

# College Readiness and College Completion at Broad Access Four-Year Institutions

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## Abstract

Many students arrive at college unprepared to do college-level work, facing a host of college readiness assessments and developmental education coursework. In this article, we examine how a student's readiness to take college classes upon entry to the university is related to four longer term postsecondary outcomes. We utilize a unique longitudinal dataset of the census of first-time freshmen at the nation's largest public 4-year state postsecondary system to describe differences by campus and across college majors. In addition we explore the use of one measure that the system does not currently use to determine readiness—high school grade point average—and its relationship with both the existing readiness measure and postsecondary outcomes. Our results indicate that grade point average can be a useful predictor of college success above and beyond the readiness measure.

## Keywords

college readiness, college completion, K-12–postsecondary alignment

Despite national calls for more students to obtain a postsecondary degree, many students arrive at college unprepared for college-level work. Reform efforts around Common Core State Standards, in conjunction with a “college for all” culture, has led to an increased focus on the transition between secondary and postsecondary systems of education. Many policymakers point to the high rates of college remediation across postsecondary institutions as evidence that high schools are not adequately preparing students for college. Providing remediation to students in college is costly and has troubled many higher education leaders and policymakers concerned with essentially paying double for basic skills that should have been completed prior to college (Strong

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American Schools, 2008). Yet college readiness is about much more than merely the short-term requirement of developmental education upon entry. As more students enter college than ever before, researchers and higher education leaders are increasingly focusing their attention on college persistence and degree receipt. In this article, we explore the importance of college readiness indicators for both short-term and longer term outcomes of college success.

Today, a college degree is more important than ever before for ensuring the economic prosperity of individuals and for society at large. Individuals with a bachelor's degree who worked full-time, year-round in 2008 had median earnings of \$55,700, compared to the \$21,900 earned by their peers with only a high school diploma (Baum, Ma, & Payea, 2010). Despite the many additional benefits associated with college completion, including better health, improved job security, and stronger families and communities, too few college students complete their postsecondary schooling. Although there are many determinants of college degree completion, arriving at college academically prepared to do college-level work is among the most important factors of collegiate success.

In this article, we investigate what it means to be college ready at the nation's largest public 4-year state postsecondary system—the California State University (CSU). Specifically, we ask the following research questions: (a) What is the relationship between college readiness and college success at nonselective 4-year institutions, and does that relationship vary across institutions and majors? (b) How well do different indicators of college readiness predict short-term and long-term college success? The rest of the article is organized as follows: in Section II, we briefly review prior literature on the causes and consequences of college readiness; in Section III, we describe the data and methodological approach we employ for this analysis; in Section IV, we describe the findings; and in Section V, we conclude and provide a discussion of policy implications.

## **Research Context**

The extant literature on college readiness and student outcomes can be broadly organized into the following areas: academic rigor prior to college entrance, knowledge and information about college, and developmental needs upon arrival at college. In addition, there is an important discussion among education practitioners, and increasingly researchers, about how to assess college readiness, particularly in light of new reform efforts to improve collegiate attainment. Below we briefly review each of these areas in the literature.

### ***High School Academic Rigor and School Quality***

Students who developed a stronger academic background in high school are more likely to arrive at college prepared for college-level work.<sup>1</sup> There is a rich body of literature that explores how high school experiences influence later outcomes for students. The Department of Education analysis authored by Clifford Adelman (1999),

*Answers in the Tool Box* and several years later, *The Toolbox Revisited* (Adelman, 2006) were early canonical pieces exploring the association between high school academic background and later college success. These pieces have provided evidence that the intensity of a student's high school curriculum is a critical predictor of college degree completion. Using the High School and Beyond cohort of 1982 high school graduates and the National Education Longitudinal Study (ELS) cohort of 1992 high school graduates, Adelman investigated the pathways that contribute to college completion. His findings described how academic intensity in high school curricula (measured by course level Carnegie units,<sup>2</sup> highest math course taken, the need for remedial coursework in English and math, and enrollment in Advanced Placement courses) is a stronger predictor of students' college degree attainment than student test scores or class rank. More specifically, Adelman (1999) found that a student's highest level of mathematics taken in high school has the strongest influence on college completion relative to any other predictor.

Statistics from the most recently available nationally representative cohort of high school students—the ELS cohort of 2002 high school graduates—corroborated the findings from earlier studies that students with higher math course-taking patterns in high school also have higher rates of both high school diploma receipt and college enrollment (Ingels et al., 2005; U.S. Department of Education, National Center for Education Statistics, ELS:2002).

It is difficult to establish a causal relationship between taking academically rigorous courses in high school and later outcomes because students self-select into rigorous courses. Students who take a more rigorous set of courses in high school likely have a host of other attributes that also lead to their success in college. For example, such students may have better academic skills, more motivation and a stronger work ethic, or perhaps more academic support and encouragement from their families or teachers. Many researchers have attempted to deal with the complexity of estimating the influence of curricular intensity on future success by using a variety of approaches. When researchers have controlled for as many observable characteristics as are available, they find a consistent positive association between curricular intensity and the following: student test scores (Attewell & Domina, 2008), high school graduation (Swanson & Schneider, 1999), college entry (Long, Conger, & Iatarola, 2012), type of college entry (Attewell & Domina, 2008), college grades (Klopfenstein & Thomas, 2009), college graduation (Adelman, 2006; Attewell & Domina, 2008), and wages (Altonji, 1992; Rose & Betts, 2004).<sup>3</sup>

Using detailed information from students' high school transcripts, Long et al. (2012) found a 7 to 11 percentage point increase in the likelihood of high school graduation and 4-year college entry between a student who takes no rigorous high school courses and a student taking just one rigorous course during high school. This study suggested that the biggest differences in student outcomes are based on math and English course levels. Enrollment in rigorous courses in other subjects, however, also leads to improved outcomes. Long et al. also found that, although more rigorous courses are associated with better student outcomes, the differences were greatest between those taking no rigorous course and those taking only one. This result

suggests that “requiring or encouraging students to enroll in even one rigorous course in their first two years of high school can substantially improve graduation and four-year college enrollment rates” (Long et al., 2012, p. 315).

In order to improve college readiness, it is useful to think through the mechanisms at play; why might more rigor in high school courses lead to better postsecondary success? First, a rigorous course of study in high school might provide richer curricula, exposing students to material they may face in college and improving their college readiness. Second, rigorous courses in high school (such as honors and AP) are frequently taught by more skilled teachers (often with additional credentials, more experience, or specialized professional development), than less rigorous courses. Third, a rigorous course of study can serve as an important signal for college admission, particularly at more selective institutions, and enrollment at a more selective college is positively associated with student outcomes. Fourth, rigorous courses attract particular students, often those most academically able and/or those most motivated, and engagement with higher ability peers may positively influence student outcomes. Finally, the relationship between rigorous course-taking and student outcomes may not be causal at all, such that the observed positive correlation is driven by a third underlying set of traits shared by academically successful students, such as drive or motivation.

