The Decay Function of the Predictive Validity of High School GPA

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Introduction

There is mounting support—trending toward overwhelming—showing that high school grade point average (GPA) is a much stronger predictor of student performance in collegiate math and English courses than are standard placement exam scores.[1] Questions remain, however, about how to best use high school GPA for placement. For example, for how long is high school GPA a valid predictor of student capacity and achievement at the postsecondary level? In other words, is there an expiration date on high school GPA?

Essentially, this question is about how predictive validity—or the extent to which high school GPA predicts grades in community college coursework—is affected by the passage of time. The Multiple Measures Assessment Project (MMAP) team,[2] a partnership between the Research and Planning Group for California Community Colleges (RP Group) and Educational Results Partnership (ERP) with the support of the California Community Colleges Chancellor's Office (CCCCO), examined the question of high school GPA's shelf life. In this research brief, we use a dataset of students who had enrolled in English and/or math at a California Community College (CCC) for whom high school GPA data were available. For a subset of the students, placement test data were also available. The overall predictive validity of those placement scores is used as a point of comparison to aid in assessing the relative strength of the predictive validity of high school GPA from 1 to 10 years after high school. Predictive validity is a type of criterion validity that can be used to evaluate a metric or variable by assessing its ability to predict another metric or variable, demonstrating a correlational or possibly causal relationship. It is commonly used to evaluate admissions instruments. **In this case, we are using it to evaluate the ability of high school GPA to predict grades in community college English and math classes.**

[1] Cf. http://bit.ly/Improving-Placement-2019, https://bit.ly/Predicting-Success-2012, http://bit.ly/GPA-Beats-Tests-2017, http://bit.ly/COMPASSValidation

[2] http://bit.ly/MMAP-2020

Dataset

The sample of transfer-level English students includes all California Community College (CCC) students with high school records in Cal-PASS Plus, California's statewide data clearinghouse, whose first college English course was at transfer-level between the 2000-2001 and 2014-2015 academic years (N = 322,827).[3] Of these, 55,700 records also included English placement test scores. The math sample was constructed similarly, with 207,332 community college students with connected high school records whose first math class was at transfer-level, 19,541 of whom also had placement test scores.[4]

Methods

Students were grouped into categories according to the number of years since their senior year in high school. For example, all students who enrolled in community college within one year of their senior year were coded as Year 1, the earliest possible year of postsecondary college enrollment (e.g., graduated high school in spring 2011 and enrolled at the community college in the 2011-2012 academic year). In a similar vein, students who graduated high school in spring 2011 but did not enroll in college until the 2012-2013 academic year, for example, were coded as Year 2, and so on.

Predictive validity was tracked for 10 years. There were few students in the dataset for whom high school data were 10 or more years old. All students with 10 or more years of delay were combined into a "Year 10+" category to better estimate the predictive validity for these relatively rare students. The overall predictive validity of the placement test scores in English and math was calculated as well and is shown as a dashed line in Figure 1 and Figure 2 for reference.

Results

The findings for English and math are shown in Figures 1 and 2, respectively. In general, the correlation between high school GPA and college grades was stronger for students with less delay between their high school exit and their community college course-taking. In other words, the correlation between high school GPA and college grades was greater for students coded as Year 1, 2, or 3. Predictive validity does decline over time, with the drop-off being steepest in the first three years. As shown in Tables 1 and 3, the number of cases available for analysis also decreases each year, making the results less reliable for the groups with the greatest delays in

[3] This sample is drawn from the same data set that was used by the Multiple Measures Assessment Project (MMAP) research team to develop statewide decision rules for multiple measures placement of incoming California Community College students.

[4] ACCUPLACER provided the math and English placement test scores.

