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Investigating Middle School Determinants of High School Achievement and Graduation in Three California School Districts

Abstract: This paper explores early predictors of high school graduation and success. Employing 7th grade cohorts from three large California school districts (San Francisco, Fresno, and Long Beach), we investigate the role of several key middle school academic performance measures in identifying students' 11th grade academic performance, passing the California High School Exit Examination on the first attempt, and diploma receipt. We find that standardized assessments, timing of algebra, and course failures in middle school provide useful indicators of students' high school academic success. Our aim is not to identify any causal mechanism by which middle school achievement leads to high school success or failure, but rather to describe important associations that may aid policymakers and school leaders to develop strategies early in students' educational pursuit of the high school diploma.

Keywords: education; graduation; high school exit exams

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1 Introduction

The economic costs of high school dropouts are substantial to individuals and society (Heckman and LaFontaine 2007; Rumberger 2011). High school dropouts are less likely to hold down regular jobs, earn about \$260,000 less over a lifetime than high school graduates and pay about \$60,000 less in taxes (Rouse 2005). Moreover, high school dropouts are more likely to face health problems (Muennig 2005), to be involved in criminal activity (Moretti 2005), and to require public assistance (Waldfogel et al. 2005). Belfield and Levin (2007a) estimate the economic losses in California from a cohort of dropouts over their lifetimes

to be as much as \$9.5 billion (a combination of lost state and local tax revenues, health expenditures, crime expenditures, and welfare costs). Of course there are also numerous civic costs to high dropout rates, including active participation in democratic society via voting and other forms of civic participation (Junn 2005).

In this paper we investigate early predictors of high school graduation and success. Employing 7th grade cohorts from three large California school districts, we investigate the role of several key middle school academic performance measures in identifying success measured at three different time points in high school: initially passing the California High School Exit Exam in 10th grade, academic performance in 11th grade, and diploma receipt. Our aim is not to identify any causal mechanism by which middle school achievement leads to high school success or failure, but rather to describe important associations that may aid policymakers and school leaders to develop strategies early in students' educational pursuit of the high school diploma. Thus, the goal of the paper is to facilitate districts', schools', and policymakers' abilities to identify the kinds of students most at risk of not graduating from high school.

2 Previous Literature

2.1 High School Completion

There is an extensive body of research on high school completion. From this work we know that prior academic achievement (Alexander et al. 1997, 2001; Goldschmidt and Wang 1999; Rumberger 2004), pauses in schooling and school mobility (Swanson and Schneider 1999; Rumberger 2004; Neild and Balfanz 2006), student attitudes and engagement in school (Rumberger 1987; Alexander et al. 1997; Swanson and Schneider 1999), and high-achieving peers (Carbonaro 1998; Kasen et al. 1998) are all associated with high school completion. The risk of dropping out also increases with age; students who have been retained are more likely to drop out (Roderick 1994; Hauser et al. 2004). Such students may experience disengagement from school early in their school careers, which leads them to drop out at higher rates (Roderick 1994).

Demographic characteristics such as race/ethnicity, gender, language and social class are also important predictors of high school completion (Hauser et al. 2004), yet their influence on the propensity to drop out is substantially reduced

upon control for academic achievement and other demographic characteristics such as social class (Jencks and Phillips 1998; Rumberger 2004). Nationally, female students graduate high school at higher rates than males, and Whites and Asians graduate high school at higher rates than Hispanics and Blacks (Swanson 2004). Graduation rates across districts also vary by concentrations of poverty and of minority students; districts with higher enrollment of students from low socioeconomic backgrounds and/or minority populations have graduation rates substantially lower than those that serve more advantaged and less diverse populations (Balfanz and Legters 2004; Swanson 2004). Family context, as represented by familial stress and parents' attitudes and values towards schooling are also significant predictors of high school dropout (Alexander et al. 1997). Additionally, differences in neighborhood and community characteristics (e.g. resources, after school programs, concentrations of poverty, unemployment rates) may also help explain differences in dropout rates (Crane 1991; Brooks-Gunn et al. 1993).

There is also an extensive body of literature on the role of schools in facilitating high school completion. This includes structural features of schools – public/private (Bryk and Thum 1989) and size (Roderick et al. 2002), which are associated with differences in completion rates. School resources, such as pupil/teacher ratio, and school policies, such as disciplinary practices, attendance rates, academic programs and climate in schools contribute to differences in dropout rates (Rumberger 2004, 2011). More recently, in a case study investigating schools in California that are “beating the odds”, school leaders credit their success of high graduation rates – relative to schools with similar demographics, to four key components: connecting with students, engaging parents and community to support school efforts, providing interventions and supports to students at-risk of dropping out, and creating a culture of accountability and high expectations (Socias et al. 2007).

Research on high school exit has also been focused on identifying early risk behaviors among students. Specifically, failing courses in earlier years (Allensworth and Easton 2005; Neild and Balfanz 2006), attendance patterns (Neild and Balfanz 2006), and misbehavior (Stroup and Robins 1972) have all been identified as key determinants of the propensity to drop out. Many students begin to fall behind in elementary and middle school, and are then unable to catch up by the time they enter high school (Bridgeland et al. 2006). The focus on the middle school years is an important one, given ample evidence that early adolescent years can occupy negative changes in academic behavior and motivation (Eccles et al. 1991). Students' engagement with and attitudes toward school develop over time, and may influence their ultimate decision to withdraw prematurely (Rumberger 2004).