It is nearly impossible to disentangle the various explanations for why rigorous courses may lead to improved educational and occupational outcomes. It is also not obvious that simply placing students in more rigorous courses will improve college readiness measures (and may in fact lead to higher rates of high school dropout). As suggested above, because students are not randomly placed into courses in high school, but rather self-select (often with the aid of parents, teachers, or counselors) into a course of study, it is difficult to separate out unobserved motivation, support, or other characteristics that may be associated with both rigorous course-taking in high school and better collegiate outcomes. Students do not enroll in a course of study by chance. Recent statistics from a nationally representative sample of high school students' course enrollment revealed that White and Asian students are much more likely to be enrolled in a more rigorous set of courses than are African American or Latino youth (U.S. Department of Education, National Center for Education Statistics, ELS:2002, as adapted from Planty, Bozick, & Ingels, 2006). Similarly, students from higher socioeconomic status (SES) families have higher levels of participation in more rigorous academic coursework than do their lower SES peers. This is consistent with research indicating that lower SES students, in particular, continue to be underrepresented at more selective postsecondary institutions because they have not completed the appropriate coursework (Carnevale & Rose, 2003). There are a host of factors that contribute to students' sorting into various levels of courses in high school: availability of courses, knowledge of offerings at the school, academic ability, interest, motivation, familial involvement (or lack thereof), and the influences of teachers, counselors, and/or peers. As such, properly addressing racial/ethnic and socioeconomic differences in analysis of course enrollment patterns requires further inquiry into each of these possible sources of existing disparities.

Research has suggested that schools serving high concentrations of low-income students often have fewer advanced curricular offerings than do schools serving a more affluent student population (Adelman, 1999; Conger, Long, & Iatarola, 2009). However, recent efforts by the federal government to ensure such opportunities are more equally distributed have attenuated the disparities in curricular offerings, particularly in courses such as Advanced Placement, between schools. Moreover, studies that accounted for school differences suggested that disparities in advanced course-taking by demographic characteristics are largely phenomena that exist within a school rather than across schools (Gamoran, 1987). This suggests that curricular disparities are mainly due to tracking or to inequalities in access to more demanding courses *within* the school (Attewell & Domina, 2008). The implications of such inequality suggests that schools need to investigate more closely the process that contributes to course sorting, particularly when it results in racial/ethnic or socioeconomic segregation in college preparatory curricular tracks.

Studies that parse out the effects of academic rigor by race/ethnicity and socioeconomic status have found that the return to taking more advanced coursework varies with the attributes of the student. Some of this variation is based on school attended. For example, Long et al. (2012) found that students attending high-poverty or academically lower quality schools experienced larger increases in their high school graduation and college enrollment rates associated with taking more rigorous courses than students attending more affluent high schools. Some of this variation may be attributable to other individual differences in response to a rigorous curriculum, perhaps differential peer effects, or support for a college-going culture. Regardless of the mechanism at work, it is important to consider rigorous course-taking as one avenue for addressing inequality in educational attainment. Using data on students in Florida public postsecondary institutions, Long, Iatarola, and Conger (2009) found that 28% to 35% of the gaps (and over three-quarters of the Asian advantage) in college readiness among college-going Black, Hispanic, and low-income students can be explained by the highest math course taken in high school.

**College knowledge and information.** Part of the explanation for the large share of students requiring remediation once they arrive in college may be a result of the limited information students possess regarding what they need to do to succeed in college. A majority of high school students—regardless of their academic performance—report that they will attend college. In fact, academic performance accounts for little of the variance in students' *expected* levels of educational attainment. Reynolds, Stewart, MacDonald, and Sisco (2006) found that between 1976 and 2000 the percentage of high school seniors indicating that they probably or definitely would complete *at least* a baccalaureate degree increased from 50% to 78%. At the same time, not surprisingly, the explanatory power of self-reported grades and participation in a college preparatory program have declined appreciably (Reynolds et al., 2006). These findings are consistent with those of Rosenbaum et al., who report that high school seniors have little understanding of what it takes to succeed in higher education (Rosenbaum, 2004). Despite a college for all culture, students often have very limited and only vague information about what

college will be like, which is particularly true for students who are the first in their family to attend college (Settersten & Ray, 2010). Nevertheless, despite a weakening association between expectations and college going, college expectations remain a significant determinant of student effort (Domina, Conley, & Farkas, 2011).

Of course not all students who enroll in college want to spend 4 years there; some might enter and then find they are unsure about why they are in college in the first place and may be unmotivated to finish (Schwartz, 2004). Students who do not know if college is for them engage in an experiment by enrolling, and in the course of this experiment gain new information about what they like and do not like (Manski, 1983) as well as what college requires of them (Deil-Amen & Rosenbaum, 2002; Person, Rosenbaum, & Deil-Amen, 2006). If, at any point, this new information causes the perceived incremental costs associated with college to outweigh the incremental benefits of continuing, a student will drop out. But students do not make choices in a vacuum; those who have the financial means, are better prepared, and attend institutions that do a better job of supporting them are more likely to find staying in college attractive relative to others who are not similarly equipped (Adelman, Daniel, & Berkovits, 2003; Kane, 1994). Although college graduation rates will never be 100%, there are likely many college students who would benefit from a college degree but who currently leave college before completing their postsecondary studies.

What might support improved information about college to support greater success? Conley's oft-cited dimensions of college and career readiness include (a) cognitive strategies (a deliberate approach to integrate content from different disciplines (e.g., research skills, interpretation of conflicting findings, etc.); (b) key content knowledge, particularly in writing, math, and scientific thinking; (c) academic behaviors such as self-management; and (d) contextual skills and awareness (i.e., knowledge of college norms) (Conley, 2010). There have been important policy efforts and program developments around all of these dimensions. Most notably, at the heart of the Common Core State Standards is the promise to better align high school curriculum with the expectations of college. Moreover, programs such as the CSU's Expository Reading and Writing professional development program with teachers is focused on providing teachers with the curricular strategies and specific content aimed at providing students with key content knowledge to improving college-ready writing.<sup>4</sup> Finally, programs such as Advancement Via Individual Determination (AVID), Upward Bound, and Summer Bridge have long focused on providing students (particularly first-generation college students from underrepresented backgrounds) with exposure to the academic and social behavior skills required for college success. There remains, however, limited evidence about the effectiveness of these programs (Bork, Mayer, Pretlow, Wathington, & Weiss, 2012; Domina, 2009).

