

**Using High-Quality Data to Evaluate High
School Antecedents of On-time College Graduation:
A School/University Collaborative Study**

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Using High-Quality Data to Evaluate Local High School Antecedents of On-time College Graduation: A School/University Collaborative Study

In the face of international comparisons showing the lower level of academic skills of students in the United States, high schools have been criticized for not adequately preparing their graduates for the academic demands of college life. This is occurring at a time when the impact of global competition has heightened the importance of maintaining an educated workforce capable of sustaining the economy. Academic remediation at the college level is expensive, and its effectiveness is open to question. The ability to evaluate the antecedents of on-time college graduation using high-quality data offers school divisions the opportunity to initiate conversations about how to enhance the skills of their graduates. A service which tracks students who enter any one of a large number of colleges after high school, and follows them through to graduation provides a much more comprehensive picture than was previously available to high school divisions of how the ever-increasing numbers of their graduates fare at college. This paper discusses the analysis of such data from two school division members of a school/university collaborative research organization.

Arguing that the U.S. is essentially living off past investments in education, Augustine (2007) asserted that “today, 50 million American jobs—almost one third of the total workforce—are at risk of being exported because we are competing with highly motivated, highly qualified individuals from around the world” (p. 28). Some industries

in the U.S. have suffered more than others from the impact of globalization, and a recent report from the Committee on Science, Engineering, and Public Policy (CSEPP, 2007) warned against complacency. The Committee invoked the image of a gathering storm to highlight the ominous scenario that “thanks to globalization, [and] driven by modern communications and other advances, workers in virtually every sector must now face competitors who live just a mouse click away in Ireland, Finland, China, India, or dozens of other nations whose economies are growing” (p. 1).

Others have also invoked the storm image in this context. For example, for the title of their paper, Kirsch, Braun, Yamamoto, and Sum (2007) borrowed the phrase “perfect storm” from Junger’s (1997) account of the perilous confluence of three meteorological events off the coast of Nova Scotia in October, 1991 that resulted in the capsizing of the fishing boat *Andrea Gail*. Kirsh et al. raised the specter of brooding inevitability for the capsizing of America’s economy as a result of the confluence of three educational factors: divergent skill distributions among U.S. population groups, changes in the economy, and the demographic trend toward a more diverse population.

Christensen, Horn, & Johnson (2008) suggested that as the “bite” of international commercial competition began to be felt in the 1980s, America turned to its schools for answers, “just as it had in the late 1950s” (p. 58). Christensen et al. suggested that it was in the process of trying to redress situations such as the divergent skill distributions (alluded to by Kirsch et al., 2007), that it became obvious that “in comparison to [students in] other countries, U.S. students were not performing as well as measured by certain standardized tests” (p. 58). According to Darling-Hammond (2007), about 70 percent of jobs in the U.S. currently “require specialized skill and training beyond high school, up

from only 5 percent at the turn of the 20th century” (p. 318). Hence, at a time when the demand for education to extend beyond the high school years has increased dramatically, it is worrisome that Barton (2005) estimated that 69 percent of high school students in 2000 graduated with a standard diploma—a decrease of 8 percent over the rate in 1969.

Having turned to its schools for answers, recent figures indicate that America is not pleased with the response of its public schools. For example, Howell, West and Peterson (2008) found “decidedly mixed assessments” (Satisfaction with public schools, ¶1), with 20 percent of respondents overall awarding grades of A or B, 50 percent awarding a C, and 25 percent awarding a D or F. The proportion of African American respondents awarding a D or F rose from 20 percent in 2007 to 31 percent in 2008, and the proportion of Hispanic respondents awarding the same poor grades doubled from 16 to 32 percent from 2007 to 2008.

The Educational Plans of High School Graduates

College Attendance is the Aim

Culling data from four national surveys, one each from 1972, 1980, 1992, and 2004, Ingels, Dalton, and LoGerfo (2008) developed an overview of how high school graduates’ plans “for next year” have changed in some respects (and remained the same in other respects) over the past three decades. Since 1972, a majority of seniors have planned to attend college in the following year, with the proportion rising from 59 percent in 1972 to 78 percent in 1992—where it remained through 2004.

Simultaneously, according to Ingels et al. (2008), the proportion of seniors intending to work full time was above 30 percent in the 1972 and 1980 surveys (32 percent and 35 percent respectively), but dropped to less than 20 percent in the 1992 and

2004 surveys (14 percent and 19 percent respectively). One implication from these figures is that high school seniors have an appreciation of the need for them to gain the specialized skill and training beyond high school graduation to which Darling-Hammond (2007) referred.

In terms of the type of college high school seniors hoped to attend, Ingels et al. (2008) found that, in 1972, 34 percent indicated that they planned to attend a 4-year college. This rose to 54 percent in 1992, and reached 61 percent by 2004. The intention to attend 2-year colleges also increased from a low of 9 percent in 1980, to reach 18 percent in 2004. The percentage of high school seniors intending to attend 2-year vocational, trade, or technical schools declined from 17 percent in 1972 to 5 percent in 2004.