Much, if not all, of the dropout/graduation research (the present one included) is descriptive or correlational in nature. Most studies share the same methodological challenges in accounting for a host of unobservable characteristics, behaviors, or attitudes that may be associated with school completion or exit. As a result, we must interpret the findings from this body of work not as causal explanations for who graduates, but as important descriptive associations useful for developing critical early indicators of students' potential risk on the road to high school completion.

2.2 High School Exit Exams

California is one of many states to implement high school exit examinations in the past two decades. As of 2012, 26 states had high school exit exam requirements, and a half dozen more had plans to implement such a requirement in the near future. Studies employing national data have found somewhat mixed evidence of the effects of exit exams on high school dropout/completion rates. Several studies using individual-level data from nationally-representative samples (mostly from cohorts of students graduating high school in the early 1990s) have found that state high school exit exams increase high school dropout rates among low-achieving students (Bishop and Mane 2001; Jacob 2001) or Black males (Dee 2003), though one similar study found no such effects (Warren and Edwards 2005). In contrast, a set of studies examining the relationship between state exit exam policies and state-level graduation rates generally finds no effect of exit exams on dropout rates (Carnoy and Loeb 2002; Greene and Winters 2004; Marchant and Paulson 2005; Warren and Jenkins 2005; but see Amerin and Berliner 2002 for a different result), though some of these studies have important methodological shortcomings (discussed at length in Dee and Jacob 2006; Warren et al. 2006). Several newer studies that correct many of the methodological shortcomings of these studies, however, find that high school dropout rates tend to increase, on average, when states implement exit exams (Dee and Jacob 2006; Warren et al. 2006; Reardon and Kurlaender 2009).

By 2009, over 70% of US students will be subject to such exam requirements (see, e.g., Center on Education Policy 2004, 2005; Dee and Jacob 2006; Warren et al. 2006). For the most part, the adoption of such policies is driven by the beliefs that a) some high school graduates lack basic skills necessary for success in the modern economy; and b) that a high school exit exam requirement will create incentives both for schools to provide better instruction for such students and for these students to work harder and learn more in school (for discussion, see

Reardon and Galindo 2002; Dee and Jacob 2006; Warren et al. 2006). However, recent work evaluating the effect of implementing the high school exit exam in California suggests that the California High School Exit Examination (CAHSEE) has had no positive effects on students' academic skills (Reardon and Kurlaender 2009).

The purpose of this paper is to provide a detailed, descriptive picture of high school completion and achievement for a 7th grade cohort of students from three of California's largest urban school districts. Specifically, we investigate the influence of middle school achievement indicators in facilitating high school completion, achievement and CAHSEE passing.

3 Methods

3.1 Sample Description

The sample contains detailed information from one 7th grade cohort of students from three large urban California school districts (Fresno, Long Beach and San Francisco) from the 2000–2001 to the 2005–2006 school year.¹ The cohorts are limited to 7th grade students in the 2000–2001 school year who are present in the district two years later at what would be 9th grade, or the beginning of high school for most students. Students who attended 7th grade in 2000–2001 would have graduated in 2005–2006 if they were not retained. Because our focus is on the middle school determinants of high school completion and success, our analyses do not include students entering the district at or later than 8th grade or students leaving the district before the beginning of 9th grade. Table 1 shows the racial/ethnic and academic compositions of the three districts and the state of California as a whole for our year of interest. Because our districts are near three of California's largest urban centers, there are differences between California's overall racial compositions and our sample districts. The academic indicators for our sample districts, however, are similar to California as a whole. While our findings may be related to California students as a whole, they are likely to apply more to students in large, urban districts.

We investigate three different outcomes along the trajectory of a student's time in high school. Since students may leave the districts, drop out of school,

¹ Although most students enter middle school in 6th grade, we only have full cohort data from our three districts starting at 7th grade.

	Fresno	Long Beach	San Francisco	California
African American	11%	18%	13%	8%
Asian	15%	9%	44%	8%
Hispanic/Latino	57%	50%	22%	48%
White	16%	17%	9%	30%
Special Education Enrollment	9%	8%	11%	10%
English Learners	28%	24%	29%	25%
Four-year Dropout Rate	16%	13%	7%	13%
Free/Reduced Price Meals	82%	69%	55%	51%
% Proficient in ELA	27%	41%	48%	42%
% Proficient in Math	27%	41%	48%	41%
Enrollment	79,046	93,589	56,236	6,312,436
Academic Performance Index	658	722	753	–

Table 1: Academic and Demographic Characteristics of Districts and the State (2005–2006).

Source: California Department of Education: <http://dq.cde.ca.gov/dataquest/>.

or miss tests, we are left with different sample sizes for the outcome associated with each year. Our available data provide us with a sample size of 12,099 students for the 10th grade outcome (passing the CAHSEE), a sample size of 10,106 students for the 11th grade outcome (grade point average [GPA] in 11th grade), and a sample size of 13,335 for the 12th grade outcome (graduation). We perform separate analyses for each outcome.