### *Collegiate Remediation*

Given high rates of remediation at the postsecondary level, many researchers have focused on evaluating the effect of being remediated on a variety of postsecondary outcomes. Part of the difficulty in assessing the impacts of remediation on collegiate

outcomes is that students who require remediation are different from those who do not, making it difficult to isolate the effect of remediation on college outcomes from the other things that make these students different. (Examples include weaker skills or less motivation.) In research that controls for students' academic skills and other demographic characteristics, students in developmental courses at community colleges have done as well as students who never participated in developmental education (Adelman, 1999; Attewell, Lavin, Domina, & Levey, 2006). More recently, a body of work by social science researchers has attempted to overcome the difficulties in comparing the outcomes of students placed in remediation to those who are not. This evidence is more compelling in many ways but still not without limitations.

There have been a handful of studies that utilize detailed student-level administrative data from specific states to isolate a causal effect of participating in remedial coursework in college. The advantage of these studies is that they are able to overcome the main obstacle in evaluating remediation—a viable comparison group. As previously suggested, students are not placed in developmental courses in an arbitrary way; they often have a host of other characteristics that are associated with both their need for remediation and their likelihood of success in college. These studies overcome this problem by establishing a comparison group for remediated students based on students who were very close to the proficiency cutoff. The assumption is that those who passed, but just barely so, are not that different from those who just barely did *not* pass and therefore needed remediation. As a result, the evidence is most applicable regarding whether remediation “works” or “does not work” for students at the margin of needing it in the first place. Nevertheless, this research yields our best guess about whether remediation policies benefit students in need of extra skills.

Results from these studies are mixed; Martorell and McFarlin (2011) found that students enrolled at Texas public institutions requiring remediation did not have better odds of passing a college-level math course, transferring from a 2-year to a 4-year college, or completing their degree. In a similar study of Florida institutions, Calcagno and Long (2008) found that students required to take developmental courses in math (compared to similar students not required to do so) accumulated more total credits, but were no more likely to complete college-level courses, to complete a certificate or AA degree, or to transfer to a 4-year university. Another study employing a similar approach at one large university campus in the Northeast found a positive effect of remedial course-taking on later outcomes (Lesik, 2008). Most recently, several studies (Boatman & Long, 2010; Melguizo, Bos, & Prather, 2013) explored multiple cutoffs for different placements and found that developmental courses function differently depending on students' level of academic preparedness, and therefore policies that may be beneficial for some students with different levels of academic preparedness may not be for others.

Employing a different analytic strategy, Bettinger and Long (2009) explored 2-year and 4-year colleges in Ohio, taking advantage of the fact that Ohio public institutions have different policies (test cutoffs) for demonstrating proficiency. They found that placement into remediation increased the probability of college persistence when comparing academically similar peers who were and were not required to take remedial courses.

Overall these studies reveal at best a mixed bag of results, suggesting that students in need of remediation do no better (and at times slightly worse) when compared to similar students. The studies also suggest that perhaps the fact that we do not see consistent positive outcomes comparing students just above and just below proficiency cutoff may imply that the assessments we use for identifying remediation are not useful or sufficiently nuanced enough (Scott-Clayton, 2012). Regardless, findings from these studies as a whole suggest that educators and policymakers should proceed with caution in implementing remedial placements, and in evaluating their impacts.

In sum, what we know from the extant literature is that many students enter college unprepared to do college-level work (as measured by placement tests they face when they arrive), and that there is at best mixed evidence that collegiate remediation improves student outcomes. Students' high school preparation remains a key determinant of their success in college, and as such, it is critical to further understand how college readiness relates to long-term student success. In this article, we employ unique administrative data to investigate what it means to be college ready at a large, nonselective, public 4-year university, and ask how well does college readiness predict college completion across institutions and majors.

## **Data and Methods**

### ***Setting***

California serves students from a tremendous range of ethnic and socioeconomic origins. The CSU system with 23 campuses is the largest public higher education systems in the country, educating about 1 in 10 California high school graduates, roughly 6% of the undergraduates enrolled in public 4-year colleges in the entire nation.<sup>5</sup> These students come from urban, suburban, and rural areas and attended public high schools that are both among the best and among the worst in the nation. Although California may not be a typical state, it reflects the student populations of other states in the United States and the mainstream public colleges that educate them very well.

### ***Data***

We employed a unique administrative dataset from the CSU Chancellor's Office, which supplied application files, term-by-term academic files, and degree files for students who completed college. The data in use for this study spanned six academic years for each of two cohorts, those who entered a CSU in 2003 and those who entered a CSU in 2004. We combined all of the data sources to generate a longitudinal set of data capturing the progress of students from college entrance through 6 years later.

### ***Measures***

We utilized the student-level, longitudinal data to examine important college-level outcomes across a student's college career at a CSU. Specifically, we examined two



short-term outcomes—GPA in the first year and whether a student persists to their second year—and two longer term outcomes—BA completion and whether that completion took longer than the standard expected 4 years.

Our two short-term outcomes encompass two early collegiate experiences that have lasting impacts on a student's trajectory towards eventual graduation. First, we computed a student's cumulative GPA through their second semester to determine first-year academic performance. We focused on first year grade point average (GPA), as students are likely enrolled in lower division, general education courses in their first year, and not yet within their specific major, making GPAs more comparable across all majors. Also, first year GPA is the outcome that is most proximal to the college readiness measure at the CSU (and the one typically validated for admissions tests such as the SAT and ACT). Lastly, focusing on GPA in the first year allowed us to look at outcomes for students who eventually transfer, stop out, or drop out. In addition to grades, the transition between the first and second year of college is crucial for students. Students who are experimenting with college or who find they were not prepared for college may be less likely to return for their second year of school. As such, we measured whether a student was present for the fall of his or her second year, creating a dichotomous variable (1 = present, 0 = not present).

The two later outcomes are both related to obtaining a degree from the 4-year institution where they started. The CSU, like many nonselective institutions, is concerned with the completion rate of its students. We operationalized college completion as completing a bachelor's degree within a 6-year window of being a first time freshman, which is in line with how CSU calculates their completion rates (1 = completed degree, 0 = did not complete). We also examined time to degree. Specifically, we measured whether students who completed their degrees did so in the traditional 4 years (including the adjacent summer to the fourth year). Although this is not a focus of the CSU, extended time to degree can be costly and may lead to lower graduation rates. We only measured this variable for students who *did* complete their degrees, so students who dropped out, transferred, or were still in school after 6 years are excluded (1 = completed degree within 4 years, 0 = completed degree in more than 4 years).

