-0.198*** (0.029)	76,029	-0.164*** (0.031)	59,455	-0.167*** (0.030)	19,656	-0.142*** (0.028)	1,561	0.030 (0.078)	1,871	-0.161 (0.160)
9th Grade	61,149	0.015 (0.019)	61,149	0.010 (0.020)	47,213	0.017 (0.020)	15,152	0.023 (0.018)	--	--	--	--
10th Grade	35,029	-0.081*** (0.023)	35,029	-0.097*** (0.024)	26,276	-0.002 (0.027)	7,858	-0.036 (0.026)	--	--	--	--
11th Grade	32,569	-0.018 (0.024)	32,569	-0.034 (0.030)	24,463	-0.023 (0.027)	7,456	-0.001 (0.042)	--	--	--	--
12th Grade	11,483	0.024 (0.045)	11,483	-0.025 (0.045)	8,426	0.041 (0.056)	2,594	0.053 (0.069)	--	--	--	--
<b>Annual GPA (Middle School)/Unweighted Cumulative GPA (High School)</b>												
7th Grade	108,413	-0.046*** (0.012)	108,413	0.001 (0.013)	86,158	0.001 (0.012)	29,302	0.006 (0.010)	3,459	-0.011 (0.040)	2,674	-0.064 (0.061)
8th Grade	76,029	0.015 (0.016)	76,029	0.009 (0.016)	59,455	0.025 (0.016)	19,656	0.036* (0.014)	1,561	0.095** (0.033)	1,871	-0.002 (0.099)
9th Grade	61,149	0.041*** (0.013)	61,149	0.047** (0.016)	47,213	0.050*** (0.014)	15,152	0.059*** (0.013)	--	--	--	--
10th Grade	35,029	0.025 (0.015)	35,029	0.016 (0.017)	26,276	0.036* (0.017)	7,858	0.069*** (0.016)	--	--	--	--
11th Grade	32,569	0.033* (0.015)	32,569	0.020 (0.015)	24,463	0.039* (0.017)	7,456	0.059*** (0.017)	--	--	--	--
12th Grade	14,991	0.039 (0.021)	14,991	0.025 (0.019)	11,020	0.040 (0.027)	2,594	0.044 (0.030)	--	--	--	--

-- indicates that the sample size was too small to estimate the model. The models include all of the pre-placement characteristics in Appendix Table A3. See Appendix Table A4 for information about how we constructed the measures. Sample sizes differ across grades mainly because samples with outcomes measured later in high school contain fewer longitudinal cohorts than those with outcomes measured earlier. See text and Appendix Tables A2 and A3 for more details.

**Table 5.** The Impact of Taking Advanced 7th-Grade Math on Students' Self-Perceptions and School-Related Behavior During Middle School

	Mixed Effects		Entropy Balancing Weights		School Fixed Effects		School Fixed Effects + PSM		Late Adopters (Fixed Effects + PSM)		Household Fixed Effects	
	N	B (SE)	N	B (SE)	N	B (SE)	N	B (SE)	N	B (SE)	N	B (SE)
<b>Teacher-Reported Math Work Effort Grades (SD Units)</b>												
7th Grade	108,413	-0.142*** (0.018)	108,413	-0.029 (0.024)	86,158	-0.074*** (0.022)	29,691	-0.053** (0.020)	3,459	-0.037 (0.056)	2,674	-0.149 (0.081)
8th Grade	76,029	-0.009 (0.018)	76,029	0.009 (0.024)	59,455	0.004 (0.026)	19,991	0.038 (0.028)	1,561	0.131* (0.063)	1,871	0.030 (0.140)
<b>Academic Self-Efficacy (SD Units)</b>												
7th Grade	64,704	-0.048*** (0.014)	64,704	-0.054*** (0.016)	51,587	-0.000612	19,214	-0.034 (0.020)	3,459	-0.074 (0.047)	1,879	0.045 (0.170)
8th Grade	49,005	-0.044** (0.016)	49,005	-0.001092	38,426	-0.036 (0.020)	13,665	-0.056 (0.031)	1,339	0.005 (0.067)	1,415	0.078 (0.279)
<b>Teacher-Reported Math Cooperation Grades (SD Units)</b>												
7th Grade	108,413	0.043** (0.019)	108,413	0.055** (0.020)	86,158	0.045 (0.026)	29,691	0.064** (0.021)	3,459	0.090* (0.043)	2,674	0.051 (0.078)
8th Grade	76,029	0.084*** (0.018)	76,029	0.088*** (0.024)	59,455	0.096** (0.030)	19,991	0.104*** (0.029)	1,561	0.100* (0.040)	1,871	0.124 (0.141)
<b>Annual Attendance Rate</b>												
7th Grade	108,413	0.100* (0.044)	108,413	0.067 (0.035)	86,158	0.073* (0.032)	31,657	0.106* (0.048)	3,459	0.355* (0.143)	2,850	-0.034 (0.182)
8th Grade	76,029	0.047 (0.056)	76,029	0.061 (0.057)	59,455	0.039 (0.047)	22,010	0.065 (0.066)	1,561	0.032 (0.193)	2,017	-0.063 (0.431)
<b>Self-Reported Behavior (SD Units)</b>												
7th Grade	64,704	0.022 (0.013)	64,704	0.007 (0.015)	51,587	0.019 (0.013)	19,214	0.027 (0.028)	2,268	-0.041 (0.053)	1,766	0.018 (0.150)
8th Grade	49,005	0.028 (0.015)	49,005	0.013 (0.017)	38,426	0.030 (0.018)	13,665	0.049* (0.022)	1,314	0.109 (0.262)	--	--
<b>Expected to Complete a B.A. or Higher<sup>1</sup></b>												
7th Grade	64,701	1.031 (0.060)	64,701	1.031 (0.046)	51,579	1.066 (0.037)	19,209	1.094 (0.074)	2,268	1.065 (0.150)	510	1.001 (0.540)
8th Grade	48,993	1.104 (0.074)	48,993	1.034 (0.046)	38,410	1.121** (0.043)	13,665	1.005 (0.062)	--	--	--	--

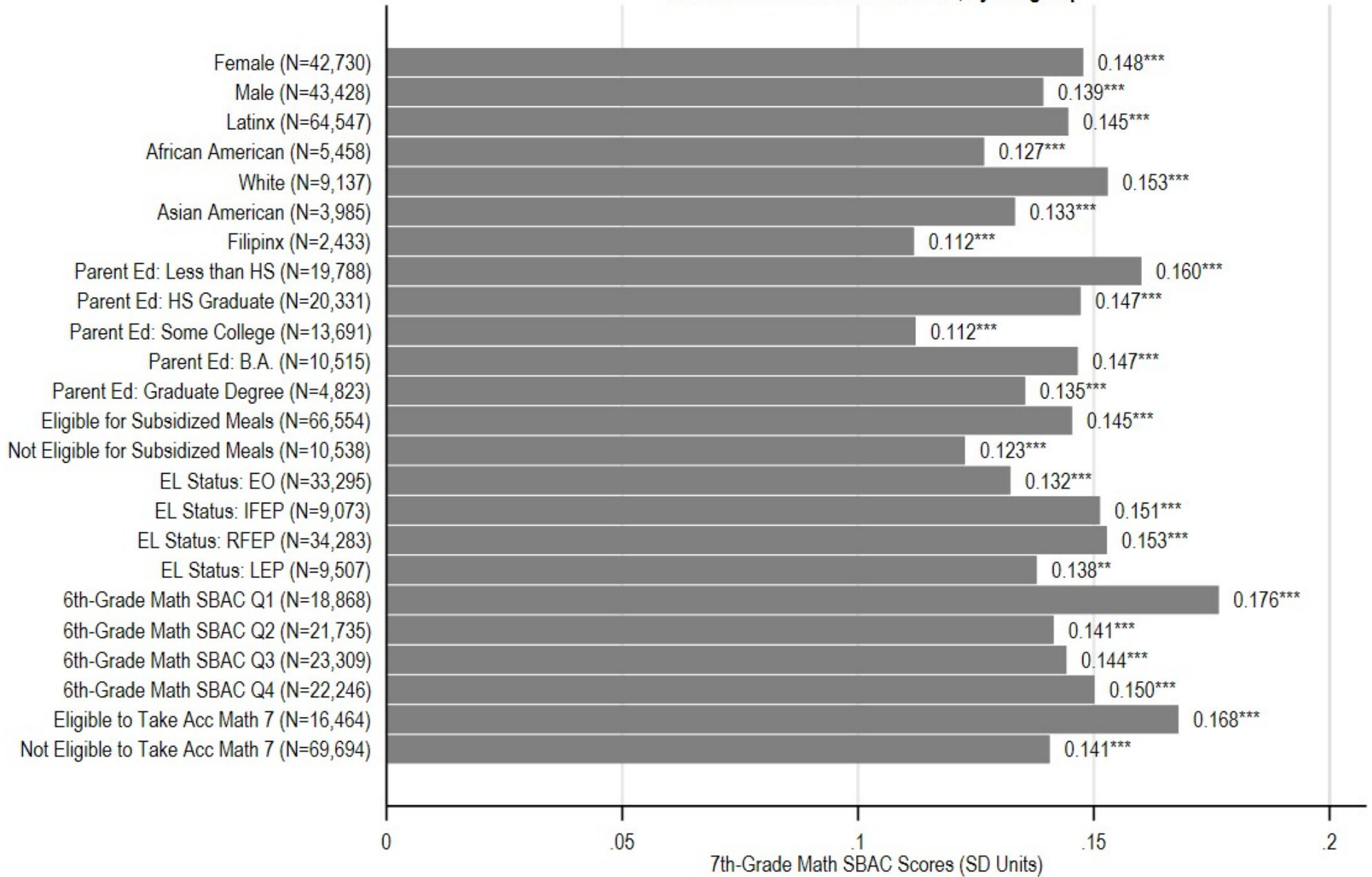
-- indicates that the sample size was too small to estimate the model. <sup>1</sup> Estimates are odds ratios. Note that Ns are lower for the self-perceptions outcomes because those measures come from survey data that are subject to survey non-response. Note, too, that some Ns are smaller than others within the same analytic sample because cases are dropped from models in which covariates perfectly predict the outcome. Sample sizes differ across grades mainly because samples with outcomes measured later in high school contain fewer longitudinal cohorts than those with outcomes measured earlier. See text and Appendix Tables A3 and A4 for more details. The models include all of the control measures in Appendix Table A3. See Appendix Table A4 for information about how we constructed the measures.

**Table 6.** The Impact of Taking Advanced 7th-Grade Math on Students' High School Course Taking & College-Related Outcomes

	Mixed Effects		Entropy Balancing Weights		School Fixed Effects		School Fixed Effects + PSM	
	N	B (SE)	N	B (SE)	N	B (SE)	N	B (SE)
<b>High School Course Taking</b>								
Passed Algebra I by the End of 9th Grade <sup>1</sup>	61,141	2.562*** (0.290)	61,141	3.519*** (0.778)	47,198	2.193*** (0.371)	14,817	2.759*** (0.530)
Earned a B or Better in Algebra I by the End of 9th Grade <sup>1</sup>	61,132	1.299*** (0.088)	61,132	1.331** (0.123)	47,200	1.184* (0.086)	15,150	1.176 (0.110)
Semesters of Rigorous Academic Coursework Passed	14,991	2.693*** (0.298)	14,991	1.718** (0.645)	11,020	2.404*** (0.464)	3,379	2.506*** (0.489)
Semesters of Rigorous Science Coursework Passed	14,991	0.722*** (0.088)	14,991	0.584** (0.210)	11,020	0.635*** (0.133)	3,379	0.505*** (0.148)
Semesters of Rigorous Math Coursework Passed	14,991	0.942*** (0.082)	14,991	0.769*** (0.232)	11,020	0.979*** (0.156)	3,379	0.972*** (0.160)
Took Calculus or Higher <sup>1</sup>	14,982	2.301*** (0.222)	14,982	2.112*** (0.261)	11,005	2.150*** (0.257)	3,313	1.941*** (0.275)
<b>Received College-Going Support and Encouragement from School Staff</b>								
9th Grade	37,623	0.050* (0.020)	37,623	0.007 (0.028)	28,991	0.057** (0.022)	9,888	-0.004 (0.033)
10th Grade	21,419	0.036 (0.023)	21,419	0.040 (0.041)	15,825	0.084** (0.026)	4,864	0.083 (0.045)
11th Grade	18,679	0.049 (0.026)	18,679	-0.008 (0.036)	13,772	0.093*** (0.027)	4,405	0.097* (0.038)
12th Grade	7,807	0.030 (0.044)	7,807	0.082 (0.047)	5,692	0.018 (0.052)	1,766	-0.013 (0.064)
<b>College Eligibility and Readiness<sup>1</sup></b>								
Completed the A-G Requirements	14,984	1.378* (0.179)	14,984	1.357*** (0.129)	11,014	1.276* (0.139)	3,373	1.148 (0.135)
Met the CSU Requirements to Take College-Level Math	14,985	1.528*** (0.189)	14,985	1.601*** (0.162)	11,014	1.405** (0.156)	3,378	1.420** (0.182)
Met the CSU Requirements to Take College-Level Math for STEM Majors	14,985	1.275* (0.156)	14,985	1.294** (0.124)	11,005	1.219* (0.120)	3,378	1.357* (0.176)
<b>Immediate College Enrollment<sup>1</sup></b>								
Any College (2- or 4-Year)	14,023	1.105 (0.129)	14,008	1.114 (0.102)	10,326	1.124 (0.075)	3,226	1.123 (0.117)
4-Year College	14,023	1.296* (0.150)	14,008	1.290** (0.113)	10,326	1.272** (0.100)	3,231	1.341** (0.148)