3.2 Outcome Measures

We investigate academic outcomes over the high school career: passing the CAHSEE on the first attempt, which usually occurs in the second year of high school; GPA in the third year of high school; and diploma receipt in the fourth year of high school.

3.3 Passing the Exit Exam in 10th Grade

We include CAHSEE pass rates as one of our outcomes of interest, given the importance of the state high school exit exam as a necessary condition of diploma receipt and as a signal for students' academic performance. While students are not required to pass the CAHSEE on the first attempt, we feel

that it is important to measure the first experience students have with the exit exam, and that first attempts at the exams are critical for establishing interventions to improve pass rates for students struggling to pass the high school exit exam. The eventual passing of the CAHSEE is also partly captured by the high school graduation measure. We represent passing the CAHSEE with a binary variable, *CAHSEE* where $CAHSEE=1$ represents passing the exit exam in 10th grade, and $CAHSEE=0$ represents failure to pass the exit exam in the 10th grade. In our 10th grade sample, 63% of students pass the exit exam. Statewide, 91.4% of California seniors in 2005–2006 passed both sections of the CAHSEE by July 2006. Whites (97.4%) and Asians (95.3%) had higher pass rates than Hispanics (85.7%) and African Americans (84.1%); and the pass rates of economically disadvantaged students (86.0%) and English Learners (76.4%) were substantially lower than the state average (California Department of Education 2006).

3.4 Grade Point Average in 11th Grade

We use the cumulative GPA over the 11th grade year as a measure of academic success for students in 11th grade. These scores are represented by the variable, *GPA11*, and range from 0 to 4, with 4 representing a perfect GPA and 0 representing all failing grades. The average GPA for the 11th grade sample is 2.46 with a standard deviation of 0.84 grade points.

3.5 Graduation in 12th Grade

Our paper does not attempt to measure the graduation rate for the district overall, only for our specific subset of the 7th grade cohort. Our method and sample therefore limit the accuracy of the estimate as a definitive graduation rate, as it does not factor in migration in and out of the school district. However, it is useful for our purposes of identifying early predictors of high school completion and success for a cohort of 7th grade students tracked longitudinally through 12th grade.² We represent graduation with a binary variable, *GRAD* with $GRAD=1$

² The challenge to measuring the dropout rate is now a ubiquitous one in education research (Orfield 2004; Heckman and LaFontaine 2007; Socias et al. 2007; Warren and Halpern-Manners 2007; NCES-Kaufman). Much like identifying graduation, the main problem in identifying an accurate dropout rate is that students migrate in and out of different districts. While schools

representing graduation by the end of 12th grade and $GRAD=0$ representing the failure to graduate by the end of 12th grade. In our 12th grade sample, 63% of all students graduate.

3.6 Middle School Predictors

To capture middle school academic performance, we include several measures. First, students' GPA in the 7th grade provides an overall picture of a student's academic achievement (the variable $GPA7$ ranges from 0 to 4). Previous literature has suggested that early course failure in school is a critical indicator of high school completion (Allensworth and Easton 2005). We include the number of courses in which students failed in 8th grade. We represent course failures with a binary variable, $FGRADE8$ where $FGRADE8=1$ represents failing two or more core courses (English language arts, mathematics, science, or social studies) in 8th grade and $FGRADE8=0$ represents failing fewer than two courses.

We also include the timing of algebra course-taking; the research base is extensive on the importance of algebra course-taking in predicting secondary and post-secondary success (Adelman 1999). We created a binary variable using the course history of the student. A course was classified as an algebra course if "Algebra" was included in the course title. One-year and two-year algebra sequences could not be separated. $ALG8=1$ represents that a student took algebra in 8th grade, and $ALG8=0$ represents that a student did not take an algebra course in 8th grade.

We include the scaled score of the California Standards Test English language arts ($CSTELA$) and mathematics ($CSTMATH$) assessments, which are used to assess the academic achievement of every student in the state of California on a yearly basis. Descriptive statistics on each of these variables is available in Table 2. Lastly, we also include an important set of binary controls that represent students' demographic characteristics from 7th grade, including race/ethnicity ($ASIAN$, $LATINO$, $BLACK$, PI , AI , $WHITE$), gender ($MALE$), and socioeconomic status ($LOWSES$). We include a measure of whether or not a student receives special education services in 7th grade ($SPED$) and whether or not a student is classified as an English language learner (ELL) in 7th grade. We also include a control for if a student was retained ($RETAIN$) at some point in middle or high

can sometimes tell if a student has transferred out of the district, most data are limited to students' presence in the district.

	Mean	Standard deviation
CAHSEE ^a	0.63	0.48
GPA11 ^a	2.46	0.84
GRAD	0.63	0.48
GPA7	2.69	0.88
ALG8	0.50	0.50
FGRADE8	0.66	0.88
CSTELA	316.07	50.02
CSTMATH	315.31	57.51
ELL	0.29	0.46
SPED	0.07	0.26
LOWSES	0.69	0.46
BLACK	0.14	0.35
LATINO	0.39	0.49
PI	0.04	0.20
ASIAN	0.23	0.42
AI	0.01	0.08
MALE	0.51	0.50
RETAIN	0.14	0.35
OVERAGE	0.11	0.31

Table 2: Summary statistics for predictors and outcomes for the graduation sample ($n=13,335^a$).