Our predictor of interest is whether or not a student is ready for college. College readiness is a nebulous term that is difficult, if not impossible, to accurately define, much less measure. In this study, we specifically used CSU's measure of college readiness: whether the student is ready for college-level math and English courses, respectively. Although this measure does not encompass the entire range of what makes a student ready for college, once a student is enrolled in college, the ability to take college-level courses is the most important signal that the student is ready. Like many other nonselective universities, campuses in the CSU system have high rates of remediation need. Currently, over 40% of all students require some remediation (in English, math, or both subjects) before they can take college-level courses. The CSU determines whether a student is exempt from remediation in English and mathematics in several ways. A student may become exempt by receiving a high score on a section of the SAT (550 for math and 500 for English) or ACT (23 for math and 22 for English). A student may receive a score of 3 or higher on a relevant AP exam. A student may also

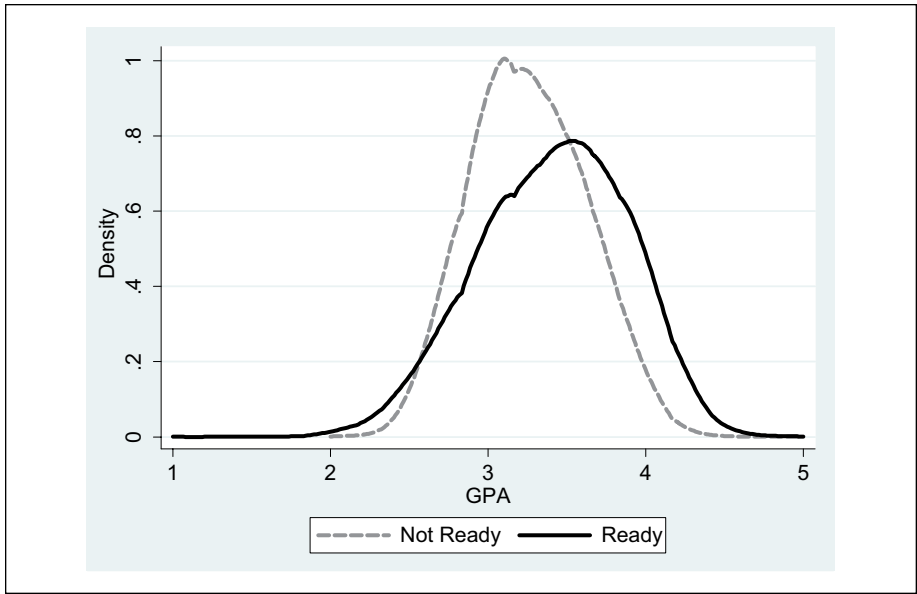
become exempt if they transfer college-level courses, such as dual enrollment credit from a community college. In 2004, California initiated the Early Assessment Program, through which a high score in that subject also guarantees remediation exemption in that subject.<sup>6</sup> Finally, if a student has not met any of the test thresholds above, and did not transfer college-level credit, then he or she takes a placement exam at the university. Students who score above the threshold (50 in math, 147 in English) are exempt from remediation and deemed ready for college-level courses. Students who score under either of the thresholds are required to enroll in remediation in those subjects, as they are deemed not yet ready for college-level courses.

In addition to the relationship between CSU's metric for college readiness and college outcomes, we also explored the use of cumulative high school GPA as a key predictor of students' college success. There are good reasons why high school GPA might be an important determinant of college success (after controlling for more standardized measures of academic ability such as those provided by the SAT and ACT). GPA is an indicator of student effort and motivation while in high school, as well as likely picking up other dimensions of ability not fully captured by existing standardized tests. Other studies of collegiate success have also demonstrated the specific contribution of GPA to predicting collegiate outcomes (Jacobson, 2011).

We investigated several covariates in the study, including race/ethnicity, gender, income, and parent education. We represent each of these measures as sets of dummy variables derived from the administrative files about each student. Race was self-reported, derived from the application file, and consists of the following values: White, Black/African American, Asian, Latino, American Indian, Pacific Islander, and decline to state. Gender was also self-reported from the application file and consists of male and female. Parent income was categorized as follows (in dollars, thousands): 24 to 36, 36 to 48, 48 to 60, 60 to 72, 72 and more, and no income provided. Parent education had three values: a high school diploma or less, education beyond a high school diploma, and no parent education provided. In addition, we also examined the relationship between readiness and the four outcomes with respect to each student's first campus attended (a set 23 dummies representing each campus). Lastly, we represented major as a set of eight dummies representing the divisions of a student's major upon entry. We grouped the 28 major categories into eight divisions: undeclared, education, health professions, social science (interdisciplinary studies, social sciences, psychology, home economics, architecture and environmental design), humanities (library science, letters, fine and applied arts, foreign languages, area studies), public affairs (public affairs and services, communication, business and management), biological sciences (biological science, agriculture and natural resources), and math/physical science (mathematics, physical science, engineering, computer and information sciences).

## *Data Analysis*

We used descriptive tables, graphs, and regressions to examine the association between college readiness and our four college outcomes. To address the first research question



**Figure 1.** High school GPA densities by college readiness.  
Note. Each density represents the distribution of GPAs for students who are in a particular category.

about the relationship between college readiness and GPA, we employed a simple two-sample *t* test to test for significant differences between mean GPA between ready students and not-ready students. For the dichotomous outcomes, we used a chi-squared test to test for significant differences in the proportion of students in each category. These relationships were intended to be completely descriptive. To continue describing the relationship between readiness and the outcomes by school and major, we tested the relationship separately for each campus and each major.

To address the second research question about the relationship between college readiness and our collegiate outcomes for similar students, we used a student's high school GPA. Because college readiness in this article is defined by the CSU and constructed from thresholds on several tests, it is difficult to find students who are academically similar on these measures but dissimilar in college readiness. However, we did have one academic variable that is not included in the determination of college readiness at CSU: high school GPA. High school GPA was used to determine eligibility to enroll at a CSU, or even eligibility to declare some majors upon entry, but is not used as a screen for or evidence of whether a student is ready to take college-level courses in English and mathematics. In addition, there is much overlap in the distribution of GPAs for ready and nonready students. Figure 1 shows the densities of GPAs for students who are college ready and students who are not ready. Although, on average, ready students had higher GPAs than students who are not ready, the distributions were very similar, which makes it easy to compare the outcomes of two students who

have a similar high school GPA, where one is deemed ready and the other deemed not ready for college.

Our models employed ordinary least squares (OLS) regression for GPA and linear probability models for the dichotomous outcomes. First, we tested the basic relationship between college readiness and the outcome, shown in Equation 1:

$$Y_i = \beta_1 READY_i + \varepsilon_i, \quad (1)$$

where  $Y_i$  is the outcome of interest for student  $i$ ,  $READY_i$  is whether a student is college ready, and  $\varepsilon_i$  is the error term for student  $i$ .

Next we tested whether that relationship holds when comparing students with similar GPAs by testing the following model:

$$Y_i = \beta_1 READY_i + \beta_1 HSGPA_i \varepsilon_i, \quad (2)$$

where  $HSGPA_i$  is the high school GPA for student  $i$ .