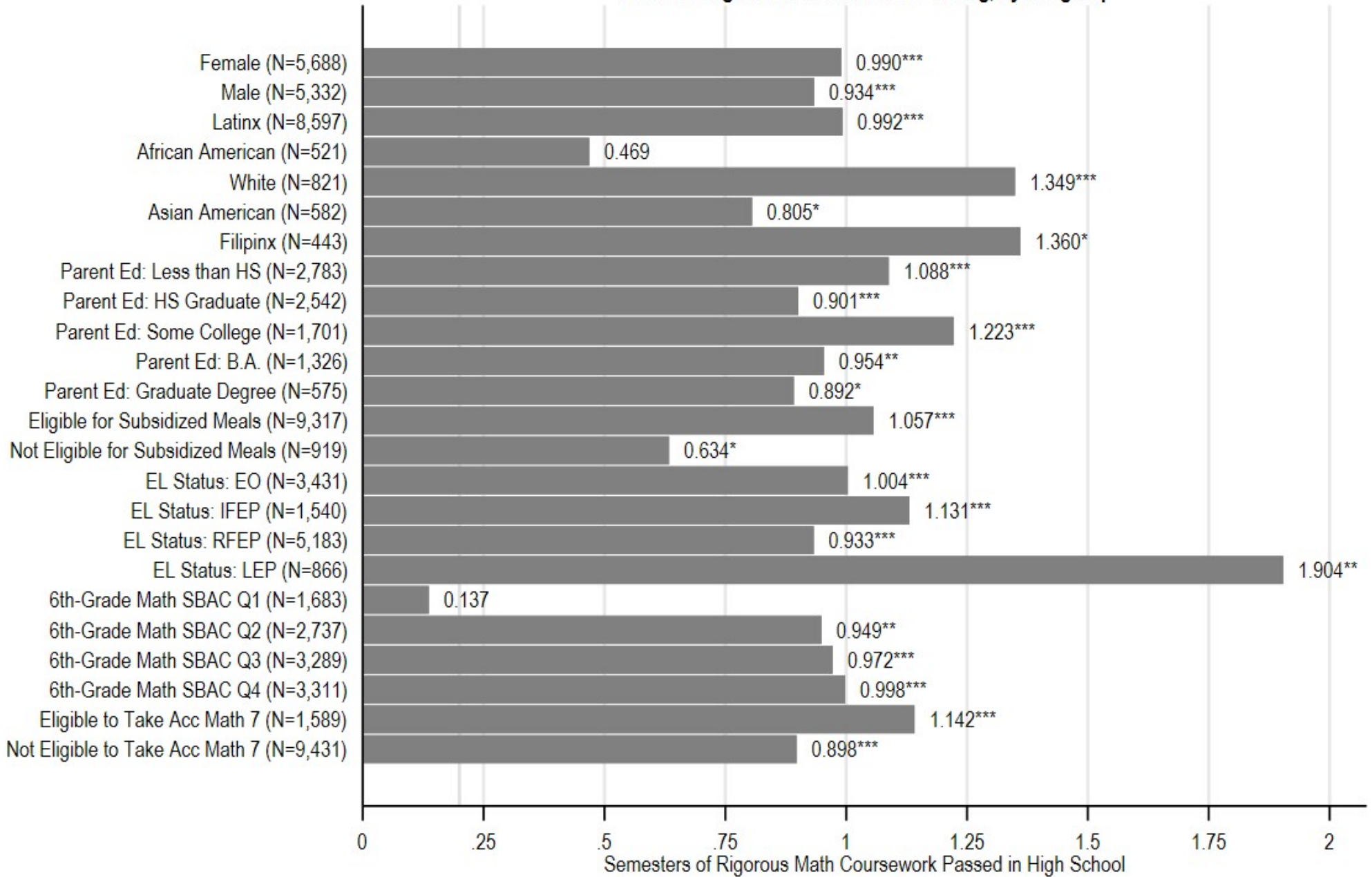
The models include all of the pre-placement characteristics in Appendix Table A3. See Appendix Table A4 for information about how we constructed the measures. Sample sizes differ across grades mainly because samples with outcomes measured later in high school contain fewer longitudinal cohorts than those with outcomes measured earlier. Note that some cases are dropped from models in which covariates perfectly predict the outcome. See text and Appendix Tables A2 and A3 for more details.

**Figure 1. The Impact of Taking Advanced 7th-Grade Math on Students' 7th-Grade Math Scores, by Subgroup**



Note: Results are from models with school fixed effects that include the measures of students' characteristics prior to placement listed in Appendix Table A3.

**Figure 2. The Impact of Taking Advanced 7th-Grade Math on Students' High School Math Course Taking, by Subgroup**



Note: Results are from models with school fixed effects that include the measures of students' characteristics prior to placement listed in Appendix Table A3.

**ONLINE SUPPLEMENT**  
**Long-term Consequences of Early Access to Educational Opportunity**

**Appendix Table A1.** Percentage of Eighth Graders Who Reported Taking Algebra I or Higher,<sup>a</sup> by Year and National Assessment of Educational Progress (NAEP) Jurisdiction

	National	California	Los Angeles Unified School District
2003	32.7%	55.7%	72.8%
2005	39.1%	64.6%	84.3%
2007	40.7%	64.4%	64.2%
2009	42.8%	64.2%	63.3%
2011	44.9%	66.6%	70.3%
2013	45.3%	67.1%	73.8%
2015	41.2%	42.2%	41.4%
2017	38.1%	23.4%	31.3%
2019	38.3%	22.2%	27.0%
2022	35.2%	19.6%	33.0%

Source: Authors' tabulations of NAEP survey data for each jurisdiction. The source data can be accessed through the NAEP Data Explorer ([2003](#), [2005-2015](#), [2017-2022](#)). Note that the national and California samples include public (charter and non-charter) and private schools, and the L.A. Unified sample includes charter and non-charter schools.

<sup>a</sup> We classify the following courses as "Algebra I or Higher": Algebra I (one year course), Algebra I (second year of a two-year course), Geometry, and Algebra II. We do not count the first year of a two-year Algebra I course as advanced math because the course would not allow a student to complete Algebra I by the end of 8th grade. (Note that our definition of "advanced" math differs from Loveless (2016) because we do not classify the first year of a two-year Algebra I course as "advanced" math.)

Note that the math course categories available in the NAEP changed in 2005 and 2017. In 2003, the NAEP data include the following math course categories: "8<sup>th</sup>-grade math," "Pre-algebra," "1<sup>st</sup>-year algebra," "geometry," "2<sup>nd</sup>-year algebra," "Integrated math," and "Other." From 2005-2015 the NAEP data include the following math course categories: "basic or general 8<sup>th</sup>-grade math," "Intro to Algebra or pre-algebra," "Algebra I (1-year course)," "1<sup>st</sup> year of two-year Algebra I," "2<sup>nd</sup> year of two-year Algebra I," "Integrated or sequential math," "Geometry," "Algebra II," "Other math class." From 2017-2022, the NAEP data include the following math course categories: "8<sup>th</sup>-grade math," "Algebra I," "Geometry," "Algebra II," and "Other." We code "1<sup>st</sup>-year algebra" (2003 data) and "Algebra I" (2017-2022 data) as one-year Algebra I courses, "2<sup>nd</sup> year of two-year Algebra I" as the second year of a two-year Algebra I course, and "2<sup>nd</sup>-year algebra" and "Algebra II" as Algebra II.

**Appendix Table A2.** Cohorts in the Analytic Samples

	7th Grade Outcomes	8th Grade Outcomes	9th Grade Outcomes	10th Grade Outcomes	11th Grade Outcomes	12th Grade Outcomes	College Outcomes
<b>Cohorts Included in the Analytic Sample</b>							
2016 7th Graders	X	X	X	X	X	X	X
2017 7th Graders	X	X	X	X	X		
2018 7th Graders	X	X	X				
2019 7th Graders <sup>a</sup>	X						
<b>N of Students Included in the Analytic Sample</b>							
Academic Outcomes	108,413	76,029	61,149	35,029	32,569	14,991	14,029
Survey Outcomes	64,704	49,005	37,623	21,419	18,661	7,840	N/A

<sup>a</sup>We do not follow the 2019 cohort beyond 7th grade because several of their outcome measures, such as 8th-grade standardized math test scores, are missing due to the COVID-19 pandemic.

**Appendix Table A3.** Student Characteristics by Analytic Sample

	All 2016 - 2019 First-Time 7th Graders Who Took Math 6 & Enrolled in Acc. Math 7 or Math 7			7th Grade Analytic Sample		
	N	Mean	SD	N	Mean	SD
Took General Math 7	127,942	0.82	0.38	108,413	0.83	0.37
Took Advanced Math 7	127,942	0.16	0.36	108,413	0.17	0.37
Met the Adv. Math 7 Eligibility Requirements at the End of 6th Grade	126,748	0.17	0.37	108,413	0.17	0.38
Age in Months in 6th Grade	127,942	134.94	4.55	108,413	134.81	4.44
Female	127,851	0.49	0.50	108,413	0.50	0.50
Latinx	127,794	0.76	0.43	108,413	0.78	0.42
Black	127,794	0.07	0.26	108,413	0.07	0.25
Asian American	127,794	0.04	0.20	108,413	0.04	0.19
Filipinx	127,794	0.02	0.15	108,413	0.02	0.15
White	127,794	0.10	0.30	108,413	0.09	0.29
Other Ethnicity	127,794	0.01	0.08	108,413	0.01	0.08
Parent Education: Less than High School	127,942	0.24	0.43	108,413	0.25	0.43
Parent Education: High School Graduate	127,942	0.23	0.42	108,413	0.24	0.43
Parent Education: Some College	127,942	0.14	0.35	108,413	0.15	0.35
Parent Education: College Graduate	127,942	0.11	0.31	108,413	0.11	0.31
Parent Education: Attended Graduate School	127,942	0.05	0.22	108,413	0.05	0.22
Parent Education: Decline to Answer/Missing	127,942	0.22	0.42	108,413	0.21	0.41
Eligible for Subsidized Meals in 6th Grade	114,102	0.88	0.32	97,325	0.89	0.32
# of School Moves K-6	100,101	1.36	0.76	91,577	1.33	0.72
Attended Non-Resident School in 6th Grade	127,471	0.35	0.48	108,081	0.34	0.48
Received Special Education Services in 6th Grade	127,942	0.14	0.34	108,413	0.11	0.31
Identified as Gifted and Talented in 6th Grade	126,073	0.18	0.38	107,185	0.19	0.39
6th-Grade EL Status: English Only	127,785	0.37	0.48	108,413	0.36	0.48
6th-Grade EL Status: Initial Fluent English Proficient	127,785	0.10	0.30	108,413	0.10	0.30
6th-Grade EL Status: Reclassified Fluent English Proficient	127,785	0.38	0.48	108,413	0.41	0.49
6th-Grade EL Status: Limited English Proficient	127,785	0.15	0.36	108,413	0.12	0.33
Attended an Elementary School in 6th Grade	127,650	0.15	0.35	108,413	0.15	0.36
6th-Grade Math Achievement Marks (SD Units)	127,906	0.01	0.99	108,413	0.02	0.98
# of Semesters of Honors Coursework Taken in 6th Grade	127,942	1.45	2.53	108,413	1.53	2.58
6th-Grade Math Standardized Test Score (SD units)	124,415	-0.03	0.96	108,413	0.01	0.94
6th-Grade ELA Achievement Marks (SD Units)	126,769	0.01	0.98	108,413	0.03	0.97
6th-Grade ELA Standardized Test Score (SD units)	123,612	-0.02	0.97	108,413	0.00	0.95
6th-Grade English Language Proficiency Exam Score (SD units)	21,889	0.02	0.99	15,493	0.23	0.66
5th-Grade Math Achievement Marks (SD Units)	118,898	-0.00	0.98	108,413	0.02	0.97

**Appendix Table A3 Continued.** Student Characteristics by Analytic Sample

	All 2016 - 2019 First-Time 7th Graders Who Took Math 6 & Enrolled in Acc. Math 7 or Math 7			7th Grade Analytic Sample		
	N	Mean	SD	N	Mean	SD
4th/5th-Grade Math Standardized Test Score (SD units)	115,647	-0.01	0.96	108,413	-0.01	0.95
5th-Grade ELA Achievement Marks (SD Units)	118,904	-0.00	0.98	108,413	0.04	0.94
4th/5th-Grade ELA Standardized Test Score (SD units)	114,833	-0.01	0.97	108,413	-0.01	0.96
6th-Grade Math Work Effort Grades (SD units)	123,420	0.01	0.99	104,349	0.02	0.98
6th-Grade Self-Reported Work Effort (SD units)	79,799	-0.00	1.00	68,939	0.02	0.98
6th-Grade Attendance Rate	127,774	96.66	4.45	108,413	96.94	3.77
Ever Suspended K-6	100,101	0.03	0.16	91,577	0.02	0.15
6th-Grade Self-Reported Behavior (SD Units)	104,162	-0.00	1.00	90,944	0.02	0.98
6th-Grade Self-Reported Growth-Mindset (SD Units)	102,680	-0.02	1.00	89,684	-0.00	0.99
6th-Grade Self-Reported Academic Self-Efficacy (SD Units)	102,546	-0.01	1.00	89,589	-0.01	0.99
6th-Grade Educational Expectations: Unsure	95,470	0.23	0.42	83,368	0.23	0.42
6th-Grade Educational Expectations: High School or Less	95,470	0.12	0.32	83,368	0.11	0.32
6th-Grade Educational Expectations: Some College	95,470	0.10	0.29	83,368	0.10	0.29
6th-Grade Educational Expectations: B.A. or Higher	95,470	0.56	0.50	83,368	0.56	0.50

Note that the Ns vary across variables within each analytic sample because some measures require students to have been continuously enrolled in the district or only apply to a subset of students, e.g., number of school moves K-6 and English language proficiency exam score. Appendix Table A4 describes how we constructed the measures in this table. See the text for a description of how we handle missing data in our analyses.