^a The CAHSEE and GPA11 samples have different sizes.

school and whether a student is over-age (*OVERAGE*) for 7th grade, (suggesting either late entry into the school system or retention before 7th grade).

3.7 Analytic Strategy

We rely on two primary descriptive methods using detailed longitudinal student-level data from each district to examine the middle school determinants of high school success. First we analyze a set of cross-tabulations of key predictor variables against the two binary outcome variables: initial CAHSEE passing and diploma receipt. The cross-tabulations display how each outcome varies by important characteristics, which is helpful in determining relationships between types of middle school achievement characteristics and each of our outcomes.³ Also, of importance to schools and policymakers, the simple

³ We remove observations with missing data on the outcomes explored in each respective set of regressions. We impute missing data on the predictors as follows: GPA using course history

cross-tabulations show which characteristics and indicators may be signs that a student will struggle (or have success) in high school.

Second, we fit a set of Ordinary Least Squares or logistic regression models for each outcome of interest. A student may have many overlapping characteristics that suggest he or she will struggle in high school. Regressions allow us to determine relationships between characteristics and high school success, while holding constant other predictors and controls. This allows us to pinpoint the characteristics that may have the most meaningful relationships with high school success. The regressions each include three sets of models. The first set of models regress the outcome measure on all of the key middle school achievement predictors; in model two, we regress the outcome measure on all of the key middle school achievement predictors and demographic controls, and in model three we regress the outcome measure on all predictors and controls, utilizing school fixed effects to account for students' enrollment in particular schools, which may differ, on average, on these outcomes.⁴ To further explore the results from these models, we display some of these relationships in graphs in the results section.

4 Results

The graduation (diploma receipt) rate in 2005–2006 for the 7th grade cohorts utilized in this analysis is 63% (Table 2). It is important to reiterate that these rates may be underestimating graduation rates for these districts, since some students may have relocated to another district or a private high school and subsequently graduated. In addition, others who dropped out may return to school or enroll in an alternative program and subsequently obtain a high school diploma. Among our 7th grade cohorts, 63% of all students pass the CAHSEE on their first attempt.

Figure 1 displays two of our outcomes – high school graduation and CAHSEE passing at first attempt by key student demographics. There are several

files, 7th grade SES identifier with 8th grade SES. Finally, we use list-wise deletion for observations missing 8th grade CST scores or course history in 8th grade, which leads to a loss of 9.1% of the Long Beach sample ($n=577$), 4.8% of the San Francisco sample ($n=304$), and 9.9% of the Fresno sample ($n=513$).

⁴ The school fixed effects include the school nearest to the time that the outcome occurs. If the student's school is not known that year, we used the student's school in the next closest year before the occurrence of the outcome.

noteworthy findings in these group comparisons. First, English Learners have lower graduation and CAHSEE pass rates relative to non-English Learners. Second, special education students have lower graduation and CAHSEE passing rates relative to non-special education students. Third, students from lower socioeconomic backgrounds fare worse in graduation rates relative to their more affluent counterparts. Fourth, females have higher graduation rates and higher CAHSEE passing rates at first attempt, relative to males. Lastly, not surprisingly, students who are retained in middle or high school, or who are over-age in 7th grade (largely as a function of being retained or behind in earlier grades) are less likely to graduate or to pass the CAHSEE at first attempt than their counterparts who were not retained or who are of average grade age.

The high school graduation rates are lower for Black, Hispanic and American Indian students, relative to White, Asian and Pacific Islander students. Graduation