Lastly, in Equation 3 we included race, gender, parent income, cohort fixed effects, campus fixed effects, and major fixed effects:

$$Y_{ijkm} = \beta_1 READY_{ijkm} \beta_1 + HSGPA_{ijkm} + COHORT_j + CAMPUS_k + MAJOR_m + \varepsilon_{ijkm}, \quad (3)$$

where  $COHORT_j$  is a set of cohort dummies,  $CAMPUS_k$  is a set of campus dummies, and  $MAJOR_m$  is a set of major dummies.

## Results

First we examined the four outcomes across the entire CSU system. Table 1 details the summary statistics of the four outcomes for the pooled 2003 and 2004 cohorts, as well as key high-school-level predictors. Note that completion rates at the CSU system were about 53%, and less than a third of those graduates complete their degrees in 4 years. Persistence rates across the system were high; about 81% of students returned for a second year. Lastly, students, on average, maintained a 2.75 GPA in their first year at a CSU. Importantly, we note that less than half of all students at a CSU are ready for college at the time of entry, despite an average high school GPA of 3.33.

It is important to note that these averages across the system differed greatly by student characteristics and by campus. Table 2 displays the diversity of students in the CSU system in terms of race/ethnicity, gender, income, and the campus attended, as well as the differences in college readiness for each group. The CSU served a diverse population of students that includes a large number of underrepresented minority groups and a high number of lower income students. Females made up a greater proportion of the two cohorts. The biggest major divisions included public

**Table 1.** College Outcomes and Key Predictors.

Variable	N	M	SD	Min.	Max.
GPA Year 1	79,438	2.75	0.85	0	4
Year 2 persistence	77,385	0.81	—	0	1
Completion	84,313	0.53	—	0	1
On-time	46,836	0.30	—	0	1
College ready	84,313	0.47	—	0	1
High school GPA	84,080	3.33	0.4284	1	5

*Note.* The 2003 and 2004 cohorts are pooled. Completion refers to graduation within 6 years of first-time freshman enrollment. On-time graduation represents graduating at in 4 years (and the adjacent summer) after first-time freshman enrollment, and is only measured for students who did graduate. Persistence represents a student returning in their second year. GPA Year 1 represents the cumulative GPA for a student on the college campus at the end of their second semester of school.

affairs/communications, social science, and students who have yet to declare a major. Those three groups made up over 60% of all students at the CSU. Education and health professions, each of which contained only one major, had the smallest share of students. Campuses varied tremendously in size and college readiness, with some colleges observing less than a third of their students entering college deemed ready by CSU.

Overall, White students at the CSU were more likely to be college ready, more likely to complete a degree, and to do so more quickly and with a higher GPA than Black, Latino, and Asian students. Only Asian students were more likely to persist than White students. Females, although less likely to be ready than male students, were more likely to graduate, do so on-time, persist, and maintain a higher GPA than male students. Students who came from lower income homes were less likely to enter the CSU system ready for college and, on average, were outperformed in all outcomes by their higher income peers. Because of these important associations, we controlled for these background characteristics in subsequent models.

Students self-select into majors for many reasons, including interest, future job prospects, major availability at their institution, and perceived difficulty of the major. In addition, some majors have their own academic eligibility standards, which keep some students out. Self-selection, eligibility, and major difficulty may play an important role in both college readiness and in our outcomes of interest. Math and physical sciences had the highest percentage of college-ready students, as well as among the highest persistence, graduation rates, and rates of on-time graduation. Meanwhile, humanities majors had the lowest percentage of college-ready students, and among the lowest persistence rates, completion rates, and the longest time to degree of any major areas.

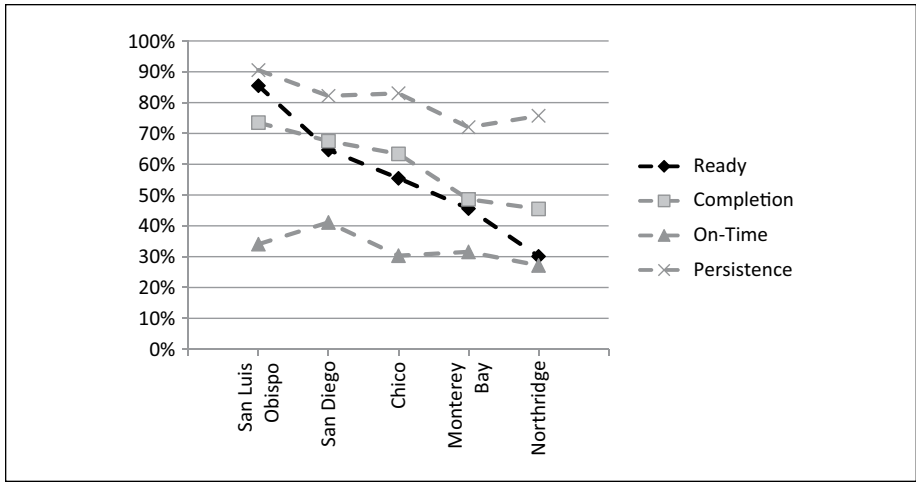
We also examined the campus differences in both college readiness and postsecondary outcomes. Figure 2 shows the differences in both readiness and outcomes for five selected campuses that include the campus with the most ready students, the campus with the least ready students, and three other representative campuses in between.

**Table 2.** College Outcomes.

	% of Total	College Ready	First Year GPA	Year Two Persistence	Completion	On-Time
<i>Race</i>						
White	35%	61%	2.85	82%	61%	37%
Latino	22%	35%	2.62	77%	44%	26%
Asian	12%	38%	2.71	84%	55%	26%
Black	5%	36%	2.49	75%	37%	27%
<i>Gender</i>						
Female	58%	43%	2.84	81%	56%	35%
Male	42%	53%	2.63	80%	49%	24%
<i>Income</i>						
Higher income	63%	52%	2.79	81%	56%	33%
Lower income	22%	34%	2.66	80%	45%	23%
<i>Major</i>						
Public affairs/communication	22%	45%	2.73	81%	50%	25%
Undeclared	22%	36%	2.76	80%	57%	39%
Social Sciences	17%	44%	2.82	80%	51%	34%
Math/physical science	14%	65%	2.61	82%	57%	36%
Humanities	9%	29%	2.91	78%	54%	27%
Biological sciences	8%	31%	2.71	84%	45%	22%
Health professions	5%	42%	2.81	81%	55%	34%
Education	4%	38%	2.83	80%	51%	19%
<i>Campus</i>						
San Diego	10%	65%	2.78	82%	68%	41%
Long Beach	8%	44%	2.88	84%	55%	23%
Fullerton	8%	45%	2.58	81%	52%	30%
Northridge	8%	30%	2.72	76%	46%	27%
San Luis Obispo	7%	86%	2.82	91%	74%	34%
San Francisco	7%	41%	2.89	79%	50%	26%
Fresno	6%	40%	2.79	84%	50%	31%
Sacramento	6%	42%	2.68	80%	45%	23%
Pomona	6%	44%	2.62	81%	55%	29%
San Jose	5%	42%	2.73	81%	48%	17%
Chico	5%	55%	2.77	83%	63%	30%
San Bernardino	4%	38%	2.72	80%	45%	29%
Los Angeles	3%	29%	2.84	74%	34%	25%
Sonoma	3%	50%	2.70	78%	61%	48%
Humboldt	2%	62%	2.75	74%	43%	26%
San Marcos	2%	41%	2.82	71%	46%	30%
East Bay	2%	42%	2.81	81%	48%	33%
Bakersfield	2%	36%	2.55	77%	44%	36%
Stanislaus	2%	49%	2.80	80%	52%	41%
Dominguez Hills	2%	31%	2.71	72%	33%	17%
Monterey Bay	1%	46%	3.02	72%	49%	32%
Channel Islands	1%	40%	2.63	78%	60%	42%
Maritime Academy	0%	60%	2.82	83%	66%	73%