**Appendix Table A3 Continued.** Student Characteristics by Analytic Sample

	All 2016 - 2018 First-Time 7th Graders Who Took Math 6 & Enrolled in Acc. Math 7 or Math 7			8th Grade Analytic Sample			9th Grade Analytic Sample		
	N	Mean	SD	N	Mean	SD	N	Mean	SD
Took General Math 7	94,494	0.84	0.36	76,029	0.83	0.37	61,149	0.84	0.36
Took Advanced Math 7	94,494	0.16	0.36	76,029	0.17	0.37	61,149	0.16	0.36
Met the Adv. Math 7 Eligibility Requirements at the End of 6th Grade	94,045	0.15	0.35	76,029	0.16	0.37	61,149	0.14	0.35
Age in Months in 6th Grade	94,494	134.96	4.57	76,029	134.78	4.42	61,149	134.76	4.42
Female	94,418	0.49	0.50	76,029	0.50	0.50	61,149	0.50	0.50
Latinx	94,366	0.76	0.43	76,029	0.78	0.42	61,149	0.82	0.39
Black	94,366	0.07	0.26	76,029	0.06	0.24	61,149	0.06	0.23
Asian American	94,366	0.04	0.20	76,029	0.04	0.20	61,149	0.04	0.19
Filipinx	94,366	0.02	0.15	76,029	0.03	0.16	61,149	0.02	0.15
White	94,366	0.10	0.30	76,029	0.09	0.28	61,149	0.06	0.24
Other Ethnicity	94,366	0.01	0.08	76,029	0.01	0.08	61,149	0.01	0.08
Parent Education: Less than High School	94,494	0.25	0.43	76,029	0.25	0.43	61,149	0.27	0.44
Parent Education: High School Graduate	94,494	0.22	0.42	76,029	0.23	0.42	61,149	0.24	0.42
Parent Education: Some College	94,494	0.15	0.35	76,029	0.15	0.36	61,149	0.14	0.35
Parent Education: College Graduate	94,494	0.11	0.31	76,029	0.11	0.31	61,149	0.09	0.29
Parent Education: Attended Graduate School	94,494	0.05	0.23	76,029	0.05	0.22	61,149	0.04	0.19
Parent Education: Decline to Answer/Missing	94,494	0.22	0.42	76,029	0.21	0.41	61,149	0.22	0.41
Eligible for Subsidized Meals in 6th Grade	81,198	0.89	0.31	65,587	0.89	0.32	53,919	0.91	0.29
# of School Moves K-6	74,052	1.36	0.74	64,853	1.33	0.71	52,684	1.33	0.71
Attended Non-Resident School in 6th Grade	94,418	0.35	0.48	76,029	0.35	0.48	61,149	0.34	0.47
Received Special Education Services in 6th Grade	94,494	0.13	0.33	76,029	0.10	0.30	61,149	0.10	0.30
Identified as Gifted and Talented in 6th Grade	92,673	0.19	0.39	74,877	0.21	0.41	60,804	0.20	0.40
6th-Grade EL Status: English Only	94,364	0.36	0.48	76,029	0.35	0.48	61,149	0.31	0.46
6th-Grade EL Status: Initial Fluent English Proficient	94,364	0.10	0.31	76,029	0.11	0.31	61,149	0.11	0.31
6th-Grade EL Status: Reclassified Fluent English Proficient	94,364	0.38	0.49	76,029	0.42	0.49	61,149	0.44	0.50
6th-Grade EL Status: Limited English Proficient	94,364	0.15	0.36	76,029	0.13	0.33	61,149	0.13	0.34
Attended an Elementary School in 6th Grade	94,272	0.15	0.36	76,029	0.15	0.36	61,149	0.17	0.37
6th-Grade Math Achievement Marks (SD Units)	94,462	-0.00	0.98	76,029	0.05	0.97	61,149	0.02	0.97
# of Semesters of Honors Coursework Taken in 6th Grade	94,494	1.47	2.53	76,029	1.59	2.60	61,149	1.47	2.54
6th-Grade Math Standardized Test Score (SD units)	93,008	-0.03	0.95	76,029	0.04	0.93	61,149	-0.00	0.92
6th-Grade ELA Achievement Marks (SD Units)	94,439	0.01	0.98	76,029	0.06	0.96	61,149	0.04	0.95

**Appendix Table A3 Continued.** Student Characteristics by Analytic Sample

2016 - 2018 First-Time 7th Grade Cohorts									
	All 2016 - 2018 First-Time 7th Graders Who Took Math 6 & Enrolled in Acc. Math 7 or Math 7			8th Grade Analytic Sample			9th Grade Analytic Sample		
	N	Mean	SD	N	Mean	SD	N	Mean	SD
6th-Grade ELA Standardized Test Score (SD units)	92,327	-0.03	0.97	76,029	0.03	0.94	61,149	-0.01	0.93
6th-Grade English Language Proficiency Exam Score (SD units)	17,320	0.13	0.81	11,783	0.23	0.68	9,951	0.22	0.68
5th-Grade Math Achievement Marks (SD Units)	87,847	0.00	0.97	76,029	0.05	0.97	61,149	0.03	0.97
4th/5th-Grade Math Standardized Test Score (SD units)	85,773	-0.01	0.96	76,029	0.02	0.95	61,149	-0.02	0.94
5th-Grade ELA Achievement Marks (SD Units)	87,851	0.01	0.97	76,029	0.06	0.94	61,149	0.03	0.94
4th/5th-Grade ELA Standardized Test Score (SD units)	85,189	-0.02	0.96	76,029	0.01	0.96	61,149	-0.03	0.94
6th-Grade Math Work Effort Grades (SD units)	94,450	0.01	0.99	76,028	0.05	0.98	61,148	0.02	0.98
6th-Grade Self-Reported Work Effort (SD units)	78,782	-0.00	1.00	64,994	0.03	0.98	52,840	0.00	0.98
6th-Grade Attendance Rate	94,359	96.84	4.20	76,029	97.17	3.50	61,149	97.20	3.49
Ever Suspended K-6	74,052	0.03	0.17	64,853	0.02	0.15	52,684	0.02	0.15
6th-Grade Self-Reported Behavior (SD Units)	79,363	-0.00	0.99	65,475	0.04	0.97	53,234	0.02	0.97
6th-Grade Self-Reported Growth-Mindset (SD Units)	78,352	-0.02	1.00	64,668	0.00	0.99	52,592	-0.02	0.99
6th-Grade Self-Reported Academic Self-Efficacy (SD Units)	78,244	-0.01	1.00	64,598	0.00	0.99	52,524	-0.02	0.99
6th-Grade Educational Expectations: Unsure	75,210	0.23	0.42	62,288	0.23	0.42	50,670	0.23	0.42
6th-Grade Educational Expectations: High School or Less	75,210	0.11	0.32	62,288	0.11	0.31	50,670	0.11	0.32
6th-Grade Educational Expectations: Some College	75,210	0.10	0.30	62,288	0.10	0.30	50,670	0.10	0.30
6th-Grade Educational Expectations: B.A. or Higher	75,210	0.55	0.50	62,288	0.56	0.50	50,670	0.55	0.50
2016 & 2017 First-Time 7th Grade Cohorts									
	All 2016 & 2017 First- Time 7th Graders Who Took Math 6 & Enrolled in Acc. Math 7 or Math 7			10th Grade Analytic Sample			11th Grade Analytic Sample		
	N	Mean	SD	N	Mean	SD	N	Mean	SD
Took General Math 7	63,942	0.85	0.36	35,029	0.84	0.37	32,569	0.83	0.37
Took Advanced Math 7	63,942	0.15	0.36	35,029	0.16	0.37	32,569	0.17	0.37
Met the Adv. Math 7 Eligibility Requirements at the End of 6th Grade	63,748	0.12	0.32	35,029	0.12	0.33	32,569	0.13	0.33
Age in Months in 6th Grade	63,942	134.98	4.59	35,029	134.66	4.36	32,569	134.62	4.32
Female	63,888	0.49	0.50	35,029	0.50	0.50	32,569	0.51	0.50
Latinx	63,842	0.76	0.43	35,029	0.82	0.39	32,569	0.82	0.39
Black	63,842	0.07	0.26	35,029	0.05	0.22	32,569	0.05	0.22

**Appendix Table A3 Continued.** Student Characteristics by Analytic Sample

	All 2016 & 2017 First-Time 7th Graders Who Took Math 6 & Enrolled in Acc. Math 7 or Math 7			10th Grade Analytic Sample			11th Grade Analytic Sample		
	N	Mean	SD	N	Mean	SD	N	Mean	SD
Asian American	63,842	0.04	0.20	35,029	0.04	0.20	32,569	0.04	0.20
Filipinx	63,842	0.03	0.16	35,029	0.03	0.16	32,569	0.03	0.17
White	63,842	0.10	0.30	35,029	0.06	0.24	32,569	0.06	0.23
Other Ethnicity	63,842	0.01	0.08	35,029	0.01	0.07	32,569	0.01	0.07
Parent Education: Less than High School	63,942	0.25	0.43	35,029	0.27	0.44	32,569	0.27	0.45
Parent Education: High School Graduate	63,942	0.22	0.42	35,029	0.24	0.42	32,569	0.24	0.42
Parent Education: Some College	63,942	0.15	0.35	35,029	0.14	0.35	32,569	0.14	0.35
Parent Education: College Graduate	63,942	0.11	0.31	35,029	0.09	0.29	32,569	0.10	0.29
Parent Education: Attended Graduate School	63,942	0.05	0.23	35,029	0.04	0.20	32,569	0.04	0.20
Parent Education: Decline to Answer/Missing	63,942	0.22	0.41	35,029	0.22	0.41	32,569	0.22	0.41
Eligible for Subsidized Meals in 6th Grade	58,501	0.90	0.30	33,356	0.91	0.29	31,012	0.91	0.29
# of School Moves K-6	50,130	1.37	0.73	30,386	1.31	0.67	28,323	1.30	0.66
Attended Non-Resident School in 6th Grade	63,888	0.34	0.47	35,029	0.33	0.47	32,569	0.33	0.47
Received Special Education Services in 6th Grade	63,942	0.12	0.33	35,029	0.08	0.27	32,569	0.07	0.26
Identified as Gifted and Talented in 6th Grade	62,145	0.21	0.40	34,738	0.24	0.43	32,305	0.24	0.43
6th-Grade EL Status: English Only	63,837	0.36	0.48	35,029	0.30	0.46	32,569	0.30	0.46
6th-Grade EL Status: Initial Fluent English Proficient	63,837	0.11	0.31	35,029	0.12	0.33	32,569	0.12	0.33
6th-Grade EL Status: Reclassified Fluent English Proficient	63,837	0.38	0.48	35,029	0.45	0.50	32,569	0.46	0.50
6th-Grade EL Status: Limited English Proficient	63,837	0.16	0.36	35,029	0.12	0.33	32,569	0.12	0.32
Attended an Elementary School in 6th Grade	63,795	0.15	0.36	35,029	0.17	0.37	32,569	0.17	0.37
6th-Grade Math Achievement Marks (SD Units)	63,915	0.00	0.98	35,029	0.09	0.96	32,569	0.11	0.95
# of Semesters of Honors Coursework Taken in 6th Grade	63,942	1.49	2.53	35,029	1.58	2.58	32,569	1.60	2.60
6th-Grade Math Standardized Test Score (SD units)	62,826	-0.02	0.96	35,029	0.07	0.89	32,569	0.10	0.88
6th-Grade ELA Achievement Marks (SD Units)	63,905	0.01	0.98	35,029	0.10	0.94	32,569	0.12	0.93
6th-Grade ELA Standardized Test Score (SD units)	62,416	-0.02	0.97	35,029	0.06	0.92	32,569	0.08	0.91
6th-Grade English Language Proficiency Exam Score (SD units)	11,518	0.14	0.80	5,048	0.27	0.65	4,596	0.30	0.64
5th-Grade Math Achievement Marks (SD Units)	59,525	0.00	0.98	35,029	0.08	0.96	32,569	0.11	0.95
4th/5th-Grade Math Standardized Test Score (SD units)	57,105	-0.01	0.96	35,029	0.03	0.94	32,569	0.05	0.94
5th-Grade ELA Achievement Marks (SD Units)	59,529	0.01	0.97	35,029	0.09	0.93	32,569	0.11	0.92
4th/5th-Grade ELA Standardized Test Score (SD units)	56,693	-0.01	0.96	35,029	0.01	0.94	32,569	0.03	0.93
6th-Grade Math Work Effort Grades (SD units)	63,909	0.01	0.99	35,029	0.09	0.96	32,569	0.11	0.95
6th-Grade Self-Reported Work Effort (SD units)	53,152	-0.00	1.00	30,415	0.04	0.96	28,353	0.06	0.95
6th-Grade Attendance Rate	63,839	96.97	4.10	35,029	97.54	3.10	32,569	97.61	3.03

**Appendix Table A3 Continued.** Student Characteristics by Analytic Sample

	All 2016 & 2017 First-Time 7th Graders Who Took Math 6 & Enrolled in Acc. Math 7 or Math 7			10th Grade Analytic Sample			11th Grade Analytic Sample		
	N	Mean	SD	N	Mean	SD	N	Mean	SD
Ever Suspended K-6	50,130	0.03	0.18	30,386	0.02	0.14	28,323	0.02	0.13
6th-Grade Self-Reported Behavior (SD Units)	53,217	-0.00	0.99	30,450	0.07	0.94	28,390	0.09	0.93
6th-Grade Self-Reported Growth-Mindset (SD Units)	53,039	-0.02	1.00	30,365	-0.00	0.98	28,310	0.00	0.98
6th-Grade Self-Reported Academic Self-Efficacy (SD Units)	52,972	-0.01	1.00	30,347	0.01	0.97	28,289	0.02	0.97
6th-Grade Educational Expectations: Unsure	50,040	0.24	0.43	28,839	0.24	0.43	26,895	0.24	0.43
6th-Grade Educational Expectations: High School or Less	50,040	0.11	0.31	28,839	0.10	0.30	26,895	0.10	0.30
6th-Grade Educational Expectations: Some College	50,040	0.11	0.31	28,839	0.11	0.31	26,895	0.11	0.31
6th-Grade Educational Expectations: B.A. or Higher	50,040	0.54	0.50	28,839	0.55	0.50	26,895	0.55	0.50
<b>2016 First-Time 7th Grade Cohort</b>									
	All 2016 First-Time 7th Graders Who Took Math 6 & Enrolled in Acc. Math 7 or Math 7			12th Grade Analytic Sample			Graduates Analytic Sample		
	N	Mean	SD	N	Mean	SD	N	Mean	SD
Took General Math 7	32,445	0.85	0.35	14,991	0.82	0.38	14,029	0.81	0.39
Took Advanced Math 7	32,445	0.15	0.35	14,991	0.18	0.38	14,029	0.19	0.39
Met the Adv. Math 7 Eligibility Requirements at the End of 6th Grade	32,340	0.11	0.31	14,991	0.13	0.33	14,029	0.13	0.34
Age in Months in 6th Grade	32,445	135.03	4.59	14,991	134.61	4.24	14,029	134.58	4.21
Female	32,414	0.49	0.50	14,991	0.51	0.50	14,029	0.52	0.50
Latinx	32,381	0.75	0.43	14,991	0.81	0.39	14,029	0.80	0.40
Black	32,381	0.07	0.26	14,991	0.05	0.21	14,029	0.05	0.21
Asian American	32,381	0.04	0.20	14,991	0.05	0.21	14,029	0.05	0.21
Filipinx	32,381	0.03	0.17	14,991	0.03	0.18	14,029	0.03	0.18
White	32,381	0.10	0.30	14,991	0.06	0.24	14,029	0.06	0.24
Other Ethnicity	32,381	0.01	0.08	14,991	0.00	0.07	14,029	0.00	0.07
Parent Education: Less than High School	32,445	0.25	0.43	14,991	0.27	0.45	14,029	0.27	0.44
Parent Education: High School Graduate	32,445	0.22	0.41	14,991	0.23	0.42	14,029	0.23	0.42
Parent Education: Some College	32,445	0.14	0.35	14,991	0.14	0.35	14,029	0.14	0.35
Parent Education: College Graduate	32,445	0.11	0.32	14,991	0.10	0.30	14,029	0.11	0.31
Parent Education: Attended Graduate School	32,445	0.06	0.23	14,991	0.04	0.20	14,029	0.04	0.21
Parent Education: Decline to Answer/Missing	32,445	0.22	0.41	14,991	0.21	0.41	14,029	0.21	0.41
Eligible for Subsidized Meals in 6th Grade	29,115	0.93	0.26	14,089	0.93	0.26	13,183	0.93	0.26