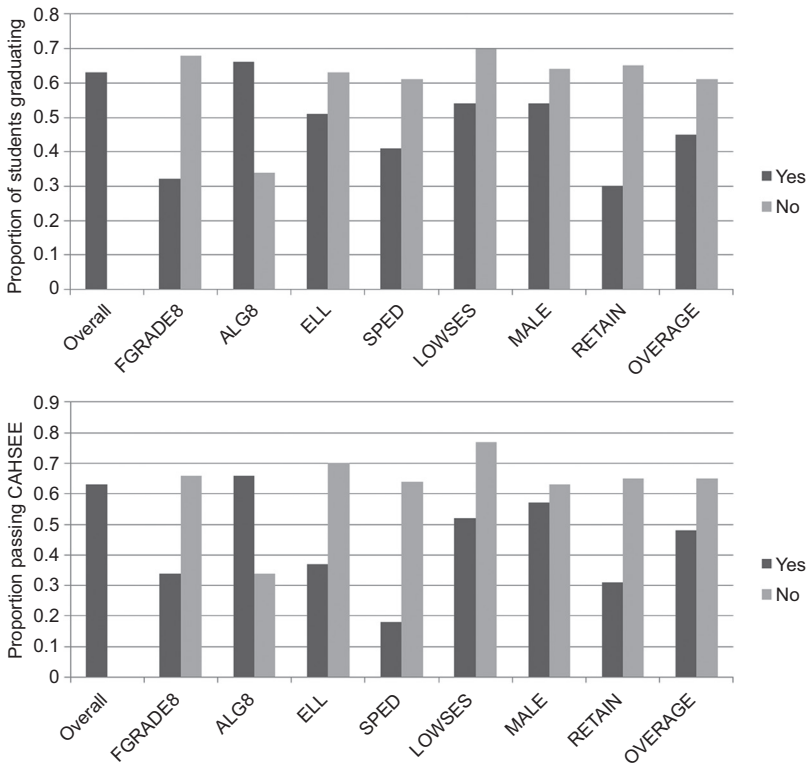


Figure 1: Graduation rates and CAHSEE pass rates by student characteristics.

rates by race/ethnicity for our 7th grade cohort of students in reaching high school indicate that 47% of African Americans, 67% of Whites, 50% of Hispanics, 66% of Pacific Islanders, 76% of Asians, and 42% of American Indians obtain high school diplomas. Similar racial/ethnic patterns are present for CAHSEE pass rates at first attempt in our sample.

4.1 Multivariate Models of High School Completion and Success

Tables 3–5 include the coefficients and standard errors from three sets of models for each of our outcomes by district. The first column of models in each table includes the predictors of interest, middle school achievement variables: 7th grade GPA, whether or not a student completed algebra by 8th grade, whether or not a student received more than one F in 8th grade, and students' scores on the 8th grade California standardized assessment tests in English and mathematics respectively, and binary variables to account for the differences between the districts in the study. The second column includes these predictors as well as a set of controls, including: English Learner status in 7th grade, special education status in 7th grade, whether or not a student is classified as low socioeconomic status, race/ethnicity, gender, whether or not a student was retained at one point after 7th grade, and over-age indicating a student may have been retained prior to 7th grade, as well as the variables representing district differences. Finally, column three includes all of the variables in column two, as well as school fixed effects to account for students' clustering in high schools, and the unique characteristics that may be associated with them. As such, the results in column three can be thought of as the *within-school* association (as opposed to the *within-district* association) between each of these predictors and the outcome.

Looking at the results presented in Table 3, it is clear that middle school achievement, (as measured by 7th grade GPA, having completed algebra by 8th grade, and CST scores) are strongly related to passing CAHSEE at the first attempt. Converting these logit coefficients to odds ratios, the odds that a student who has taken algebra by 8th grade will pass the CAHSEE on the first attempt are 2.2 times the odds that a student who has not taken algebra by 8th grade will pass the CAHSEE on the first attempt (based on results from the school fixed effects model 3 in Table 3). Individual background and demographic controls are associated with CAHSEE passing rates, above and beyond achievement across the three districts. Both ELL students and students in special education are less likely to pass the CAHSEE on their first attempts, compared to students not designated ELL or

	Model 1	Model 2	Model 3
GPA7	0.628*** (0.046)	0.636*** (0.050)	0.642*** (0.052)
ALG8	0.857*** (0.114)	0.797*** (0.116)	0.813*** (0.122)
FGRADE8	-0.105** (0.040)	-0.122** (0.041)	-0.110** (0.042)
CSTELA	0.036*** (0.001)	0.033*** (0.001)	0.033*** (0.001)
CSTMATH	0.021*** (0.001)	0.020*** (0.001)	0.019*** (0.001)
ELL		-0.408*** (0.073)	-0.407*** (0.076)
SPED		-0.681*** (0.131)	-0.711*** (0.136)
LOWSES		-0.269** (0.082)	-0.158 (0.086)
BLACK		-0.601*** (0.112)	-0.436*** (0.119)
LATINO		-0.257** (0.099)	-0.085 (0.103)
PI		-0.156 (0.168)	0.115 (0.178)
ASIAN		-0.190 (0.116)	-0.111 (0.122)
AI		-0.439 (0.407)	-0.116 (0.444)
MALE		0.425*** (0.062)	0.426*** (0.064)
RETAIN		-0.598*** (0.090)	-0.627*** (0.095)
OVERAGE		-0.195* (0.096)	-0.206* (0.100)
Constant	-18.647*** (0.388)	-16.794*** (0.440)	-16.206*** (0.468)
District Effects	Yes	Yes	No
School Effects	No	No	Yes
n	12,099	12,099	11,721
Pseudo R2	0.517	0.530	0.538
BIC	7804.1	7697.4	7620.9

Table 3: Parameter estimates and standard errors from logistic regression models predicting 10th grade CAHSEE passing.