Note. Lower income students are students with families making less than \$36,000 per year.

The percent of college readiness ranged from a high of 86% to a low of about 30%. The outcomes, however, varied less; completion ranged from 74% at the campus with the most prepared students to a low of 47% at the campus with the least



**Figure 2.** Outcomes and college readiness for selected colleges.  
Note. The graph displays five selected colleges that range from the campus with the most college-ready students to the least college-ready students.

**Table 3.** College Readiness and Outcomes.

Outcome	College Ready	Not Ready	Difference	
GPA Year 1	2.86	2.66	0.2	***
Year 2 persistence	84.2%	78.1%	6.1%	***
Completion	57.8%	49.1%	8.7%	***
On-time	36.6%	23.9%	12.8%	***

Note. Significance tests are two sample t test for GPA and chi-squared for all dichotomous outcomes.  
\* $p < .05$ . \*\* $p < .01$ . \*\*\* $p < .001$ .

prepared students. Second year persistence rates hovered between 80% and 90% for all campuses, and on-time graduation is universally around 30% to 40% regardless of college readiness levels at the selected schools.

### The Relationship Between College Readiness and College Outcomes

Our analysis corroborates with existing work to find that college readiness is clearly associated with college outcomes. Table 3 shows the mean outcomes for those who are ready versus those who are not ready, and displays a test to determine the significance of the difference between the two groups. College-ready students had, on average, a GPA that is 0.2 grade points higher than students who were not ready, and college ready students were 6.1 percentage points more likely to persist to their second year. In addition, college-ready students were 8.7 percentage points more likely to complete

college and 12.8 percentage points more likely to do so on time compared to students who are not ready for college. Each of these differences was statistically significant, suggesting that across all campuses and majors, ready students have better outcomes than those who are not ready.

We next explored whether the relationship between college readiness and college outcomes vary by campus and major. Figure 3 shows the advantage for college-ready students at each campus; each panel represents one of our key outcomes. The point for each campus represents the average difference in outcomes between college-ready and not-college-ready students in each respective campus; the bars represent 95% confidence intervals around those mean differences. Note that for each outcome, there were campuses where there is very little or no relationship between college readiness and later outcomes, while there is a large relationship for others. The graphs are each sorted by the magnitude of the relationship so that the campuses at the right have the largest advantage for college-ready students. We see perhaps the largest range by campuses in the GPA gap between college-ready students and those who are not ready.

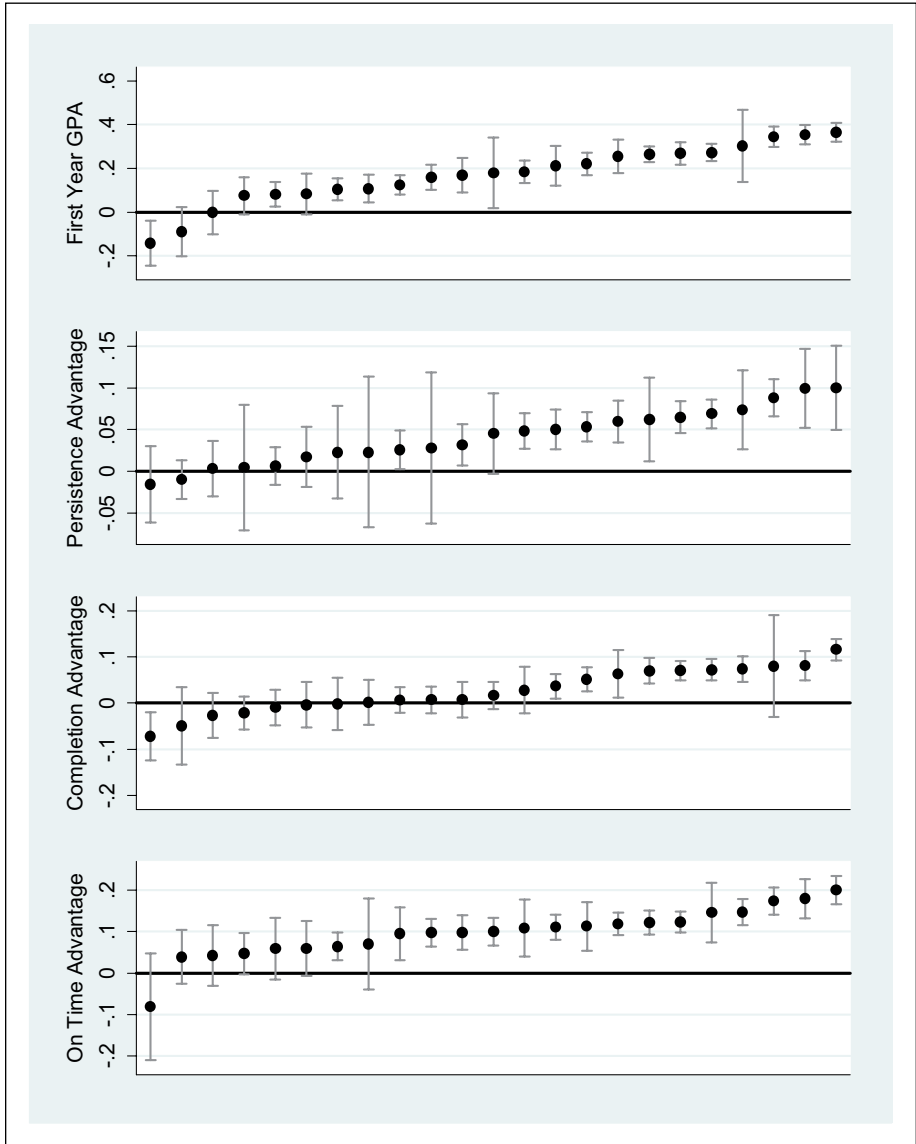
Figure 3 illustrates that college-ready students at most campuses had a positive, significant advantage when compared to students who are deemed not ready (as much of a GPA advantage of 0.38 grade points). At a few campuses, there was no advantage for college-ready students. At about half of the CSU campuses, students who were college ready are not statistically significantly more likely to persist into their second year than those who were not ready for college, and the other half of campuses had a 5 to 10 percentage point gap in persistence rate between ready and not-ready students. Turning to the completion-related outcomes, only nine of the campuses showed a significant advantage in completion rates for college-ready students, but most campuses showed a statistically significant advantage in terms of graduating on time. We might expect this, as students who are not college ready are required to take additional developmental course work in their first year. The relationship between readiness and each outcome was similar and consistently significant for each major area.