**Appendix Table A3 Continued.** Student Characteristics by Analytic Sample

	All 2016 First-Time 7th Graders Who Took Math 6 & Enrolled in Acc. Math 7 or Math 7			12th Grade Analytic Sample			Graduates Analytic Sample		
	N	Mean	SD	N	Mean	SD	N	Mean	SD
# of School Moves K-6	25,110	1.37	0.73	12,948	1.29	0.64	12,119	1.28	0.63
Attended Non-Resident School in 6th Grade	32,414	0.30	0.46	14,991	0.29	0.45	14,029	0.30	0.46
Received Special Education Services in 6th Grade	32,445	0.12	0.33	14,991	0.04	0.20	14,029	0.04	0.19
Identified as Gifted and Talented in 6th Grade	30,658	0.24	0.42	14,743	0.29	0.45	13,797	0.30	0.46
6th-Grade EL Status: English Only	32,377	0.35	0.48	14,991	0.29	0.45	14,029	0.29	0.45
6th-Grade EL Status: Initial Fluent English Proficient	32,377	0.12	0.32	14,991	0.13	0.34	14,029	0.14	0.34
6th-Grade EL Status: Reclassified Fluent English Proficient	32,377	0.38	0.49	14,991	0.49	0.50	14,029	0.49	0.50
6th-Grade EL Status: Limited English Proficient	32,377	0.15	0.36	14,991	0.09	0.29	14,029	0.09	0.28
Attended an Elementary School in 6th Grade	32,375	0.15	0.36	14,991	0.17	0.37	14,029	0.17	0.37
6th-Grade Math Achievement Marks (SD Units)	32,427	-0.00	0.98	14,991	0.16	0.94	14,029	0.20	0.93
# of Semesters of Honors Coursework Taken in 6th Grade	32,445	1.45	2.51	14,991	1.64	2.63	14,029	1.69	2.65
6th-Grade Math Standardized Test Score (SD units)	31,694	-0.02	0.96	14,991	0.17	0.86	14,029	0.20	0.85
6th-Grade ELA Achievement Marks (SD Units)	32,425	0.01	0.98	14,991	0.16	0.92	14,029	0.21	0.90
6th-Grade ELA Standardized Test Score (SD units)	31,494	-0.02	0.97	14,991	0.15	0.89	14,029	0.18	0.88
6th-Grade English Language Proficiency Exam Score (SD units)	5,623	0.14	0.79	1,654	0.40	0.55	1,441	0.41	0.55
5th-Grade Math Achievement Marks (SD Units)	30,379	0.01	0.98	14,991	0.16	0.95	14,029	0.19	0.94
4th/5th-Grade Math Standardized Test Score (SD units)	27,827	0.00	0.97	14,991	0.09	0.95	14,029	0.12	0.95
5th-Grade ELA Achievement Marks (SD Units)	30,381	0.02	0.97	14,991	0.16	0.91	14,029	0.19	0.90
4th/5th-Grade ELA Standardized Test Score (SD units)	27,517	-0.01	0.96	14,991	0.05	0.93	14,029	0.08	0.93
6th-Grade Math Work Effort Grades (SD units)	32,423	0.01	0.99	14,991	0.16	0.94	14,029	0.20	0.93
6th-Grade Self-Reported Work Effort (SD units)	27,863	-0.00	1.00	13,427	0.09	0.93	12,599	0.12	0.92
6th-Grade Attendance Rate	32,402	97.16	3.95	14,991	97.86	2.78	14,029	97.92	2.69
Ever Suspended K-6	25,110	0.03	0.18	12,948	0.02	0.13	12,119	0.02	0.12
6th-Grade Self-Reported Behavior (SD Units)	27,901	0.00	0.99	13,444	0.12	0.91	12,613	0.14	0.90
6th-Grade Self-Reported Growth-Mindset (SD Units)	27,803	-0.01	1.00	13,402	0.03	0.98	12,574	0.04	0.98
6th-Grade Self-Reported Academic Self-Efficacy (SD Units)	27,752	-0.01	1.00	13,390	0.05	0.95	12,567	0.06	0.95
6th-Grade Educational Expectations: Unsure	26,085	0.23	0.42	12,694	0.23	0.42	11,918	0.23	0.42
6th-Grade Educational Expectations: High School or Less	26,085	0.11	0.32	12,694	0.09	0.29	11,918	0.09	0.28
6th-Grade Educational Expectations: Some College	26,085	0.12	0.32	12,694	0.11	0.32	11,918	0.11	0.31
6th-Grade Educational Expectations: B.A. or Higher	26,085	0.54	0.50	12,694	0.57	0.50	11,918	0.57	0.49

Note that the Ns vary across variables within each analytic sample because some measures require students to have been continuously enrolled in the district or only apply to a subset of students, e.g., number of school moves K-6 and English language proficiency exam score. Appendix Table A4 describes how we constructed the measures in this table. See the text for a description of how we handle missing data in our analyses.

**Appendix Table A4. Measures****Treatment Indicator**

Took a Full Year of Advanced 7th-Grade Math	We code students as having taken a full-year of advanced 7th-grade math if their 7th-grade transcripts indicated that they enrolled in “Accelerated Math 7” during the fall and spring semesters of their 7th-grade year. The district also offered a seventh-grade Algebra I course for students who had already completed an advanced math course in sixth grade. We exclude students who took advanced sixth-grade math from our analyses and thus do not code seventh-grade Algebra I as an advanced math course, as no students in the sample took it.
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**Controls**

Age in Months	We calculate students' age in months as of August 15th of their 6th-grade year.
Female	We code students' gender based on their modal gender classification in their 6th-grade year. <sup>a</sup>
Ethnicity	We code students' ethnicity based on their modal ethnicity classification in their 6th-grade year. <sup>a,b</sup>
Parents' Educational Attainment	We code students' parents' educational attainment based on the highest level of education their parent reported completing as of the end of students' 6th-grade year. <sup>c</sup>
Subsidized Meal Eligibility	We code students as eligible for subsidized meals if they were eligible in the fall or spring term of their 6th-grade year.
# of School Moves K-6	We count the number of times students' school identification code changed from kindergarten through 6th grade. The measure includes normative moves from elementary to middle school and is missing if students were not continuously enrolled in the district K-6.
Attended a School of Choice	We code students who did not attend their neighborhood school in 6th grade as having attended a school of choice.
Attended an Elementary School	We code students as having attended an elementary school if they attended a school that awarded elementary achievement marks (i.e., marks on a 1–4 scale) during the spring semester of their 6th-grade year.
Received Special Education Services	We code students as having received special education services if they had an IEP on record with the district at any point during their 6th-grade year.
ELL Classification	We code students' English language learner classification based on their classification in the spring of their 6th-grade year.
Took Honors English	We code students as having taken honors English in 6th grade if they took at least one semester of “Honors English 6” in 6th grade. <sup>d</sup>
Took Honors History	We code students as having taken honors history in 6th grade if they took at least one semester of “Honors World History: Ancient Civilizations” in 6th grade. <sup>d</sup>
Took Honors Science	We code students as having taken honors science in 6th grade if they took at least one semester of “Honors Integrated Science 6” in 6th grade. <sup>d</sup>
Took General Math	We code students as having taken general 6th-grade math if they took “Math 6” during both terms of 6th grade. <sup>e</sup>
Took ESL Math	We code students as having taken ESL math if they took “ESL Math” during both terms of 6th grade. <sup>e</sup>
Took Alternate Curriculum Math	We code students as having taken alternate curriculum math if they took “Alt. Curr. Math 6” during both terms of 6th grade. <sup>e</sup>

**Appendix Table A4 Continued. Measures**


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Met the 7th-Grade Advanced Math Placement Requirements	In accordance with the district’s course eligibility policies during the time of our study, we code 2015-16 and 2016-17 7th graders who attended a middle school in 6th grade as eligible to take advanced 7th-grade math if they received a “B” or better in the spring term of their 6th-grade math course, met or exceeded expectations on their 6th-grade math Smarter Balance Assessment (SBAC), and scored “proficient” on the district’s 6th-grade math placement exam. We code students who attended elementary schools in 6th grade as being eligible to take advanced 7th-grade math if they earned a “4” in the spring term of their 6th-grade math course, met or exceeded expectations on their 6th-grade math SBAC, and scored proficient on the district’s 6th-grade math placement exam. We code 2017-18 and 2018-19 7th graders who attended a middle school in 6th grade as eligible to take advanced 7th-grade math if they received a “B” or better in the spring term of their 6th-grade math course and met or exceeded expectations on their 6th-grade math SBAC. We code students who attended elementary schools in 6th grade as being eligible to take advanced 7th-grade math if they earned a “4” in the spring term of their 6th-grade math course and met or exceeded expectations on their 6th-grade math SBAC.
Math GPA	We calculate students’ math GPAs by taking the mean of their 6th-grade math academic achievement marks. We standardize students’ GPAs by year, grade level, and school type (elementary or middle school) so that the measure has a mean of zero and standard deviation of one in the population of 6th graders who attended the same type of school (elementary or middle school). <sup>f</sup> Our models include linear, squared, and cubed terms.
Math SBAC Score	We standardize students’ 6th-grade math SBAC scores by year and grade level so that the measure has a mean of zero and standard deviation of one in the population of tested 6th graders. Our models include linear, squared, and cubed terms.
ELA GPA	We calculate students’ ELA GPAs by taking the mean of their 6th-grade ELA academic achievement marks. We standardize students’ GPAs by year, grade level, and school type (elementary or middle school) so that the measure has a mean of zero and standard deviation of one in the population of 6th graders who attended the same type of school (elementary or middle school). Our models include linear, squared, and cubed terms.
ELA SBAC Score	We standardize students’ 6th-grade ELA SBAC scores by year and grade level so that the measure has a mean of zero and standard deviation of one in the population of tested 6th graders. Our models include linear, squared, and cubed terms.
Math Placement Exam Score	The district required students in the 2015-16 and 2016-17 cohorts to take a math placement exam at the end of 6th grade. The district discontinued the test in 2016-17, so these data are not available for the 2017-18 and 2018-19 cohorts. We standardize students’ 6th-grade math placement scores by year so that the measure has a mean of zero and standard deviation of one in the population of tested 6th graders. Our models include linear, squared, and cubed terms.
CELDT/ELPAC Exam Score	We standardize students’ 6th-grade California English Language Development Test (CELDT)/English Language Proficiency Assessments for California (ELPAC) scores by year, grade level, and test type (initial or summative) so that the measure has a mean of zero and standard deviation of one among tested 6th graders. The 2015-16, 2016-17, and 2017-18 cohorts took the CELDT. The 2018-19 cohort took the initial CELDT and summative ELPAC assessments. Our models include linear, squared, and cubed terms.
5th-Grade Math GPA	We calculate students’ math GPAs by taking the mean of their 5th-grade math academic achievement marks. We standardize students’ GPAs by year and grade level so that the measure has a mean of zero and standard deviation of one in the population of 5th graders. Our models include linear, squared, and cubed terms.

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**Appendix Table A4 Continued. Measures**


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4th/5th-Grade Math Standardized Test Score	We standardize students' 4th- or 5th-grade math standardized test scores by year and grade level so that the measure has a mean of zero and standard deviation of one in the population of tested 4th/5th graders. Because the district discontinued the CA Standards Tests (CSTs) in 2012-13 and adopted the SBACs in 2014-15, we do not have standardized test score data from the 2015-16 cohort's 5th-grade year (2013-14). Thus, we use the 2015-16 cohort's 4th-grade CST scores, and the 2016-17 through 2018-19 cohorts' 5th-grade SBAC scores. Our models include linear, squared, and cubed terms.
5th-Grade ELA GPA	We calculate students' ELA GPAs by taking the mean of their 5th-grade ELA academic achievement marks. We standardize students' GPAs by year and grade level so that the measure has a mean of zero and standard deviation of one in the population of 5th graders. Our models include linear, squared, and cubed terms.
4th/5th-Grade ELA Standardized Test Score	We standardize students' 4th- or 5th-grade ELA standardized test scores by year and grade level so that the measure has a mean of zero and standard deviation of one in the population of 4th/5th graders. Because the district discontinued the CSTs in 2012-13 and adopted the SBACs in 2014-15, we do not have standardized test score data from the 2015-16 cohort's 5th-grade year (2013-14). Thus, we use the 2015-16 cohort's 4th-grade CST scores, and the 2016-17, 2017-18, and 2018-19 cohorts' 5th-grade SBAC scores. Our models include linear, squared, and cubed terms.
Annual Attendance Rate	We calculate students' attendance rate by dividing the number of days students were present by the number of days students were enrolled in a district school during their 6th-grade year. Our models include linear, squared, and cubed terms.
Ever Suspended K-6	We code students as having been suspended if they received an in- or out-of-school suspension during their kindergarten through 6th-grade years. The measure is missing if students were not continuously enrolled in the district K-6.
Math Work Effort GPA	We calculate students' math work effort GPAs by taking the mean of their 6th-grade math work effort marks. We standardize students' GPAs by year and grade level so that the measure has a mean of zero and standard deviation of one in the population of 6th graders. <sup>g</sup> Our models include linear, squared, and cubed terms.
Overall Work Effort GPA	We calculate students' overall work effort GPAs by taking the mean of all of their 6th-grade math work effort marks. We standardize students' GPAs by year and grade level so that the measure has a mean of zero and standard deviation of one in the population of 6th graders. <sup>g</sup> Our models include linear, squared, and cubed terms.
Self-Reported Work Effort	We measure self-reported work effort with the following two items from the district's school climate survey: <sup>h</sup> "I came to class prepared."; "I got my work done right away instead of waiting until the last minute." (alpha=.57-.58). The district removed these two items from the 2017-18 school climate survey. Thus, we cannot measure self-reported work effort in 6th grade for the 2018-19 7th graders. To construct the indices, we take the mean of the items and then standardize the mean relative to the population of 6th graders who responded to the survey in a given year.
Self-Reported Behavior	We measure self-reported classroom behavior with the following six items from the district's school climate survey: <sup>h</sup> "I remembered and followed directions."; "I paid attention, even when there were distractions."; "I stayed calm even when others bothered or criticized me."; "I allowed others to speak without interruption."; "I was polite to adults and peers."; "I kept my temper in check." (alpha=.68-.81). To construct the indices, we take the mean of the items and then standardize the mean relative to the population of 6th graders who responded to the survey in a given year.
Growth-Mindset	We measure growth mindset with four items from the district's school climate survey: <sup>h</sup> "My intelligence is something that I can't change very much."; "Challenging myself won't make me any smarter."; "There are some things I am not capable of learning."; "If I am not naturally smart in a subject, I will never do well in it." (alpha=.67-.78). To construct the indices, we take the mean of the items and then standardize the mean relative to all 6th graders who responded to the survey in a given year.