College Graduation and Higher Pay

Income figures lend considerable support to the apparent trend evidenced in Ingels et al. (2008) towards high school graduates' preference for bachelor's degrees as opposed to finding work after high school graduation. For example, "the earnings of those with a high school diploma decreased by \$5,600 between 1980 and 2005, while the earnings of those with a bachelor's or higher degree increased by \$2,300" (U.S. Department of Education, National Center for Education Statistics, 2007, Response ¶2). In 2005, males and females with bachelor's degrees or higher earned \$48,400 and \$39,500 respectively, compared to their peers with high school diplomas or GED qualifications who earned just \$29,600 and \$23,500 respectively (all in 2004 dollars).

The High School Predicament

The "increasing commitment of states and school districts to ensure that all students graduate from high school with college-ready skills" (ACT, 2008, Test-taking

pool will expand further next year, ¶3), and the steady increase in the percentage of high school seniors expecting to attend college have occurred at a time when there has been a corresponding increase in the total elementary and secondary school enrolment (since fall 1985). In just the upper grades, enrolment rose from 11.3 million in 1990 to 14.9 million in 2005, with projections suggesting 15.0 million in 2007. Further projections suggest a total of 2 percent increase over the 2007 high figure by the year 2016 (U.S. Department of Education, National Center for Education Statistics, 2008, Response ¶1, 2). Thus, high schools are being expected to produce better prepared graduates at a time when high schools are dealing with ever higher enrollments.

The increasing expectation among high school seniors of attending either 4-year or 2-year institutions (Ingels et al. 2008), combines with the generally increasing size of the senior class to form two of the factors of the potential perfect storm scenario for high schools as they attempt to adequately prepare their college-focused graduates. Adding to this dual confluence, Kirsch et al. (2007) asserted that the National Assessment of Educational Progress (NAEP) long-term trend indicated flat or only slightly increasing achievement scores in reading and mathematics between 1984 and 2004 (accompanied by essentially unchanged achievement gaps). This flat achievement outcome joins the scenario as the third factor of a potential “perfect storm” engulfing high schools. To further reinforce the concern regarding flat achievement outcomes, ACT (2008) reported unchanged outcomes from 2007 among the record 1.4 million test-takers in 2008, with 43 percent meeting or surpassing ACT’s college readiness benchmarks in math, 53 percent in reading, 28 percent in science, and a small percentage decrease to 68 percent in English.

Predictors of College Graduation

High schools are ready targets for criticism of what is seen as the poor level of preparedness for college study of many freshmen (e.g. Wise, 2008). If students do not have the required skills, colleges often provide remedial or developmental courses. Attewell, Lavin, Domina, and Levey (2006) suggested that 40 percent of “traditional undergraduates take at least one such course” (p. 886). However, these are expensive, and the evidence of their effectiveness is not strong (Attewell et al., 2006; Calcagno & Long, 2008; Grubb, 2001; Merisotis & Phipps, 2000).

Among the demographic variables that are relevant to this study and that have been implicated in success in college are gender and socioeconomic status (SES). Jansen (2004), Smith and Naylor (2001), and Richardson and Woodley (2003) found that gender plays a part in predicting graduation from college, with women being more successful than men, attaining higher grades, finishing their study faster, and showing less retention than men. The evidence in relation to SES is more nuanced, with Pustjens, Van de Gaer, and Van Damme (2004), Robbins et al. (2004), Smith and Naylor (2001), Smith and Naylor (2005) finding that the higher SES students had better academic performance, and Van den Berg and Hoffman (2005) finding no significant SES effect on academic performance.

Lastly, some reports have focused on the relationship between a wide range of high school “investment factors” (Walpole, 2008) and graduation from college (see Appendix A). These “investment factors” include involvement with activities like service clubs and athletics, as well as intellectual pursuits signified by taking Advanced

Placement or dual enrolment classes. Only some of these student data are customarily recorded in school division data warehouses.

At the outcome end, there is ample documentation of the potential for improving the rate of college graduation. For example, Knapp, Kelly-Reid, Ginder, and Miller (2008) reported college graduation rates 6 years after enrollment for the cohort year 2000 students at 4-year institutions at an overall 57.5 percent, ranging from a high of 64.5 percent for private, not-for-profit institutions to a low of 32.6 percent for private for-profit institutions, with public institutions at an intermediate 54.8 percent. (“Graduation” was understood as completion within 150 percent of normal program time—up to 6 years after enrolment for 4-year institutions.) For the 2003 cohort at 2-year institutions, the overall graduation rate 3 years after enrollment was 32.3 percent overall, ranging from a high of 58.9 percent for private for-profit institutions, to a low of 23.2 percent for public institutions, and with the private not-for-profit institutions recording an intermediate 55.1 percent graduation rate.