Figure 4 was constructed similarly to Figure 3 and shows the advantage for college-ready students compared to students who are not ready for college for each outcome by major at entry. Though the effects are similar for all majors, the effects of readiness were usually higher for some majors. Education majors benefitted more than other majors for most outcomes, whereas undeclared students consistently had smaller benefits to entering college ready than other majors.

### *Improving Determinants of College Outcomes*

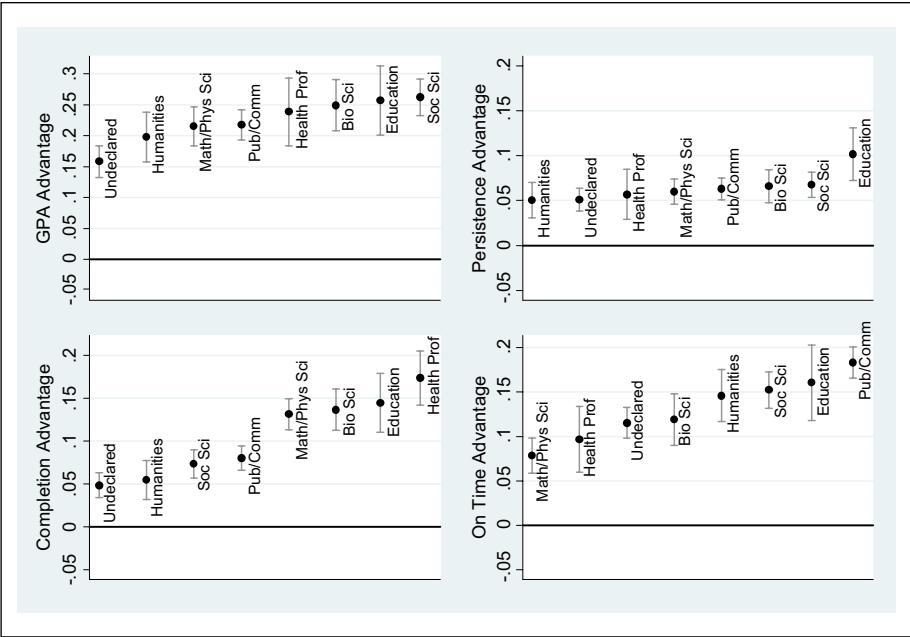
In Table 4 we provide coefficients from a set of nested models that examined the relationship between college readiness and each of the four outcomes. Model 1 for each outcome shows the raw relationship between readiness and each outcome, respectively (similar to the descriptive differences previously described). In Model 2, we analyzed the relationship between college readiness and each respective outcome,





**Figure 3.** Relationship between college readiness and outcomes by campus.  
Note. Each point represents a separate regression of readiness on the outcome (OLS and linear probability models where appropriate). Error bars show 95% confidence intervals.

controlling for a student’s high school GPA; and finally, in Model 3, we added controls for high school GPA, student demographics (including race/ethnicity, gender, parent education, income), campus differences, major at entry, and cohort fixed effects.



**Figure 4.** Relationship between college readiness and outcomes by major.  
Note. Each point represents a separate regression of readiness on the outcome (OLS and linear probability models where appropriate). Error bars show 95% confidence intervals.

Model 1 highlights the same mean differences displayed in Table 3 above and serves as baseline model for each set of regressions. Specifically, Model 1A shows that college-ready students had, on average, a college GPA that is 0.2 grade points higher than students who were not ready, and Model 2A shows college-ready students are 6.1 percentage points more likely to persist to their second year. The graduation-related outcomes show that college-ready students were 8.7 percentage points more likely to complete college (Model 3A), and 12.7 percentage points more likely to do so on time compared to students who are not ready for college (Model 4A); not surprisingly, all of these differences were statistically significant.

Model 2 for each outcome demonstrates that once we compare similar students (in terms of high school GPA) the magnitude of the CSU college readiness indicator was substantially attenuated (in some cases, the coefficient summarizing the relationship between the CSU college readiness indicator and these outcomes was cut in half). For example, college-ready students were 8.7 percentage points more likely to complete a degree within 6 years compared to students who are not ready. However, when compared to students with similar GPA, that advantage shrunk to 4.4 percentage points. We see similar attenuation for the other three outcomes. There are likely multiple reasons for this attenuation. First, college readiness is likely measured with error (i.e.,

**Table 4.** Linear Probability Model and OLS Estimates for Outcomes by College Readiness.

Covariates	Panel A: GPA Year 1			Panel B: Year 2 Persistence		
	Model 1A	Model 2A	Model 3A	Model 1B	Model 2B	Model 3B
	N	N	Y	N	N	Y
Readiness	0.199*** (0.006)	0.096*** (0.006)	0.133*** (0.006)	0.061*** (0.003)	0.033*** (0.003)	0.030*** (0.003)
High school GPA		0.662*** (0.007)	0.736*** (0.007)		0.120*** (0.004)	0.108*** (0.004)
Constant	2.685*** (0.004)	0.496*** (0.023)		0.781*** (0.002)	0.389*** (0.013)	
R <sup>2</sup>	0.014	0.12	0.171	0.006	0.02	0.031
N	79,438	79,225	79,225	77,385	77,226	77,226

Covariates	Panel C: Completion			Panel D: On-Time Completion		
	Model 1C	Model 2C	Model 3C	Model 1D	Model 2D	Model 3D
	N	N	Y	N	N	Y
Readiness	0.087*** (0.003)	0.044*** (0.003)	0.014*** (0.003)	0.127*** (0.004)	0.096*** (0.004)	0.090*** (0.004)
High school GPA		0.282*** (0.004)	0.239*** (0.004)		0.154*** (0.005)	0.152*** (0.005)
Constant	0.781*** (0.002)	0.429*** (0.014)		0.239*** (0.003)	0.272*** (0.018)	
R <sup>2</sup>	0.008	0.065	0.100	0.019	0.038	0.106
N	84,313	84,080	84,080	46,836	46,720	46,720

Note. Estimates are from linear probability models for completion, on-time, and persistence, and OLS for GPA in Year 1. Standard errors are in parentheses. Covariates include race, gender, income, cohort fixed effects, campus fixed effects, and major fixed effects.  
\**p* < .05. \*\**p* < .01. \*\*\**p* < .001.

a dichotomous variable mostly measured through standardized test results); and importantly, it is a construct that may be difficult to identify clearly in students. High school GPA could offer more or different information about a students’ college readiness. Importantly, high school GPA likely represents a combination of both academic characteristics and other skills such as motivation and effort that also help determine both college readiness and college success. Nevertheless, it is important to note that CSU’s college readiness measure remains a significant predictor of all four outcomes, even when considering high school GPA.