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**Appendix Table A4 Continued. Measures**

<b>Controls</b>	
Academic Self-Efficacy	We measure academic self-efficacy with four items from the district's school climate survey: <sup>h</sup> "I can earn an A in all my classes."; "I can do well on all my tests, even when they're difficult."; "I can master the hardest topics in my classes."; "I can meet all the learning goals my teachers set." (alpha=.82-.88). To construct the indices, we take the mean of the items and then standardize the mean relative to all 6th graders who responded to the survey in a given year.
Educational Expectations	We measure students' educational expectations in 6th grade using a school climate survey item: <sup>h</sup> "What is the highest level of education you plan to complete?" The item had four categories: "I am unsure of my plans," "high school diploma," "technical/vocational school/two-year college," and "four-year college degree or higher." We label students who indicated they planned to complete a technical or vocational program or two-year degree as planning to complete "some college."
<b>Outcomes</b>	
Math SBAC Score <sup>i</sup>	We standardize students' math SBAC scores by year and grade level so that the measures have a mean of zero and standard deviation of one in the population of tested 7th/8th graders. <sup>j</sup>
ELA SBAC Score	We standardize students' ELA SBAC scores by year and grade level so that the measures have a mean of zero and standard deviation of one in the population of tested 7th/8th graders. <sup>j</sup>
PSAT Scores <sup>k</sup>	We standardize students' 10th-grade PSAT scores by year, grade level, and subject so that the measures for each subject have a mean of zero and standard deviation of one in the population of tested 10th graders in a given year. <sup>j</sup>
Passed an AP Exam	We construct a binary indicator of whether a student passed at least one AP exam with a three or better during their 9th-through 12th-grade years. We code students who were not enrolled in the district from 9th through 12th grade as missing.
Math GPA	We calculate students' math GPAs by taking the mean of their math academic achievement marks in a given year. <sup>l</sup>
Middle School GPA	We calculate students' middle school GPAs by dividing the product of students' grade points and credits attempted by students' credits attempted: $\Sigma(\text{grade points} * \text{attempted course credits}) / \Sigma(\text{attempted course credits})$ .
Cumulative Unweighted GPA	The district provides cumulative unweighted high school GPAs that include the coursework students completed in high school, including courses taken for credit in other school districts, at a community or four-year college, or an adult school.
Cumulative Weighted GPA	The district provides cumulative weighted high school GPAs that include the coursework students completed in high school, including courses taken for credit in other school districts, at a community or four-year college, or an adult school.
Passed Algebra I by the End of 9th Grade	We code students as having passed Algebra I by the end of 9th grade if they received a "D" or better in the spring semester of the course in middle school or in 9th grade. We base our measure on students' spring grades because the district uses spring grades to determine students' course placements for the following year. <sup>m</sup>
Earned a B or Better in Alg. I by the End of 9th Grade	We code students as having earned at least a "B" average in Algebra I by the end of 9th grade if their math GPA was greater than or equal to 3.0 in the year they took Algebra I. If a student repeated Algebra I, the measure is based on their highest Algebra I GPA. <sup>m</sup>
# Adv./Honors/AP/IB Semesters Passed in HS	Following Long, Conger, and Iatarola (2012), we construct a measure of the number of honors, AP, IB, advanced, and dual enrollment courses in which students earned a "D" or better during their 9th- through 12th-grade years.
Took Calculus or Higher in HS	We code students as having taken Calculus or higher in high school if they took at least one semester of a Calculus or higher-level course (e.g., Discrete Mathematics, Linear Algebra) at their high school or through a dual enrollment program.
Attendance Rate	We calculate students' annual attendance rate by dividing the number of days students were present by the number of days students were enrolled in a district school in a given year and then multiplying by 100. <sup>n</sup>

**Appendix Table A4 Continued. Measures**


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Math Work Effort GPA	We calculate students' math work effort GPAs by taking the mean of their math work effort marks. We standardize students' work effort GPAs by year and grade level so that the measure has a mean of zero and standard deviation of one among all students in each grade level. <sup>1</sup>
Math Cooperation GPA	We calculate students' math cooperation GPAs by taking the mean of their math cooperation marks. We standardize students' cooperation GPAs by year and grade level so that the measure has a mean of zero and standard deviation of one among all students in each grade level. <sup>1,0</sup>
Self-Reported Behavior	We measure self-reported classroom behavior with the following three items from the district's school climate survey: <sup>h</sup> "I remembered and followed directions."; "I paid attention, even when there were distractions."; "I stayed calm even when others bothered or criticized me." (alpha=.69-.82). Our behavior measures for 7th through 12th grade include fewer items than our 6th-grade measure because the district removed several of the behavior items from the school climate survey in 2017-18. To make the measures comparable across cohorts, we only include items available for all of the cohorts in a given grade level. To construct the indices, we take the mean of the items and then standardize the mean relative to all students in the grade level who responded to the survey in that year.
Academic Self-Efficacy	We measure academic self-efficacy with the following three items from the district's school climate survey: <sup>h</sup> "I can do well on all my tests, even when they're difficult."; "I can master the hardest topics in my classes."; "I can meet all the learning goals my teachers set." (alpha=.86-.92). To construct the indices, we take the mean of the items and then standardize the mean relative to all students in the grade level who responded to the survey in that year.
Expected to Complete a B.A. or Higher	We measure students' educational expectations using the following survey item from the district's school climate survey: <sup>h</sup> "What is the highest level of education you plan to complete?" We code students as expecting to earn a bachelor's degree or higher if they indicated they expected to earn a bachelor's degree or graduate degree. During most of the years of our study, 2016-17 through 2020-21, students who indicated they were unsure about the highest level of education they planned to complete, saw a follow-up item that asked them to make their best guess about how far they planned to go in school. To make the measure comparable across cohorts, our 7th-grade educational expectations measure does not recode "unsure" responses with students' best guesses, as only two of our cohorts saw the follow-up item. Our 8th through 12th-grade measures recode unsure students using their best guess. <sup>p</sup>
Received College-Going Support from School Staff	We measure whether students reported receiving encouragement to attend college and college information from school staff using three items from the district's school climate survey: <sup>h</sup> "Most adults at my school expect me to go to college."; "Adults at my school have talked to me about different college choices for my future."; "Adults at my school have helped me learn the details of getting into college." (alpha=.76-.83). To construct the indices, we take the mean of the items and then standardize the mean relative to all students in the grade level who responded to the survey in that year.
Completed the A-G Requirements	The A-G requirements are a set of 15 academic preparatory courses that students must pass with a "C" or better to be eligible to attend a public four-year college in CA. We code students as having completed the A-G requirements if the students' A-G status was listed as "complete" in district data files the spring of their 12th-grade year.
Placed into College-Level Math (Non-STEM Majors)	We code students as having met the requirements to place into college-level math for non-STEM majors at a CSU campus if they met the placement requirements specified by the CSU Chancellor's Office (e.g., earned a 3 or higher on an AP Calculus or Statistics exam or earned a weighted math GPA of 3.3 or higher) in high school. <sup>q</sup>

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**Appendix Table A4 Continued. Measures**


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Placed into College-Level Math (STEM Majors)	We code students as having met the requirements to place into college-level math for STEM and math-intensive majors at a CSU campus if they met the placement requirements specified by the CSU Chancellor's Office (e.g., earned a 3 or higher on an AP Calculus or Statistics exam or a weighted math GPA of 3.5 or higher) in high school. <sup>q</sup>
Enrolled in Any College	We measure whether students enrolled in a less than two-year, two-year, or four-year college the fall after graduating from high school using NSC data. <sup>r</sup>
Enrolled in a Four-Year College	We measure whether students enrolled in a four-year college the fall after graduating from high school using (NSC) data. <sup>r</sup>

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<sup>a</sup> If students' 6<sup>th</sup>-grade classifications were missing, we imputed them from the most recent non-missing modal classification from kindergarten through 5th grade. If students did not have a modal value in a given year (i.e., their fall and spring records contained conflicting data), we coded the students' classification in that year as missing. <sup>b</sup> We combine American Indian, Alaskan Native, Pacific Islander, and multiethnic students into another "other ethnicity" category due to small sample sizes. <sup>c</sup> If students' parents' educational attainment was missing in the 6th grade, we imputed their parents' educational attainment with their most recent non-missing record from kindergarten through 6th grade. <sup>d</sup> Virtually all 6th graders who took honors courses in 6th grade took two semesters of the course. <sup>e</sup> Virtually all students took a full year of the same 6th-grade math course. We exclude students who took two different math courses during the same academic year because, in all but one case, the students took one semester each of advanced 6th-grade math and general 6th-grade math. <sup>f</sup> We include students' math content courses in our GPA calculations. Some students took math intervention courses in addition to their content course. We exclude these courses from our GPA calculations to make math GPAs comparable across students. <sup>g</sup> Due to a change in the district's elementary school grading policies in 2017-18, we do not have 6th-grade work effort grades for 2018-19 7th graders who attended an elementary school in 6th grade. <sup>h</sup> The school district administered the 2014-15 school climate survey in the spring, the 2015-16 and 2016-17 surveys in the winter, and the 2017-18 survey in the fall. <sup>i</sup> CA typically administers an SBAC math exam to 11th graders. However, our cohorts were in 11th grade in 2019-20 and 2020-21. The 2019-20 SBAC was not administered due to COVID-19 and the 2020-21 SBAC was administered after a year of remote instruction and to only a subset of 11th graders. Thus, we do not use 11th grade math SBAC scores as an outcome. <sup>j</sup> We use students' scores from the year in which they would have been enrolled in 8th or 10th grade if they progressed normally (e.g., we use 2017-18 SBAC scores for our 8th-grade math SBAC measure regardless of whether 2016-17 first-time 7th graders were promoted to 8th grade). <sup>k</sup> We have PSAT scores for most students because the district administered the PSAT during the school day to all 10th graders. <sup>l</sup> We include students' math content courses in our GPA calculations. <sup>m</sup> Students in the district we study typically take Algebra in 9th grade, but can take it as early as 6th grade. <sup>n</sup> We exclude 2019-20 attendance data due to issues of data quality during the initial months of remote instruction due to the COVID-19 pandemic. <sup>o</sup> We do not include cooperation GPAs as a control measure because elementary school 6th graders, who comprise 15 percent of our sample, do not receive cooperation marks. <sup>p</sup> We also estimate models where we do not recode "unsure" responses and the results are not substantively different. <sup>q</sup> Among students in our sample who enrolled in a four-year college, 60.5% attended a CSU campus. The CSU chancellor's office sets the math course placement policies for all campuses. During the time of our study, CSU used multiple measures for course placement, including students' math test scores (SBAC, SAT or SAT subject tests, AP, IB, or CLEP exams), math grades, and course taking. Due to COVID-19, no students in our sample took an 11th-grade math SBAC and very few took the SAT, or SAT subject test. We do not have CLEP data, so our measure is primarily based on students' AP and IB exam results, math grades, and math course taking. Students who do not meet the college-level math placement requirements are required to either attend a summer remedial math program called Early Start or take a math course with support—i.e., concurrently enroll in a math intervention course intended to improve students' math skills (California State University, n.d.). <sup>r</sup> The NSC includes data on 97% of college enrollments nationwide. We define immediate fall enrollment as NSC does, which is enrollment between August 15th and October 31st (NSC, 2021).