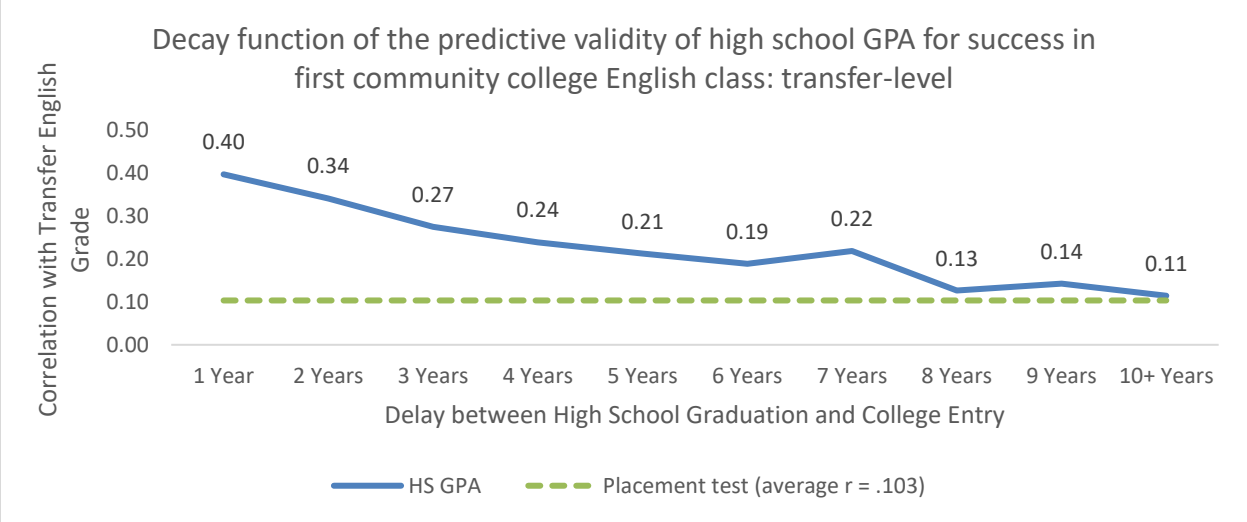
enrollment.

English Results

As shown in Table 2, there are significant differences between the predictive validity of high school GPA and the predictive validity of the placement test for years 1 through 7. Although not all of these differences were significant, where there are significant differences, they show that high school GPA is a significantly stronger predictor of grades in community college English than the placement test scores.

The predictive validity of high school GPA for transfer-level English grade shows a steady decline over time. While the correlation between high school GPA and college grade is always higher than the average correlation between ACCUPLACER scores and grade in transfer-level English, after an 8-year delay between high school and college, the difference is no longer statistically significant. This pattern is well-described by a logarithmic function ($y = -0.122\ln(x) + 0.4091$). The observed pattern of the predictive utility of high school GPA declining relatively sharply in the first 3 years and then gradually leveling out fits the aforementioned logarithmic function closely; the R^2 value of 0.95 (versus a maximum possible value of 1.00). Due to rapidly dropping sample sizes across years since high school, it is not clear if the predictive validity will reach a plateau or continues to decline. However, for all observed years—certainly up to year 7 and possibly beyond—the predictive validity of high school GPA is higher than the predictive validity of the placement test in regard to predicting grade[5] in transfer-level English.

Figure 1. Correlation of High School GPA with Grade in First Community College English Class: Transfer-Level



[5] Grades are converted to numeric values as follows A = 4; B = 3; C = 2; D = 1; F = 0; Withdrawal = 0. Note that California Community Colleges do not assign "+" or "-" grades.

Table 1. Correlation between High School GPA and Grade in Transfer-Level English Class by Years of Delay with Sample Size by Year

	1 Year	2 Years	3 Years	4 Years	5 Years	6 Years	7 Years	8 Years	9 Years	10+ Years
Correlation	0.40*	0.34*	0.27*	0.24*	0.21*	0.19*	0.22*	0.13	0.14	0.11
High school GPA sample size	204,149	65,405	26,204	12,233	6,841	4,037	2,109	1,077	517	255

* Difference between the predictive validity of high school GPA and the predictive validity of placement test scores is statistically significant at $p < .05$.