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

	Model 1	Model 2	Model 3
GPA7	0.465*** (0.009)	0.394*** (0.010)	0.395*** (0.009)
ALG8	0.031 (0.017)	0.047** (0.017)	0.022 (0.017)
FGRADE8	-0.187*** (0.009)	-0.165*** (0.008)	-0.164*** (0.008)
CSTELA	0.002*** (0.000)	0.002*** (0.000)	0.002*** (0.000)
CSTMATH	0.002*** (0.000)	0.002*** (0.000)	0.002*** (0.000)
ELL		0.003 (0.015)	-0.000 (0.014)
SPED		0.122*** (0.022)	0.120*** (0.022)
LOWSES		0.001 (0.014)	0.001 (0.014)
BLACK		-0.056** (0.021)	-0.080*** (0.021)
LATINO		-0.126*** (0.017)	-0.132*** (0.017)
PI		-0.025 (0.030)	-0.045 (0.030)
ASIAN		0.066*** (0.018)	0.075*** (0.018)
AI		-0.203** (0.074)	-0.176* (0.074)
MALE		-0.080*** (0.011)	-0.070*** (0.011)
RETAIN		-0.321*** (0.016)	-0.445*** (0.018)
OVERAGE		-0.017 (0.018)	-0.027 (0.018)
Constant	-0.144** (0.046)	0.188** (0.061)	0.321*** (0.060)
District Effects	Yes	Yes	No
School Effects	No	No	Yes
n	10,106	10,106	10,073
Pseudo R2	0.563	0.589	0.611
BIC	16,927.7	16,396.3	15,775.0

Table 4: Parameter estimates and standard errors from regression models predicting 11th grade GPA.

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

	Model 1	Model 2	Model 3
GPA7	0.757*** (0.034)	0.666*** (0.036)	0.662*** (0.040)
ALG8	-0.001 (0.068)	0.014 (0.069)	0.098 (0.077)
FGRADE8	-0.433*** (0.029)	-0.404*** (0.029)	-0.380*** (0.032)
CSTELA	0.006*** (0.001)	0.006*** (0.001)	0.006*** (0.001)
CSTMATH	0.005*** (0.001)	0.005*** (0.001)	0.004*** (0.001)
ELL		-0.037 (0.057)	-0.069 (0.062)
SPED		0.180* (0.081)	0.157 (0.088)
LOWSES		-0.182** (0.057)	-0.109 (0.064)
BLACK		0.155 (0.080)	0.213* (0.090)
LATINO		0.041 (0.068)	0.040 (0.077)
PI		0.171 (0.118)	0.128 (0.131)
ASIAN		0.315*** (0.080)	0.188* (0.091)
AI		-0.390 (0.269)	-0.090 (0.300)
MALE		0.051 (0.044)	0.021 (0.049)
RETAIN		-0.872*** (0.065)	-0.856*** (0.078)
OVERAGE		-0.394*** (0.066)	-0.438*** (0.072)
Constant	-18.774*** (0.373)	-16.845*** (0.425)	-16.206*** (0.468)
District Effects	Yes	Yes	No
School Effects	No	No	Yes
n	13,335	13,335	12,757
Pseudo R2	0.215	0.229	0.293
BIC	13,836.7	13,683.4	12,101.8

Table 5: Parameter estimates and standard errors from logistic regression models predicting graduation.

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

in special education, respectively. Unlike the graduation outcome, here we note that controlling for prior achievement and other demographic characteristics, African American students have, on average, lower CAHSEE pass rates at first attempt, relative to White students. We also note an interesting significant effect of gender, such that controlling for prior achievement and other demographic characteristics, male students have, on average, higher CAHSEE passing rates at first attempt, relative to female students. We again note the importance of the variables over-age and/or retain, indicating students that were retained in early or later grades have, on average, lower CAHSEE passing rates at first attempt.

Turning to achievement in high school, Table 4 presents Ordinary Least Squares (OLS) regression results predicting 11th grade GPA. Again, not surprisingly, we note the significant influence of middle school achievement, specifically, 7th grade GPA, number of Fs in 8th grade, and mathematics and English 8th grade CST scores. We also note that male students, on average, have significantly lower GPAs, relative to female students, controlling for all else in the model. There were consistent findings on racial/ethnic differences for Latino, Black, and American Indian students, where all three groups appear to fare worse relative to White students, controlling for early achievement and all other background characteristics. Asian students consistently performed better than White students, controlling for the same set of covariates. Socioeconomic status was a significant predictor of 11th grade GPA, interestingly in a similar way as in the other models – low socioeconomic status students fare worse on 11th grade GPA, controlling for early achievement patterns and a variety of other background characteristics.

From the results in Table 5 we note that 7th grade GPA is consistently a significant predictor of high school completion, controlling for a variety of other characteristics. Students who have higher achievement, as measured by GPA, are more likely to graduate, on average, relative to their lower achieving counterparts, controlling for a variety of background characteristics. Math and English CST scores have a similar relationship with high school completion. We also note that Fs in 8th grade appear to have a negative influence on high school completion, controlling for all other variables.

Turning to the demographic controls, we note relatively little consistent influence of individual characteristics on our outcomes, controlling for prior achievement. Specifically, English Learners and special education students in 7th grade do not appear to have higher risks of not graduating, controlling for prior achievement. Students from lower socioeconomic backgrounds are less likely to graduate from high school, controlling for prior achievement and other individual characteristics. Race/ethnicity does not have a consistent, significant impact on high school graduation, controlling for a variety of other

characteristics. Asian students are consistently more likely to graduate controlling for prior academic achievement and a host of other characteristics. In the school fixed effects model, African American students are in fact more likely to graduate than White students, controlling for other demographic and academic characteristics. This finding only appears in the school fixed effects model, suggesting the possibility that Black students may sort into different types of school than White students, and when compared to students in their own school with similar background characteristics, they are more likely to graduate. Finally, being retained in middle or high school (*RETAIN*) or earlier than 7th grade (*OVERAGE*) is associated with lower likelihoods of high school completion.