**Appendix Table A5.** Student Characteristics by Schools' Math Course Offerings

	Schools That Did Not Offer Any Sections of Advanced 7th-Grade Math			Schools That Did Not Offer Enough Sections <sup>1</sup> of Advanced 7th-Grade Math to Accommodate All Eligible Students			Schools That Offered Enough Sections of Advanced 7th-Grade Math to Accommodate All Eligible Students		
	(Mean # of Schools=43) <sup>2</sup>			(Mean # of Schools=16)			(Mean # of Schools=62)		
	N	Mean	SD	N	Mean	SD	N	Mean	SD
Female	22,273	0.49	0.50	23,113	0.49	0.50	63,027	0.50	0.50
Latinx	22,273	0.88	0.33	23,113	0.74	0.44	63,027	0.75	0.43
Black	22,273	0.08	0.26	23,113	0.05	0.22	63,027	0.07	0.25
Asian American	22,273	0.01	0.11	23,113	0.04	0.20	63,027	0.05	0.21
Filipinx	22,273	0.01	0.08	23,113	0.03	0.16	63,027	0.03	0.17
White	22,273	0.02	0.16	23,113	0.13	0.34	63,027	0.10	0.30
Other Ethnicity	22,273	<0.01	0.06	23,113	0.01	0.09	63,027	0.01	0.08
Parent Education: Less than High School	22,273	0.31	0.46	23,113	0.22	0.41	63,027	0.23	0.42
Parent Education: High School Graduate	22,273	0.24	0.43	23,113	0.25	0.43	63,027	0.23	0.42
Parent Education: Some College	22,273	0.10	0.3	23,113	0.16	0.37	63,027	0.16	0.36
Parent Education: College Graduate	22,273	0.05	0.22	23,113	0.13	0.34	63,027	0.12	0.32
Parent Education: Attended Graduate School	22,273	0.02	0.14	23,113	0.06	0.24	63,027	0.05	0.23
Parent Education: Deline to Answer/Missing	22,273	0.28	0.45	23,113	0.18	0.39	63,027	0.20	0.40
Eligible for Subsidized Meals in 6th Grade	20,249	0.97	0.17	20,083	0.84	0.37	56,993	0.87	0.33
6th-Grade EL Status: English Only	22,273	0.27	0.44	23,113	0.42	0.49	63,027	0.37	0.48
6th-Grade EL Status: Initial Fluent English Proficient	22,273	0.10	0.29	23,113	0.10	0.30	63,027	0.11	0.31
6th-Grade EL Status: Reclassified Fluent English Proficient	22,273	0.46	0.50	23,113	0.39	0.49	63,027	0.40	0.49
6th-Grade EL Status: Limited English Proficient	22,273	0.18	0.38	23,113	0.10	0.29	63,027	0.12	0.32
6th-Grade Math Achievement Marks (SD Units)	22,273	-0.11	0.99	23,113	0.07	0.97	63,027	0.04	0.98
# of Semesters of Honors Coursework Taken in 6th Grade	22,273	0.88	2.04	23,113	1.76	2.71	63,027	1.68	2.66

**Appendix Table A5 Continued.** Student Characteristics by Schools' Math Course Offerings

	Schools That Did Not Offer Any Sections of Advanced 7th-Grade Math			Schools That Did Not Offer Enough Sections <sup>1</sup> of Advanced 7th-Grade Math to Accommodate All Eligible Students			Schools That Offered Enough Sections of Advanced 7th-Grade Math to Accommodate All Eligible Students		
	(Mean # of Schools=43) <sup>2</sup>			(Mean # of Schools=16)			(Mean # of Schools=62)		
	N	Mean	SD	N	Mean	SD	N	Mean	SD
Met or Exceeded Standards on 6th-Grade Math Standardized Test	22,273	0.16	0.37	23,113	0.34	0.47	63,027	0.27	0.45
6th-Grade Math Standardized Test Score (SD units)	22,273	-0.23	0.89	23,113	0.13	0.94	63,027	0.04	0.94
6th-Grade ELA Achievement Marks (SD Units)	22,273	-0.12	0.97	23,113	0.11	0.95	63,027	0.05	0.97
6th-Grade ELA Standardized Test Score (SD units)	22,273	-0.23	0.90	23,113	0.11	0.95	63,027	0.05	0.95
6th-Grade Math Work Effort Grades (SD units)	21,836	-0.11	0.99	21,776	0.11	0.97	60,737	0.04	0.98
Eligible to Take Advanced 7th-Grade Math	22,273	0.09	0.29	23,113	0.26	0.44	63,027	0.17	0.37
Attended a School where <20 Students were Eligible to Take Advanced Math	22,273	0.68	0.47	23,113	0.00	0.00	63,027	0.19	0.39

N students=108,413; N Schools=126 (the number of schools varies across cohorts, the total number of schools represented in the sample is 126)

The table includes students in our 7th-grade analytic sample. See Appendix Table A4 for details on how we constructed the measures in this table.

<sup>1</sup> We determined schools' math course offerings by cohort, i.e., whether the school offered the course in a given year, and created a student-level categorical variable that indicated whether the students' school did not offer the course, did not offer enough sections, or offered a sufficient number of sections. We classified a school as not offering advanced math if we did not observe any students enrolled in the course during a given academic year. We classified a school as offering too few sections if the number of eligible students exceeded the maximum number of students who could enroll in the course (i.e., maximum enrollment=# of sections \* maximum allowable course enrollment per district policy documents) during a given academic year. We classified a school as offering a sufficient number of sections if the maximum number of students who could enroll in the course in a given academic year was equal to or exceeded the number of eligible students.

<sup>2</sup> The number of schools that offered Acc. Math 7 varies across the cohorts we examine; thus, we show the average for each category.

**Appendix Table A6.** Characteristics of Students Who Attended a School that Offered Advanced 7th-Grade Math, by Course Placement and Eligibility

	Students Enrolled in General Math						Students Enrolled in Advanced Math					
	Not Eligible to Take Advanced 7th-Grade Math			Eligible to Take Advanced 7th-Grade Math			Not Eligible to Take Advanced 7th-Grade Math			Eligible to Take Advanced 7th-Grade Math		
	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD
Female	63,235	0.48	0.50	4,662	0.54	0.50	6,458	0.53	0.50	11,802	0.54	0.50
Latinx	63,235	0.80	0.40	4,662	0.64	0.48	6,458	0.72	0.45	11,802	0.51	0.50
Black	63,235	0.07	0.25	4,662	0.05	0.21	6,458	0.08	0.28	11,802	0.05	0.21
Asian American	63,235	0.02	0.16	4,662	0.07	0.26	6,458	0.06	0.23	11,802	0.15	0.35
Filipinx	63,235	0.02	0.14	4,662	0.05	0.21	6,458	0.03	0.16	11,802	0.07	0.25
White	63,235	0.08	0.27	4,662	0.18	0.39	6,458	0.11	0.31	11,802	0.22	0.42
Other Ethnicity	63,235	0.01	0.08	4,662	0.01	0.10	6,458	0.01	0.08	11,802	0.01	0.09
Parent Education: Less than High School	63,235	0.26	0.44	4,662	0.17	0.37	6,458	0.20	0.40	11,802	0.12	0.33
Parent Education: High School Graduate	63,235	0.25	0.43	4,662	0.20	0.40	6,458	0.23	0.42	11,802	0.17	0.37
Parent Education: Some College	63,235	0.16	0.36	4,662	0.18	0.38	6,458	0.16	0.37	11,802	0.16	0.37
Parent Education: College Graduate	63,235	0.09	0.29	4,662	0.18	0.39	6,458	0.13	0.34	11,802	0.25	0.43
Parent Education: Attended Graduate School	63,235	0.04	0.19	4,662	0.09	0.28	6,458	0.07	0.26	11,802	0.14	0.35
Parent Education: Decline to Answer/Missing	63,235	0.21	0.40	4,662	0.18	0.38	6,458	0.20	0.40	11,802	0.15	0.36
Eligible for Subsidized Meals in 6th Grade	57,219	0.91	0.29	4,014	0.74	0.44	5,792	0.86	0.35	10,066	0.68	0.47
6th-Grade EL Status: English Only	63,235	0.36	0.48	4,662	0.46	0.50	6,458	0.40	0.49	11,802	0.49	0.50
6th-Grade EL Status: Initial Fluent English Proficient	63,235	0.08	0.28	4,662	0.14	0.35	6,458	0.15	0.35	11,802	0.18	0.38
6th-Grade EL Status: Reclassified Fluent English Proficient	63,235	0.41	0.49	4,662	0.40	0.49	6,458	0.44	0.50	11,802	0.32	0.47
6th-Grade EL Status: Limited English Proficient	63,235	0.15	0.36	4,662	0.01	0.08	6,458	0.01	0.11	11,802	<0.01	0.05
6th-Grade Math Achievement Marks (SD Units)	63,235	-0.25	0.91	4,662	0.90	0.50	6,458	0.46	0.76	11,802	1.10	0.39
# of Semesters of Honors Coursework Taken in 6th Grade	63,235	1.07	2.26	4,662	2.73	2.97	6,458	2.71	2.93	11,802	4.08	2.78
Met or Exceeded Standards on 6th-Grade Math Standardized Test	63,235	0.10	0.30	4,662	1.00	0.00	6,458	0.35	0.48	11,802	1.00	0.00
6th-Grade Math Standardized Test Score (SD units)	63,235	-0.28	0.79	4,662	1.00	0.32	6,458	0.48	0.59	11,802	1.33	0.43

**Appendix Table A6 Continued.** Student Characteristics of Students Who Attended a School that Offered Advanced 7th-Grade Math, by Course Placement and Eligibility

	Students Enrolled in General Math						Students Enrolled in Advanced Math					
	Not Eligible to Take Advanced 7th-Grade Math			Eligible to Take Advanced 7th-Grade Math			Not Eligible to Take Advanced 7th-Grade Math			Eligible to Take Advanced 7th-Grade Math		
	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD
6th-Grade ELA Achievement Marks (SD Units)	63,235	-0.17	0.93	4,662	0.71	0.69	6,458	0.45	0.80	11,802	0.89	0.58
6th-Grade ELA Standardized Test Score (SD units)	63,235	-0.25	0.83	4,662	0.84	0.59	6,458	0.50	0.71	11,802	1.21	0.58
6th-Grade Math Work Effort Grades (SD units)	60,292	-0.19	0.97	4,429	0.74	0.60	6,208	0.40	0.83	11,600	0.89	0.47

The table includes students in our 7<sup>th</sup>-grade analytic sample who attended a school that offered advanced math in their 7<sup>th</sup>-grade year. See Appendix Table A4 for details on how we constructed the measures in this table.

**Appendix Table A7.** Results for the High School Graduates Sample

	Mixed Effects		Entropy Balancing Weights		School Fixed Effects		School Fixed Effects + PSM	
	N	B (SE)	N	B (SE)	N	B (SE)	N	B (SE)
<b>Standardized Math Test Scores (SD Units)</b>								
7th-Grade SBAC	14,029	0.151*** (0.017)	14,029	0.119*** (0.021)	10,330	0.134*** (0.021)	2,820	0.138*** (0.026)
8th-Grade SBAC	14,029	0.189*** (0.019)	14,029	0.119*** (0.029)	10,330	0.191*** (0.027)	2,820	0.196*** (0.030)
10th-Grade PSAT	14,029	0.151*** (0.021)	14,029	0.146*** (0.034)	10,330	0.127*** (0.029)	2,820	0.131*** (0.024)
<b>Standardized ELA Test Scores (SD Units)</b>								
7th-Grade SBAC	14,029	0.040* (0.017)	14,029	-0.015 (0.023)	10,330	0.031 (0.018)	2,820	0.031 (0.029)
8th-Grade SBAC	14,029	0.073*** (0.018)	14,029	-0.022 (0.027)	10,330	0.070*** (0.020)	2,820	0.066* (0.026)
10th-Grade PSAT	14,029	0.054** (0.020)	14,029	0.014 (0.028)	10,330	0.036 (0.024)	2,820	0.045 (0.026)
<b>Passed At Least One AP Exam<sup>1</sup></b>								
9th-12th Grade	14,023	1.345*** (0.102)	14,023	1.337*** (0.118)	10,318	1.316*** (0.101)	2,820	1.470*** (0.142)
<b>Math Grade Point Average</b>								
7th Grade	14,029	-0.362*** (0.046)	14,029	-0.241*** (0.039)	10,330	-0.246*** (0.048)	3,232	-0.222*** (0.045)
8th Grade	14,029	-0.242*** (0.040)	14,029	-0.218*** (0.043)	10,330	-0.240*** (0.040)	3,232	-0.166** (0.052)
9th Grade	14,029	-0.044 (0.036)	14,029	-0.012 (0.037)	10,330	-0.050 (0.044)	3,232	-0.035 (0.044)
10th Grade	14,029	-0.094** (0.037)	14,029	-0.092** (0.031)	10,330	-0.097* (0.044)	3,232	-0.088 (0.057)
11th Grade	14,029	-0.049 (0.035)	14,029	-0.056 (0.040)	10,330	-0.065 (0.040)	3,232	-0.043 (0.057)

**Appendix Table A7 Continued.** Results for the High School Graduates Sample

	Mixed Effects		Entropy Balancing Weights		School Fixed Effects		School Fixed Effects + PSM	
	N	B (SE)	N	B (SE)	N	B (SE)	N	B (SE)
<b>Math Grade Point Average</b>								
12th Grade <sup>2</sup>	10,822	0.029 (0.044)	10,822	-0.018 (0.045)	7,954	0.046 (0.053)	2,495	0.079 (0.069)
<b>Middle School Annual GPA/Unweighted Cumulative HS GPA</b>								
7th Grade	14,029	-0.042 (0.022)	14,029	-0.045 (0.023)	10,330	-0.009 (0.025)	3,232	-0.013 (0.023)
8th Grade	14,029	-0.013 (0.024)	14,029	-0.022 (0.023)	10,330	-0.012 (0.027)	3,232	0.008 (0.026)
9th Grade	14,029	0.011 (0.022)	14,029	0.026 (0.025)	10,330	0.013 (0.026)	3,232	0.025 (0.028)
10th Grade	14,029	0.014 (0.021)	14,029	0.017 (0.021)	10,330	0.015 (0.026)	3,232	0.036 (0.031)
11th Grade	14,029	0.019 (0.020)	14,029	0.021 (0.019)	10,330	0.016 (0.024)	3,232	0.032 (0.028)
12th Grade	14,029	0.030 (0.020)	14,029	0.023 (0.019)	10,330	0.028 (0.024)	3,232	0.041 (0.030)
<b>Teacher-Reported Math Work Effort Grades (SD Units)</b>								
7th Grade	14,029	-0.131*** (0.039)	14,029	-0.095* (0.043)	10,330	-0.104* (0.049)	3,232	-0.089* (0.043)
8th Grade	14,029	-0.066* (0.033)	14,029	-0.025 (0.041)	10,330	-0.092* (0.042)	3,232	-0.074 (0.045)
<b>Academic Self-Efficacy (SD Units)</b>								
7th Grade	7,898	-0.025 (0.034)	7,898	0.030 (0.042)	5,788	0.024 (0.044)	2,359	0.105* (0.047)
8th Grade	8,305	-0.090** (0.034)	8,305	-0.106* (0.044)	6,188	-0.051 (0.049)	2,562	-0.093 (0.057)