Table 2. Z-Score and Significance Test of the Difference Between the Predictive Validity of High School GPA vs. Placement Test Scores Using the Fisher-Z transformation: Transfer-Level English

	1 Year	2 Years	3 Years	4 Years	5 Years	6 Years	7 Years	8 Years	9 Years	10+ Years
Z Score	81.991	36.688	16.410	8.816	5.420	2.992	3.395	0.611	0.781	0.119
Significance	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.270	0.217	0.453

Math Results

Likewise, the predictive validity of high school GPA for transfer-level math shows a steady decline. With transfer-level math, it is over the first 5 years, from a correlation of 0.43 to 0.22 (see Figure 2). Among those students taking their first math class in community college 5 years after exiting high school, the difference between the predictive validity of high school GPA for transfer-level math grade and the predictive validity of ACCUPLACER test scores is only distinguishable at the thousandths place value (0.223 vs. 0.217, respectively). Although GPA maintains a slight edge, the difference at year five is not statistically significant.

Year five is something of an anomaly, however, as the predictive validity of high school GPA recovers in year six and thereafter appears to plateau or even increase slightly. The power to detect significant differences declines sharply after year six due to decreasing sample sizes. While the trend is maintained, the difference between the predictive validity of high school GPA and ACCUPLACER scores is not significant for years 7 and up. As with English, at no point is the correlation between high school GPA and grade in transfer-level math significantly lower than the average correlation between ACCUPLACER scores and grade. The overall pattern for math is well-described by a polynomial function ($y = 0.0096x2 - 0.1057x + 0.5349$) with an R^2 value of 0.951. Due to rapidly dropping sample sizes across years since high school, it is not clear if the predictive validity of high school GPA attains a plateau, increases, or perhaps exhibits some other pattern after year 6.

Figure 2. Correlation of High School GPA with Grade in First Community College math Class: Transfer-Level

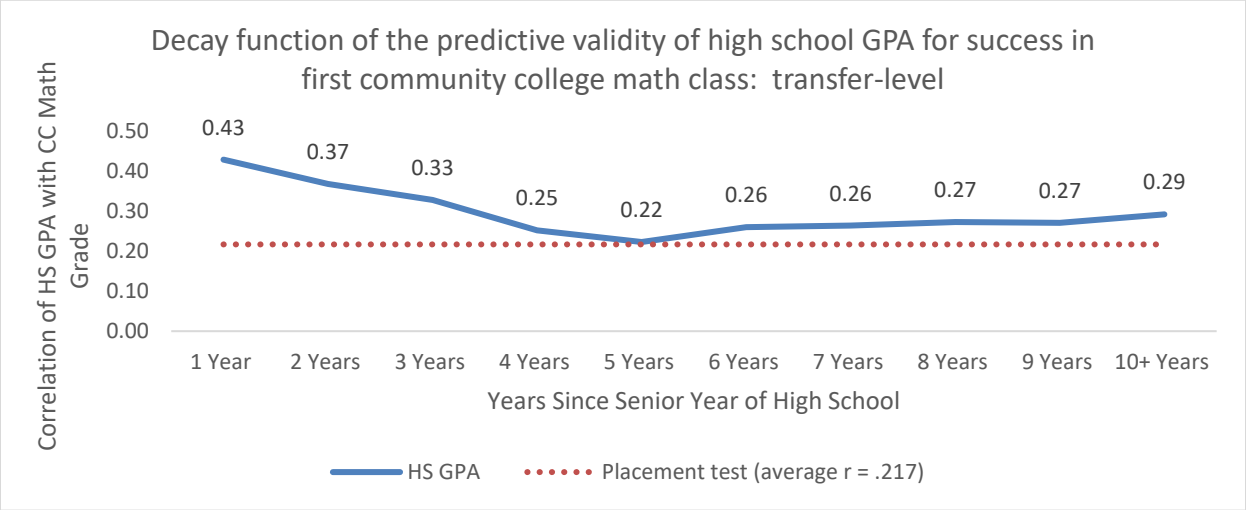


Table 3. Sample Size by Year for High School GPA and Placement Test Correlations with Transfer-Level Math

	1 Year	2 Years	3 Years	4 Years	5 Years	6 Years	7 Years	8 Years	9 Years	10+ Years
Correlation	0.43*	0.37*	0.33*	0.25*	0.22	0.26*	0.26	0.27	0.27	0.29
HS GPA sample size	19,535	107,762	44,982	19,236	8,074	4,376	2,309	1,138	472	348

* Difference between the predictive validity of high school GPA and the predictive validity of placement test scores is statistically significant at $p < .05$.