To further interpret our findings from the multivariate analysis we present two prototypical plots. We display plots that indicate the predicted probability of initially passing the CAHSEE for students with demographic and academic characteristics typical of the “average” student across the three districts. Figure 2 presents the fitted probabilities of diploma receipt as a function of ELA CST score for the racial groups who are otherwise an “average” student across the three

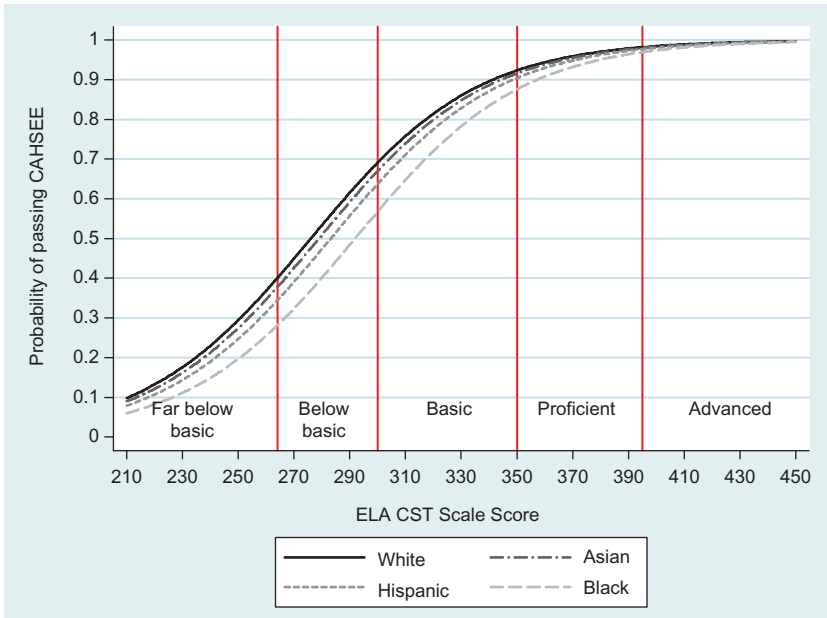


Figure 2: Probability of Passing CAHSEE by CST ELA Score, by race.

districts (i.e., for students with the same average characteristics, except for race).⁵ For each group, it is obvious that the probability for passing the CAHSEE is much higher for students who score Basic, Proficient, or Advanced. African American students are less likely to graduate than otherwise similar White students.

Turning to differences in CAHSEE performances by ELL designation, Figure 3 presents the probability of passing the CAHSEE on the first attempt, again for students classified as ELL and students not classified as ELL who are otherwise “average” students *across* the three districts. Again, the relationship between CST scores and the probability of passing the CAHSEE on the first attempt is quite similar, with students scoring basic, proficient, or advanced in 8th grade having much higher probabilities of passing the CAHSEE on their first attempt, relative to students with lower CST scores. ELL students who score basic on the ELA CST section are still about 10% less likely to initially pass the CAHSEE than students who are not classified as ELL, but are otherwise average students.

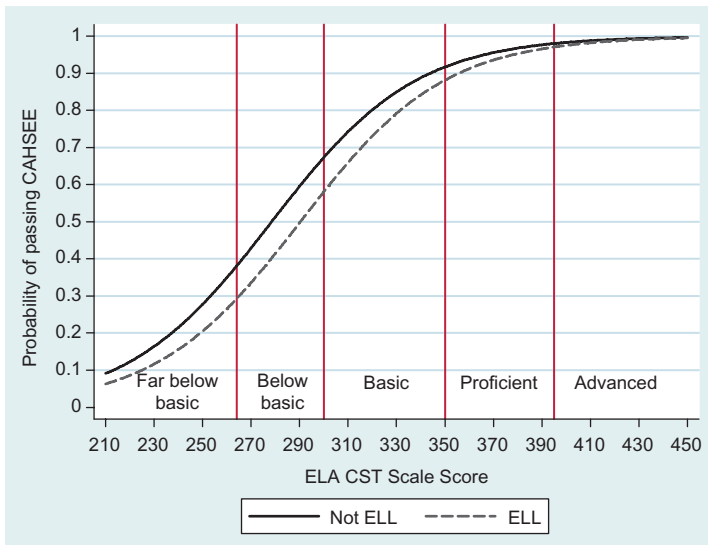


Figure 3: Probability of Passing the CAHSEE by CST ELA, by English Learner Status.

⁵ Combining our districts, the “average” student has a 2.56 GPA, about 48% likely to have taken algebra by 8th grade, score about 315 on the CST ELA and 313 on the CST math in 8th grade.