**Appendix Table A7 Continued.** Results for the High School Graduates Sample

	Mixed Effects		Entropy Balancing Weights		School Fixed Effects		School Fixed Effects + PSM	
	N	B (SE)	N	B (SE)	N	B (SE)	N	B (SE)
<b>Teacher-Reported Math Cooperation Grades (SD Units)</b>								
7th Grade	14,029	0.002 (0.039)	14,029	0.012 (0.045)	10,330	-0.022 (0.052)	3,232	-0.014 (0.049)
8th Grade	14,029	0.031 (0.032)	14,029	0.001 (0.034)	10,330	0.018 (0.044)	3,232	-0.031 (0.040)
<b>Annual Attendance Rate</b>								
7th Grade	14,029	0.059 (0.075)	14,029	0.065 (0.092)	10,330	0.056 (0.095)	3,232	0.098 (0.124)
8th Grade	14,029	-0.029 (0.083)	14,029	0.007 (0.086)	10,330	0.041 (0.090)	3,232	0.018 (0.115)
<b>Self-Reported Behavior (SD Units)</b>								
7th Grade	7,898	-0.021 (0.031)	7,898	0.014 (0.027)	5,788	-0.020 (0.030)	2,359	0.008 (0.041)
8th Grade	8,305	0.008 (0.032)	8,305	0.023 (0.034)	6,188	0.032 (0.042)	2,562	0.070 (0.053)
<b>Expected to Complete a B.A. or Higher</b>								
7th Grade	7,897	0.977 (0.091)	7,897	0.960 (0.114)	5,783	0.991 (0.112)	2,348	0.864 (0.135)
8th Grade	8,299	0.999 (0.080)	8,299	0.963 (0.103)	6,187	0.972 (0.104)	2,544	0.725 (0.119)
<b>High School Course Taking</b>								
Passed Algebra I by the End of 9th Grade <sup>1</sup>	14,027	2.678*** (0.536)	14,027	4.652*** (1.720)	10,228	1.925** (0.455)	2,624	2.566*** (0.738)
Earned a B or Better in Algebra I by the End of 9th Grade <sup>1</sup>	14,027	1.216* (0.095)	14,027	1.423** (0.189)	10,327	1.112 (0.139)	3,232	1.001 (0.144)
Semesters of Rigorous Academic Coursework Passed	14,029	2.793*** (0.298)	14,029	1.783** (0.660)	10,330	2.544*** (0.453)	3,232	2.402*** (0.525)
Semesters of Rigorous Science Coursework Passed	14,029	0.757*** (0.089)	14,029	0.613** (0.212)	10,330	0.673*** (0.127)	3,232	0.491*** (0.144)
Semesters of Rigorous Math Coursework Passed	14,029	1.010*** (0.083)	14,029	0.835*** (0.235)	10,330	1.049*** (0.155)	3,232	1.019*** (0.178)
Took Calculus or Higher <sup>1</sup>	14,024	2.423*** (0.231)	14,024	2.176*** (0.255)	10,319	2.296*** (0.281)	3,173	2.076*** (0.310)

**Appendix Table A7 Continued.** Results for the High School Graduates Sample

	Mixed Effects		Entropy Balancing Weights		School Fixed Effects		School Fixed Effects + PSM	
	N	B (SE)	N	B (SE)	N	B (SE)	N	B (SE)
<b>Received College-Going Support and Encouragement from School Staff</b>								
9th Grade	9,696	0.040 (0.035)	9,696	0.093 (0.053)	7,150	0.035 (0.035)	2,274	0.056 (0.044)
10th Grade	10,462	0.036 (0.035)	10,462	0.079 (0.053)	7,666	0.039 (0.035)	2,481	0.011 (0.042)
11th Grade	10,784	0.037 (0.034)	10,784	0.085 (0.045)	7,831	0.050 (0.038)	2,527	0.042 (0.051)
12th Grade	8,346	0.038 (0.037)	8,346	0.083 (0.047)	6,105	0.023 (0.049)	1,934	0.011 (0.055)
<b>College Eligibility and Readiness<sup>1</sup></b>								
Completed the A-G Requirements	14,024	1.411** (0.184)	14,024	1.532*** (0.159)	10,327	1.309* (0.143)	3,249	1.213 (0.146)
Met the CSU Requirements to Take College-Level Math	14,027	1.689** (0.286)	14,027	1.935*** (0.212)	10,327	1.539*** (0.181)	3,249	1.489** (0.197)
Met the CSU Requirements to Take College-Level Math for STEM Majors	14,027	1.410** (0.170)	14,027	1.468*** (0.140)	10,319	1.352** (0.141)	3,249	1.377* (0.190)
<b>Immediate College Enrollment<sup>1</sup></b>								
Any College (2- or 4-Year)	14,023	1.105 (0.129)	14,023	1.114 (0.102)	10,326	1.124 (0.075)	3,226	1.123 (0.117)
4-Year College	14,023	1.296* (0.150)	14,023	1.290** (0.113)	10,326	1.272** (0.100)	3,231	1.341** (0.148)

<sup>1</sup> Estimates are odds ratios. Note that Ns are lower for the college-going support and encouragement outcomes because those measures come from survey data that are subject to survey non-response. Note, too, that some Ns are smaller than others within the same analytic sample because cases are dropped from models in which covariates perfectly predict the outcome.

<sup>2</sup> Note that the Ns are lower than for other 12th-grade outcomes because 12th graders who have already passed Algebra II with a “D” or better are not required to take math in 12th grade.

The models include all of the control measures in Appendix Table A3. See Appendix Table A4 for information about how we constructed the measures.

**Appendix Table A8.** The Impact of Taking Advanced 7th-Grade Math on Students' High School Self-Perceptions and School-Related Behavior

	Mixed Effects		Entropy Balancing Weights		School Fixed Effects		School Fixed Effects + PSM	
	N	B (SE)	N	B (SE)	N	B (SE)	N	B (SE)
Teacher-Reported Math Work Effort Grades (SD Units)								
9th Grade	61,149	0.043** (0.015)	61,149	0.034 (0.018)	47,173	0.042* (0.018)	15,126	0.035 (0.020)
10th Grade	35,029	-0.012 (0.020)	35,029	-0.036 (0.027)	26,239	0.007 (0.027)	7,845	0.036 (0.033)
11th Grade	32,569	0.024 (0.020)	32,569	0.028 (0.030)	24,410	0.028 (0.025)	7,414	0.043 (0.035)
12th Grade	11,383	0.016 (0.033)	11,383	-0.042 (0.032)	8,356	0.028 (0.039)	2,710	0.045 (0.042)
Academic Self-Efficacy (SD Units)								
9th Grade	37,623	0.010 (0.018)	37,623	-0.007 (0.025)	28,991	0.016 (0.021)	9,888	-0.010 (0.030)
10th Grade	21,419	-0.002 (0.023)	21,419	-0.022 (0.030)	15,825	0.030 (0.026)	4,864	0.087* (0.035)
11th Grade	18,679	-0.009 (0.025)	18,679	-0.010 (0.033)	13,772	0.003 (0.030)	4,405	0.001 (0.034)
12th Grade	7,807	0.034 (0.035)	7,807	0.052 (0.048)	5,692	0.087 (0.044)	1,766	0.088 (0.053)
Teacher-Reported Math Cooperation Grades (SD Units)								
9th Grade	61,149	0.054*** (0.015)	61,149	0.054** (0.019)	47,173	0.050** (0.018)	15,126	0.040* (0.019)
10th Grade	35,029	0.031 (0.020)	35,029	0.011 (0.028)	26,239	0.052 (0.029)	7,845	0.085* (0.035)
11th Grade	32,569	0.064** (0.021)	32,569	0.044 (0.025)	24,410	0.057* (0.025)	7,414	0.082* (0.037)
12th Grade	11,383	-0.005 (0.034)	11,383	-0.079* (0.038)	8,356	0.001 (0.048)	2,710	0.022 (0.047)
Annual Attendance Rate								
9th Grade	40,372	0.035 (0.108)	40,372	0.004 (0.091)	30,132	0.201* (0.089)	10,776	0.231 (0.138)
10th Grade	16,807	-0.051 (0.142)	16,807	-0.010 (0.280)	12,335	0.142 (0.127)	4,690	0.451* (0.192)
11th Grade	17,053	0.071 (0.359)	17,053	0.157 (0.203)	13,066	0.133 (0.366)	3,407	-0.172 (0.368)
12th Grade	14,991	0.056 (0.362)	14,991	-0.054 (0.300)	11,020	0.277 (0.372)	4,004	0.474 (0.308)
Self-Reported Behavior (SD Units)								
9th Grade	37,623	0.037* (0.018)	37,623	0.045* (0.021)	28,991	0.040* (0.019)	9,888	0.038 (0.033)
10th Grade	21,419	0.018 (0.023)	21,419	0.018 (0.022)	15,825	0.030 (0.024)	4,864	0.077* (0.038)
11th Grade	18,679	0.038 (0.023)	18,679	0.003 (0.037)	13,772	0.051 (0.033)	4,405	0.063 (0.042)
12th Grade	7,807	0.021 (0.034)	7,807	0.045 (0.039)	5,692	0.054 (0.040)	1,766	0.026 (0.052)
Expected to Complete a B.A. or Higher <sup>1</sup>								
9th Grade	37,616	1.175* (0.084)	37,616	1.218** (0.077)	28,980	1.211*** (0.060)	9,888	1.145 (0.083)
10th Grade	21,410	1.074 (0.100)	21,410	1.230** (0.090)	15,814	1.075 (0.066)	4,863	1.208* (0.112)
11th Grade	18,673	1.009 (0.097)	18,673	1.009 (0.076)	13,767	1.039 (0.072)	4,405	1.054 (0.105)
12th Grade	7,803	1.064 (0.161)	7,803	1.155 (0.132)	5,675	1.114 (0.120)	1,760	1.000 (0.138)

<sup>1</sup> Estimates are odds ratios; Note that Ns are lower for the self-perceptions outcomes because those measures come from survey data that are subject to survey non-response.

Note, too, that some Ns are smaller than others within the same analytic sample because cases are dropped from models in which covariates perfectly predict the outcome.

Sample sizes differ across grades mainly because samples with outcomes measured later in high school contain fewer longitudinal cohorts than those with outcomes measured earlier. Note that the attendance Ns are lower because we exclude attendance data from 2019-20 because those data are unreliable due to remote instruction. See the text and Appendix Tables A3 and A4 for more details.

**Appendix Table A9.** Mechanisms that Contribute to the Impact of Taking Advanced 7th-Grade Math on Students' 7th-Grade Math Test Scores

	Student Covariates Only		Student Covariates + Classmate Characteristics		Student Covariates + Teacher Characteristics		Student Covariates + Classmate & Teacher Characteristics	
	B	SE	B	SE	B	SE	B	SE
Took Advanced 7th-Grade Math	0.177***	0.008	0.063***	0.011	0.149***	0.008	0.058***	0.011
Classmate Characteristics								
Class Size			-0.001***	0.000			-0.002***	0.000
Mean 6th-Grade Math SBAC Score (SD Units)			0.127***	0.008			0.113***	0.008
Standard Deviation of Math SBAC Scores (SD Units)			0.001	0.020			0.012	0.020
Mean 6th-Grade Math GPA (SD Units)			-0.036***	0.008			-0.030***	0.008
Standard Deviation of Math GPA (SD Units)			-0.038*	0.016			-0.029	0.016
Mean Self-Reported Behavior (SD Units)			0.013**	0.004			0.012**	0.004
% Expect to Complete B.A. or Higher			0.000	0.000			0.000	0.000
Teacher Characteristics								
Novice Teacher					-0.030*	0.014	-0.032*	0.014
Long Term Substitute					0.109	0.131	-0.002	0.129
National Board Certified Teacher					0.071***	0.014	0.067***	0.013
Math Credential: Middle School Authorization					0.023**	0.008	0.028***	0.008
Math Credential: Foundational					0.024***	0.007	0.027***	0.007
Math Credential: Full					Ref.	Ref.	Ref.	Ref.
Math Credential: Other					-0.050***	0.010	-0.010	0.011
Math Course Taught in Prior Year: Elem. School Math					-0.101***	0.024	-0.088***	0.024
Math Course Taught in Prior Year: 6th Grade					0.016	0.008	0.024**	0.008
Math Course Taught in Prior Year: Advanced 6th Grade					0.063*	0.029	0.053	0.028
Math Course Taught in Prior Year: 7th Grade					Ref.	Ref.	Ref.	Ref.
Math Course Taught in Prior Year: Advanced 7th Grade					0.060***	0.007	0.046***	0.007
Math Course Taught in Prior Year: 8th Grade					-0.011	0.006	-0.003	0.006
Math Course Taught in Prior Year: Alg. I or Higher					0.044***	0.008	0.036***	0.008

The table includes students in our seventh-grade analytic sample. N=108,413.

The models in the table are mixed effect models that include the pre-placement student characteristics in Appendix Table A3.

**Appendix Table A10.** Mechanisms that Contribute to the Impact of Taking Advanced 7th-Grade Math on Students' 7th-Grade Math Grade Point Averages

	Model 1		Model 2		Model 3		Model 4	
	B	SE	B	SE	B	SE	B	SE
Took Advanced 7th-Grade Math	-0.435***	0.032	-0.029	0.030	-0.325***	0.023	-0.018	0.029
Classmate Characteristics								
Class Size			-0.014***	0.001			-0.011***	0.001
Mean 6th-Grade Math SBAC Score (SD Units)			-0.371***	0.020			-0.325***	0.021
Standard Deviation of Math SBAC Scores (SD Units)			-0.147**	0.052			-0.113*	0.052
Mean 6th-Grade Math GPA (SD Units)			0.081***	0.021			0.048*	0.021
Standard Deviation of Math GPA (SD Units)			-0.017	0.041			-0.026	0.041
Mean Self-Reported Behavior (SD Units)			-0.024*	0.011			-0.019	0.011
% Expect to Complete B.A. or Higher			-0.001**	0.000			-0.001*	0.000
Teacher Characteristics								
Novice Teacher					0.233***	0.038	0.188***	0.036
Long Term Substitute					-1.014**	0.360	-0.445	0.342
National Board Certified					0.014	0.040	0.046	0.037
Math Credential: Middle School Authorization					0.062**	0.022	0.023	0.021
Math Credential: Foundational					0.004	0.020	-0.006	0.019
Math Credential: Full					Ref.	Ref.	Ref.	Ref.
Math Credential: Other					0.481***	0.028	0.147***	0.029
Math Course Taught in Prior Year: Elem. School Math					0.060	0.068	0.004	0.064
Math Course Taught in Prior Year: 6th Grade					0.176***	0.023	0.079***	0.023
Math Course Taught in Prior Year: Advanced 6th Grade					-0.246**	0.084	-0.168*	0.079
Math Course Taught in Prior Year: 7th Grade					Ref.	Ref.	Ref.	Ref.
Math Course Taught in Prior Year: Advanced 7th Grade					-0.103***	0.019	-0.044*	0.018
Math Course Taught in Prior Year: 8th Grade					0.042*	0.018	-0.016	0.017
Math Course Taught in Prior Year: Alg. I or Higher					-0.096***	0.024	-0.069**	0.022

The table includes students in our seventh-grade analytic sample. N=108,413.