Table 4. Z-Score and Significance Test of the Difference Between the Predictive Validity of High School GPA vs. Placement Test Scores Using the Fisher-Z transformation: Transfer-Level Math

	1 Year	2 Years	3 Years	4 Years	5 Years	6 Years	7 Years	8 Years	9 Years	10+ Years
Z Score	22.355	31.389	14.684	2.936	0.328	1.708	1.318	1.288	0.706	0.973
Significance	0.000	0.000	0.000	0.002	0.372	0.044	0.094	0.099	0.240	0.165

Conclusion

As shown in prior research (Bahr et al., 2019; Ngo & Kwon, 2015; Scott-Clayton, et al., 2014), the predictive validity of high school GPA compares favorably to the overall predictive validity of English and math placement test scores. Certainly, there is a decay in the predictive validity of high school GPA over time; the strongest predictive validity occurs in the years immediately after high school. However, this paper shows that even as students get older and further away in time from their high school studies, high school GPA remains either a stronger predictor than placement test scores or at least a predictor of equivalent strength.

The predictive validity of high school GPA appears to eventually reach a relatively consistent plateau that is at least nominally higher than the average predictive validity of ACCUPLACER test scores. These findings are congruent with previously published research by Westrick and Allan (2015) that demonstrates that American College Testing (ACT), showing that while high school GPA is a far better predictor for students of traditional college age, for the array of nontraditional students,[6] GPA remained at least as predictive of student performance as ACT's now defunct COMPASS Placement Tests in English and math (Westrick & Allen, 2015).

It is perhaps helpful to think of the dataset used in this analysis as providing something like a time telescope—its powerful, data-driven lens can pierce the fog of time and let us see across many years of student experience and history. When we turn our telescope to transfer-level math, we find that the predictive validity of math drops steadily from its peak of 0.43 to its nadir of 0.22, apparently the same level of predictive validity as the average for the placement test scores. Fortunately, we have the extra resolution to zoom in and see that the predictive validity of high school GPA is 0.223, while the placement test score average is 0.217. While not a large difference, it nonetheless supports a clear conclusion that GPA is a stronger predictor of course success than the placement test.

Research Limitations

While observed patterns are suggestive of the long-term validity of high school GPA, the current dataset contained relatively small numbers of students who enrolled in transfer-level math and English 10 or more years after high school. Combining all transfer-level math courses to increase power for distant years has the side effect of reducing our ability to understand how patterns might differ for specific courses. A similar argument can be made regarding how the decay function of the predictive validity of high school GPA might vary across different subgroups of students. Without more data on students with a large number of years of delay, disaggregation of results by subgroups of interest cannot provide reliable results.

[6] Westrick & Allen (2015) defined nontraditional students as those who were 20 years of age or older when initially matriculating.

The current research paper also only reflects scores from one placement test vendor, as we did not have access to other placement tests. Additional placement test scores would provide a different comparison and perhaps show different results.

Further Research

The limitations of this study suggest the following two directions for further research: 1) build a bigger data telescope (i.e., collect more data) in order to see "further out in time;" and 2) replicate and extend the patterns observed in this paper (i.e., a linear decay for English and polynomial decay function for math).

To build a bigger data telescope we must understand the representation of students with 10 years or more of delay in the dataset, we must examine the availability of student unit record high school data that can be matched to community college enrollment data from 10 or more years ago. However, there is a lag between increasing participation in the Cal-PASS Plus data-sharing system and the availability of student cases with many years of delay between high school exit and community college enrollment. Participation in Cal-PASS Plus and the consequent volume of data collected has improved over the past 10 years. Continuing to improve data collection over time would result in a greater proportion of students with longer delays being available for analysis in future years. Collecting more data would allow for a greater resolution and confidence in the analysis of students with very long delays between high school enrollment and first math or English enrollment at the community college.

It is also important to replicate these findings to better understand if the observed patterns of predictive validity decay which conform closely to known mathematical functions are universal or particular. In other words, are these decay functions consistent across other contexts, systems, and time frames? While it is possible that these decay function patterns are universal, it will take further research in other contexts and datasets to test that hypothesis.

References

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