5 Conclusion

The goal of this paper is to aid schools, districts and education policymakers to identify the students most at risk of dropping out of high school prematurely, or who are struggling to pass the California High School Exit Exam. Many districts and schools are developing early warning systems to support students deemed at risk, either as a result of weak academic performance, and/or specific behavior, such as absenteeism (Bridgeland et al. 2006).

We find several important middle school determinants of high school success that can be utilized to target students early. *First*, standardized assessments provide useful indication of students' likelihood of graduation and CAHSEE failure. Students scoring far below basic on the California assessments had very low rates of CAHSEE passing at first attempt (8% in ELA and 14% in mathematics). This is an important finding given that mathematics on the CAHSEE exam is largely at the 8th grade level. In fact, much earlier assessments provide strong indication of later success. Utilizing data from San Diego Unified School District, Zau and Betts (2008) find students' 4th grade test scores to be significant predictors of CAHSEE passing. *Second*, corroborating with earlier research (Smith 1996; Adelman 2006; Evan et al. 2006), timing of algebra is a strong predictor of students' high school success. In our three districts, there was a 10% difference in graduation rates between students who had completed algebra by the 8th grade and those who had not. *Third*, we find that retention in earlier (and later) years is a strong predictor of high school completion, a finding that is also supported by previous research on high school completion (Roderick 1994; Entwisle et al. 2004). *Fourth*, middle school course failures also proved to be an important indicator of likelihood of graduation, and for forecasting CAHSEE passing at first attempt.

Despite the likely differences between schools along these outcomes, our results on the middle school indicators were robust when adjusting for school fixed effects. We find overall modest effects of student demographic characteristics, above and beyond academic performance measures. One exception is the socioeconomic status indicator for which, there are clearly persistent negative associations with high school diploma receipt and overall 11th grade GPA. This suggests that school systems might attend particularly to students from low-income homes when targeting dropout prevention programs, since these students have lower 11th grade GPAs and 12th grade completion rates than students from higher-income homes who have similar middle-school academic outcomes.

By many different calculations, California is facing a high school dropout crisis (Rumberger and Arellano 2007). Belfield and Levin (2007a) estimate the economic benefits of raising the rate of high school graduation in California to \$115,000 to the federal government and \$54,000 to state and local government,

and the total social gains at \$392,000 for each additional graduate over a lifetime.⁶ The potential benefits of raising the graduation rates in California clearly outweigh the likely additional investments necessary to produce more graduates in the state (Belfield and Levin 2007b).⁷

Over the last two years, California has made a substantial investment in trying to improve pass rates on the high school exit exam. The Budget Act of 2006 and Assembly Bill 1811 created nearly \$70 million specifically targeted to improving passing rates.⁸ However, these monies are restricted to interventions after the 10th grade (when students typically first take and either pass or fail the CAHSEE). This is far too late in students' high school graduation trajectories, given what we know from middle school indicators. It is important to note that in recent years, targeted CAHSEE remediation monies are more flexible and do target middle school students. The primary purpose of identifying students at risk of dropping out prematurely or not meeting graduation requirements is to target interventions early. There is no doubt that the transition from middle school to high school is one of great challenge for many students. An extensive body of research in adolescent development and behavior suggests that many students experience a decline in academic motivation and engagement in the middle school years (Eccles and Midgley 1991). These declines are manifest in increasing self-doubt, a lack of confidence in one's abilities, and rising academic pressures, among other factors (Eccles forthcoming). While behaviors of disengagement, apathy or stress may be difficult to target in middle school students, indicators of weak academic performance can provide useful information to teachers, school leaders and parents of struggling students.

Our findings are consistent with a growing body of research that has identified early signals of academic failure and high school dropout (Dynarski and Gleason 1999). These signals include course failures in core academic subjects

6 These are based on increased productivity among high school graduates resulting in higher earnings and therefore tax payments; reduced reliance on health services, public assistance, and criminal justice system (see Belfield and Levin 2007 for detailed discussion).

7 A cost-benefit analysis of educational investments that might improve California's high school graduation rate suggest that investments, such as raising teacher quality, reducing class size, publicly funded pre-school, head start, and after-school programs are likely to yield positive returns, albeit at a greater cost to state and local governments (Belfield and Levin 2007b).

8 California Department of Education Notice of the Apportionment for the California High School Exit Examination Intensive Instruction and Services Fiscal Year 2006-07.
http://www.slocoe.org/business/business_systems/fiscal_bulletins/FY06_07/GB%2042%201006.pdf.

in middle school (Neild and Balfanz 2006; Allensworth and Easton 2007), grade retention (Roderick 1994), early achievement (Zau and Betts 2008), and timing of algebra enrollment (Adelman, 2006). Moreover, other studies have also identified additional behavioral signals such as truancy (Neild and Balfanz 2006; Allensworth and Easton 2007) or elementary school behavior (Ensminger and Slusarcick 1992; Zau and Betts 2008) that, although not explored in this study, may further reveal risk of academic failure. Our results indicate that schools and districts have the necessary information in middle school to identify students at risk of not completing high school and/or not passing the California High School Exit Exam. Policymakers may in fact witness the desired improvements in CAHSEE pass rates and graduation outcomes if substantial investments are directed for early interventions.

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