The models in the table are mixed effects models that include the pre-placement student characteristics in Appendix Table A3.

**Appendix Table A11.** Mechanisms that Contribute to the Impact of Taking Advanced 7th-Grade Math on Students' 7th-Grade Math SBAC Scores and Math Grade Point Averages, by Mechanism

	7th-Grade Math SBAC Scores				7th-Grade Math GPA			
	Took Advanced Math in 7th Grade		Predictor		Took Advanced Math in 7th Grade		Predictor	
	B	SE	B	SE	B	SE	B	SE
Took Advanced 7th-Grade Math	0.177***	0.008			-0.435***	0.032		
Classmate Characteristics								
Class Size	0.171***	0.013	0.002***	0.000	-0.354***	0.029	-0.028***	0.001
Mean 6th-Grade Math SBAC Score (SD Units)	0.063***	0.014	0.110***	0.006	0.109***	0.030	-0.481***	0.014
Standard Deviation of Math SBAC Scores (SD Units)	0.170***	0.013	-0.038*	0.019	-0.482***	0.029	-0.269***	0.053
Mean 6th-Grade Math GPA (SD Units)	0.124***	0.014	0.054***	0.007	-0.239***	0.032	-0.209***	0.018
Standard Deviation of Math GPA (SD Units)	0.162***	0.014	-0.045**	0.015	-0.491***	0.031	-0.160***	0.042
Mean Self-Reported Behavior (SD Units)	0.149***	0.013	0.041***	0.004	-0.300***	0.028	-0.188***	0.010
% Expect to Complete B.A. or Higher	0.160***	0.013	0.001***	0.000	-0.320***	0.028	-0.007***	0.000
Teacher Characteristics								
Novice Teacher	0.173***	0.013	-0.072***	0.013	-0.432***	0.028	0.407***	0.037
Long Term Substitute	0.175***	0.013	-0.069***	0.014	-0.444***	0.027	0.133**	0.040
National Board Certified	0.174***	0.013	0.059***	0.014	-0.444***	0.027	-0.026	0.040
Math Credential	0.172***	0.013			-0.396***	0.028		
Middle School Authorization			0.010	0.008			0.083***	0.021
Foundational			0.012	0.007			-0.004	0.020
Full			Ref.	Ref.			Ref.	Ref.
Other			-0.078***	0.010			0.600***	0.026
Math Course Taught in Prior Year	0.152***	0.012			-0.356***	0.028		
Elem. School Math			-0.097***	0.024			0.070	0.068
6th Grade			0.004	0.008			0.268***	0.023
Advanced 6th Grade			0.059*	0.029			-0.263**	0.086
7th Grade			Ref.	Ref.			Ref.	Ref.
Advanced 7th Grade			0.057***	0.007			-0.113***	0.020
8th Grade			-0.020**	0.006			0.095***	0.018
Alg. I or Higher			0.035***	0.008			-0.125***	0.024

The table includes students in our seventh-grade analytic sample. N=108,413. The table shows the coefficients for taking advanced 7th-grade math, with the pre-placement student characteristics in Appendix Table A3 and each individual predictor added to the model (e.g., the “class size” row shows the coefficients for taking advanced 7th-grade math and class size from a model that includes the pre-placement characteristics Appendix Table A3, a treatment indicator, and class size). The models in the table are mixed effects models.

**Appendix Table A12.** The Impact of Taking Advanced 7th-Grade Math on Students' 7th-Grade Math Test Scores and Math Grade Point Averages, with and without Teacher Fixed Effects

	7 <sup>th</sup> -Grade Math Test Scores				7 <sup>th</sup> -Grade Math Grade Point Averages			
	Model without Teacher Fixed Effects		Model with Teacher Fixed Effects		Model without Teacher Fixed Effects		Model with Teacher Fixed Effects	
	N	B (SE)	N	B (SE)	N	B (SE)	N	B (SE)
Mixed Effects	37,526	0.120*** (0.010)	37,526	0.126*** (0.007)	37,526	-0.307*** (0.024)	37,526	-0.286*** (0.016)
Entropy Balancing Weights	37,526	0.091*** (0.016)	37,526	0.128*** (0.010)	37,526	-0.144*** (0.037)	37,526	-0.211*** (0.031)
Fixed Effects	37,461	0.099*** (0.013)	37,461	0.122*** (0.008)	37,461	-0.220*** (0.038)	37,461	-0.242*** (0.034)
Fixed Effects + PSM	12,983	0.127*** (0.008)	12,983	0.128*** (0.009)	12,983	-0.236*** (0.031)	12,983	-0.235*** (0.030)

These models include only students whose teachers taught both general and advanced seventh-grade math in the same year. The models in the left columns for each outcome replicate effects from prior models but for this smaller sample. Models in the right columns for each outcome compare the math test scores or math grade point averages of students who were enrolled in advanced versus general math but were taught by the same teacher (because that teacher taught both courses in the same year). The fixed effects model with propensity score matching includes students who were matched within teacher and year. The models include all of the pre-placement characteristics in Appendix Table A3.

**Appendix Table A13.** Sensitivity Testing: Estimates of the Impact of Advanced 7th-Grade Math on 3rd-Grade Math Test Scores, Math GPA, and Math Work Effort Grades

	Mixed Effects		Entropy Balancing Weights		School Fixed Effects		School Fixed Effects + PSM	
	N	B (SE)	N	B (SE)	N	B (SE)	N	B (SE)
<b>3rd-Grade Math Test Scores (SD Units)</b>								
Pooled	75,624	0.009 (0.008)	75,624	0.009 (0.009)	59,403	0.012 (0.009)	19,806	-0.007 (0.011)
2016	24,776	0.006 (0.014)	24,776	0.004 (0.016)	18,209	0.008 (0.016)	4,956	-0.021 (0.029)
2017	25,043	-0.015 (0.014)	25,043	-0.007 (0.020)	19,462	-0.013 (0.017)	5,098	-0.001 (0.023)
2018 <sup>1</sup>	--	--	--	--	--	--	--	--
2019	25,805	0.002 (0.012)	25,805	0.012 (0.014)	21,732	0.001 (0.012)	6,296	-0.002 (0.015)
<b>3rd-Grade Math GPA (SD Units)</b>								
Pooled	103,001	-0.001 (0.009)	103,001	0.007 (0.012)	81,905	0.004 (0.010)	27,978	-0.003 (0.017)
2016	24,940	0.024 (0.016)	24,940	0.040* (0.018)	18,319	0.022 (0.019)	4,970	0.010 (0.026)
2017	26,460	-0.032 (0.019)	26,460	-0.014 (0.020)	20,479	-0.032 (0.017)	5,108	-0.027 (0.023)
2018	25,684	0.023 (0.018)	25,684	0.027 (0.021)	21,277	0.031 (0.018)	6,010	0.019 (0.023)
2019	25,917	-0.014 (0.017)	25,917	-0.029 (0.017)	21,830	-0.017 (0.017)	6,302	0.014 (0.015)
<b>3rd-Grade Math Work Effort Grades (SD Units)</b>								
Pooled	103,001	0.014 (0.010)	103,001	0.022 (0.012)	81,905	0.015 (0.011)	27,978	0.017 (0.017)
2016	24,940	-0.009 (0.019)	24,940	0.000 (0.015)	18,319	-0.030 (0.018)	4,970	-0.055** (0.020)
2017	26,460	0.025 (0.020)	26,460	0.040 (0.026)	20,479	0.025 (0.022)	5,108	0.019 (0.037)
2018	25,684	0.021 (0.020)	25,684	0.023 (0.020)	21,277	0.028 (0.021)	6,010	0.011 (0.023)
2019	25,917	0.012 (0.019)	25,917	0.015 (0.020)	21,830	0.009 (0.019)	6,302	0.017 (0.023)

-- indicates that we could not estimate the model for the cohort

<sup>1</sup> Students who were first-time 7th graders in 2017-18 did not take a standardized math test in 3<sup>rd</sup> grade due to changes in CA's standardized testing program. The models include all of the control measures in Appendix Table A3. See Appendix Table A4 for information about how we constructed the measures.

**Appendix Table A14.** Robustness of Estimates to Unobserved Confounders

	OLS Estimate	R2 with Treatment		R2 with Outcome		Robustness of the Sign of the Estimate		Robustness of Statistical Significance at 0.05 Level	
		Full Model	Without Academic Variables	Full Model	Without Academic Variables	X Times as Strong as Academic Variables	Robustness Value (RV)	X Times as Strong as Academic Variables	Robustness Value (RVa)
<b>Standardized Test Scores</b>									
7th-Grade Math SBAC	0.14***	0.54	0.37	0.81	0.63	0.24	9.24	0.23	8.63
8th-Grade Math SBAC	0.20***	0.55	0.37	0.77	0.62	0.35	11.45	0.33	10.73
10th-Grade PSAT Math	0.15***	0.57	0.37	0.56	0.46	0.30	6.32	0.25	5.18
Passed At Least one AP Exam in HS	0.07***	0.55	0.39	0.34	0.29	0.44	5.26	0.29	3.46
<b>GPA and Course Taking</b>									
7 <sup>th</sup> -Grade Math GPA	-0.27***	0.54	0.37	0.55	0.46	0.37	8.41	0.34	7.80
8 <sup>th</sup> -Grade Math GPA	-0.17***	0.55	0.37	0.49	0.41	0.25	5.05	0.21	4.28
Earned a B or Better in Algebra I by the End of 9th Grade	0.04***	0.53	0.37	0.25	0.22	0.20	2.25	0.12	1.36
12th-Grade Cumulative Unweighted GPA	0.04*	0.55	0.39	0.49	0.45	0.12	1.99	0.01	0.13
Semesters of Rigorous Academic Coursework	2.43***	0.55	0.39	0.57	0.52	0.42	8.76	0.33	7.03
Semesters of Rigorous Science Coursework	0.64***	0.55	0.39	0.44	0.40	0.50	7.69	0.39	5.94
Semesters of Rigorous Math Coursework	0.98***	0.55	0.39	0.44	0.40	0.83	12.89	0.72	11.24
Took Calculus or Higher in HS	0.13***	0.55	0.39	0.31	0.27	1.37	11.42	1.17	9.74
<b>School-Related Behavior and Academic Self-Efficacy</b>									
7th-Grade Teacher-Reported Math Work Effort Grades (SD Units)	-0.07***	0.54	0.37	0.45	0.41	0.15	2.71	0.11	2.05
7th-Grade Academic Self-Efficacy	-0.04***	0.53	0.37	0.26	0.25	0.35	1.29	0.12	0.44
8th-Grade Teacher-Reported Math Cooperation Grades (SD Units)	0.10***	0.55	0.37	0.37	0.34	0.26	3.44	0.20	2.66
7th-Grade Annual Attendance <sup>1</sup>	0.07	0.54	0.37	0.51	0.51	0.25	0.64	-	-

**Appendix Table A14 Continued.** Robustness of Estimates to Unobserved Confounders

	OLS Estimate	R2 with Treatment		R2 with Outcome		Robustness of the Sign of the Estimate		Robustness of Statistical Significance at 0.05 Level	
		Full Model	Without Academic Variables	Full Model	Without Academic Variables	X Times as Strong as Academic Variables	Robustness Value (RV)	X Times as Strong as Academic Variables	Robustness Value (RVa)
<b>College Eligibility and Readiness</b>									
Completed A-G Requirements	0.03**	0.55	0.39	0.28	0.26	0.18	2.34	0.04	0.49
Met CSU College-Level Math Requirement	0.08***	0.55	0.39	0.41	0.36	0.37	6.13	0.26	4.35
Met CSU College-Level Math Requirement for STEM Majors	0.07***	0.55	0.39	0.41	0.35	0.34	5.11	0.22	3.31
<b>Immediate College Enrollment</b>									
Four-Year College	0.06***	0.55	0.39	0.20	0.18	0.47	3.88	0.24	1.99

The benchmark variables include: students' 4th/5th grade math and ELA CST/SBAC scores, 6th grade math and ELA SBAC scores, 5th and 6th grade math and ELA GPAs, 6th-grade math and academic work effort GPAs, 6th-grade math course, and indicator variables for whether students were eligible to take advanced 7th-grade math or classified as gifted and talented. RV indicates the percent of the residual variance of the treatment and outcome the unobserved confounder would have to explain to bring the point estimate to zero. RVa indicates the percent of the residual variance of the treatment and outcome the unobserved confounder would have to explain for the estimate to be indistinguishable from zero. The models include all of the control measures in Appendix Table A3 and school and cohort fixed effects.

<sup>1</sup> The estimate for seventh-grade attendance rate is not statistically significant at conventional levels in this model. Thus, we only show the estimated strength an unobserved confounder would have to be to reduce the seventh-grade attendance rate point estimate to zero.

**Appendix Table A15.** Estimates for Selected Outcomes using Inverse Probability Censoring Weights

	B	SE
<b>Standardized Test Scores</b>		
7th-Grade Math SBAC	0.14***	0.01
8th-Grade Math SBAC	0.20***	0.02
10th-Grade PSAT Math	0.15***	0.02
Passed At Least One AP Exam in HS	1.34***	0.10
<b>GPA and Course Taking</b>		
7 <sup>th</sup> -Grade Math GPA	-0.27***	0.03
8 <sup>th</sup> -Grade Math GPA	-0.17***	0.03
Earned a B or Better in Algebra I by the End of 9th Grade	1.18*	0.09
12th-Grade Cumulative Unweighted GPA	0.04	0.03
Semesters of Rigorous Academic Coursework	2.37***	0.46
Semesters of Rigorous Science Coursework	0.62***	0.13
Semesters of Rigorous Math Coursework	0.98***	0.15
Took Calculus or Higher in High School	2.19***	0.26
<b>School-Related Behavior and Academic Self-Efficacy</b>		
7th-Grade Teacher-Reported Math Work Effort Grades (SD Units)	-0.07***	0.02
7th-Grade Academic Self-Efficacy	-0.04*	0.02
8th-Grade Teacher-Reported Math Cooperation Grades (SD Units)	0.10***	0.03
7th-Grade Annual Attendance	0.07*	0.03
<b>College Eligibility and Readiness</b>		
Completed A-G Requirements	1.29*	0.14
Met CSU College-Level Math Requirement	1.40***	0.15
Met CSU College-Level Math Requirement for STEM Majors	1.22*	0.12
<b>Immediate College Enrollment</b>		
Four-Year College	1.27***	0.10

The models include all of the control measures in Appendix Table A3.