In addition to attenuating the relationship between college readiness and these outcomes, high school GPA was significantly associated with each outcome, even when accounting for a student’s college readiness level. This may suggest that despite the potential problems with high school GPA (variations in academic rigor between

schools, grade inflation, and nonacademic course impacts), the GPA represents something consistently important about a student's college readiness, or at the very least provides some information about their likelihood of success in college, and could be included in the calculation of college readiness.

Finally, in an attempt to compare similar students beyond academic measures, we included controls for demographic measures such as race/ethnicity, gender, and income, and include campus fixed effects and major area fixed effects in Models 3 for each outcome. Even controlling for each of these factors, students who were deemed college ready still have better outcomes. The inclusion of the demographic information has little impact on the relationship between readiness and persistence, as well as readiness and on-time graduation, when considering high school GPA. There was a moderate impact on the readiness coefficient from Model 2A to Model 3A in readiness (from 0.96 to 0.133). The most substantial change due to the inclusion of demographic and campus information occurs in completion, where there was a 50% reduction in the relationship between readiness and completion from Model 2C to Model 3C (from 4.4 percentage points to only 1.4 percentage points). For all four outcomes, the relationship between high school GPA and the outcomes, controlling for readiness, remained largely unchanged by the inclusion of demographic characteristics of students, campus fixed effects, and major fixed effects.

## **Discussion and Conclusion**

There have been enormous advances in postsecondary expansion and college access over the past half-century, yet rates of 4-year college degree completion have not kept up with the increasing rates of college participation. Today, more than ever, a college degree is critical for ensuring the economic prosperity of individuals and for society at large (Baum et al., 2010). Despite the many additional benefits associated with college completion, including higher lifetime earnings, better health, improved job security, and stronger families and communities, too few college students complete their postsecondary schooling. Among the many determinants of college degree completion, arriving at college academically prepared to do college-level work is among the most predictive factors of collegiate success (Bettinger, Boatman, & Long, 2013; Kurlaender & Howell, 2010).

Our analysis focused on one large public postsecondary system with high rates of college remediation and asked the following: How well do college readiness indicators predict longer term college success, specifically degree completion, and how much variation is there across campuses and across majors? Our results, first, corroborate with existing studies that demonstrate that students identified as needing remediation upon entry fare worse on a host of outcomes. We extend this body of literature and demonstrate important differences in this fundamental association across different CSU campuses and, importantly, across majors. Although much has been written about self-selection into institutional types (specifically college selectivity), self-selection into majors and fields of study remains largely unexplored. Moreover, although this article only brushes the surface on campus differences, there

is a great need to further delve into the institutional factors that may facilitate degree completion for all students. Finally, we also provide important evidence of the influence of high school GPA in predicting college success—above and beyond college screeners for remediation need. There are important discussions in the literature (see, e.g., Scott-Clayton, 2012) around the weak predictive power of college placement tests for purposes of remedial placement, as well as policy discussions around the need for multiple measures in course placement decisions, particularly at broad access institutions.<sup>7</sup>

Common Core State Standards and other state-specific reform efforts are highly focused on making a tighter connection between what happens at the secondary level and what is likely to be necessary for success at the postsecondary level. Long before the Common Core State Standards, some states had initiated efforts for greater alignment. For example, California implemented the Early Assessment Program in 2004, a program intended to provide students with a signal about their college readiness in 11th grade, provide teachers with professional development about improving college readiness, and help students find ways to utilize their 12th grade year to better prepare for college (Howell, Kurlaender, & Grodsky, 2010; Policy Analysis for California Education, 2012). Outside of California, for example, Michigan in 2006 adopted the Michigan Merit Curriculum, a more rigorous set of high school graduation requirements with the intended goal of better preparing students for college.<sup>8</sup> And Oregon's PASS (Proficiency-based Admission Standards System), which aims to offer a multi-dimensional picture of college readiness, including state assessments from high school, teacher evaluations of student coursework, and "work examples," in addition to the traditional criteria requested by college applications, such as SAT, AP, and so forth (Conley, 2010).

The fact that college readiness is an important indicator of college success is not new. In this article, we demonstrate, first, how well indicators of college readiness predict college outcomes at the nation's largest public 4-year postsecondary system, and how this varies across campuses that enroll students of different academic and demographic backgrounds. We also highlight how college readiness may influence major selection within college campuses. Finally, we find important evidence that colleges can improve their measures of college readiness by incorporating high school GPA, thereby potentially mitigating the overplacement of students in remedial courses. Our results highlight the need to ensure that researchers and policymakers must account not only for the rich set of information available from students' secondary school histories, but also to consider the multiple ways in which inter- and intra-institutional variation (largely a function of student selection) may influence the college readiness–college success calculation.

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## Declaration of Conflicting Interests

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## Notes

1. Sections of this are adapted from a larger review drafted for The College Board Advocacy & Policy Center. Available at <http://advocacy.collegeboard.org/sites/default/files/affinity-network-academic-preparation-college.pdf>
2. As cited in Adelman (2006), "[a] Carnegie unit is the basic credit system for U.S. secondary schools. It is generally recognized as representing a full year (36–40 weeks) in a specific class meeting four or five times per week for 40–50 minutes per class session" (p. xvii).
3. Enrolling in a rigorous course of study in high school is associated not only with higher educational attainment but also with improved labor market outcomes. Several studies find that enrolling in more advanced mathematics courses in high school leads to higher wages once in the workforce (Altonji, 1992; Levine & Zimmerman, 1995; Rose & Betts, 2004).
4. The ERWC program, which includes both a professional development component and full curricula for high school English courses, is currently being evaluated under an IES Investing in Innovation (i3) grant.
5. This calculation is based on a published CSU enrollment of 450,000 students (<http://www.calstate.edu/>) and enrollment of 7.2 million student in public 4-year colleges nationwide in 2007 (<http://nces.ed.gov/pubs2009/2009155.pdf>).
6. For additional information about the EAP and its impact on college readiness, see <http://www.edpolicyinca.org/publications/california%E2%80%99s-early-assessment-program-its-effectiveness-and-obstacles-successful>
7. See, for example, the Long Beach College Promise (<http://lbcc.edu/promisepathways/>).
8. The impact of this reform is currently being investigated by a team of researchers at the Michigan Consortium for Educational Research (<http://michiganconsortium.org/research/>).

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