Purpose of Study

This study arose in the context of a long-running research collaborative of school divisions sponsored by a large university in central Virginia. The members of this collaborative endorsed a study to investigate the adequacy of the preparation of the collaborative member divisions’ high school graduates for their subsequent college experience—whether they enrolled at a four-year or a two-year college. The recent availability of a service known as *StudentTracker* (National Student Clearinghouse, 2008) provided an opportunity to use higher quality data than that provided by surveys of graduates (for example) to open up useful discussions with teachers and school

administrators around how schools can potentially modulate what they do to better facilitate “adequate preparation.”¹ Subsequent Task Force meetings of the school/university collaborative with representatives from the member school divisions operationalized the indicator of “adequate preparation” to mean “graduating in four years from a four-year college or in two years from a two-year college.” This criterion is what is referred to as “on-time graduation” in the context of this paper.

Sample Selection

This study was focused on the most recent high school cohort for whom 4-yr college graduation was available: the cohort that graduated from high school in May, 2003. Under the definition of on-time graduation adopted for this study, these students would have graduated by May, 2005 if they went to a 2-year college, or by May, 2007 if they went to a 4-yr college. Participating school divisions were asked to include every high school graduate for the year ending May, 2003 in their data.

Study Variables

The members of the collaborative were well aware that many variables beyond the control of schools enter into determining whether a college student graduates on-time (for example, Eggens, van der Werf, & Bosker, 2008; Miller & Herreid, 2008). At the same time, collaborative members were keen to discuss how they could enhance their high school graduates’ preparation for college-level work.

A number of meetings with the data professionals in the two school divisions that participated in this study looked at the availability of warehoused electronic data that had been implicated in previous studies of students’ college graduation. Pertinent variables from the respective warehouses were merged with the data on college

attendance/graduation obtained from *StudentTracker*. The variables included for each student from the school division warehouses were: gender, race, limited English proficiency status, special education status, school attended, diploma type, final GPA, class size, class rank, highest verbal and mathematics scores on SAT, number of days student was in the division, number of days absent, and whether an AP class/exam was taken. From *StudentTracker*, the variables were whether a 2-yr or 4-yr college was attended by each student, whether that college was public or private, and the year of graduation from that college.

Methodology

The two school division members of the collaborative who engaged the services of *StudentTracker* (one division was already a subscriber, and the other decided to become a subscriber as an outcome of the discussions around this study) submitted individual student identifiers to the service, and, in return, were provided with information on those students' college-attendance/graduation status. The two participating school divisions' data specialists merged these data with the data from the school divisions' warehouses. All resulting data records were de-identifying prior to being submitted for analysis. The two participating school divisions are quite different in terms of both size and student composition, as shown in Appendix B.

Analysis

Logistic regression is well-suited to the aim of this study (Agresti & Finlay, 2007; Peng, Kuk, & Ingersoll, 2002; Peng, Tak-Shing, Stage, & St. John, 2002; Wright, 1998): the outcome variable is binary (graduated on-time or did not graduate on-time), and the size of the data sets easily meets the criterion that there should be 50 observations per

indicator variable (Wright, 1998). Further, the usual interpretations of the logistic regression model in terms of odds ratios are likely to spark discussions concerning how the school divisions can enhance the odds that their high-school graduates will graduate from college on-time.

Conceptually, the logistic regression model, as applied to this study, assumes there is a propensity, O , towards graduating on-time, and that it is an unobserved, continuous variable, related to a set of independent variable predictors by a linear relationship such that the estimated outcome variable for the true O is $\hat{o} = b_0 + b_1x_{i1} + b_2x_{i2} + \dots + b_px_{ip}$, where b_j is the j^{th} regression coefficient, x_{ij} is the j^{th} predictor for the i^{th} student, and p is the number of predictors (Peng, Tak-Shing et al., 2002). Given this situation, then $\pi_i = \frac{e^{-(b_0+b_1x_{i1}+b_2x_{i2}+\dots+b_px_{ip})}}{1+e^{-(b_0+b_1x_{i1}+b_2x_{i2}+\dots+b_px_{ip})}}$ gives a value for π_i (the probability that the i^{th} student will graduate on-time) (Agresti & Finlay, 2007). The regression coefficients were estimated through SPSS (2007, Release 15.0.1.1, Windows version) through an iterative maximum likelihood method employing a forward stepwise selection algorithm incorporating both an entry test and a removal test for each variable at each step.

Each school division's data were processed separately, using a random 70 percent of the cases to develop a logistic regression model. The model was cross-validated against the remaining 30 percent of the cases in that division—a procedure designed to give a sense of the generalizability of the model within that division (Wright, 1998). The models were developed for the “regular classroom” students (students not classified as either special education or limited English proficiency), who were from comparably sized high schools within each division (some considerably smaller high schools in the data were special purpose high schools). Also, separate models were developed for students

who went to 2-yr and 4-yr colleges. These demarcations within the overall data set were imposed to ensure logically consistent subsets of the data. For example, it is well-known that the graduation rates from 2-yr and 4-yr colleges are different (e.g., Knapp et al., 2008), so the same variable may play out differently depending on the type of college the high school graduate attends.

All of the following results are based on the data provided by *StudentTracker*, and hence represent students attending one of the cooperating institutions. While these data are arguably far more comprehensive than that available from other ways that high school commonly gain data from graduates (e.g., alumni surveys), *StudentTracker* does not cover every college in the U.S. Hence, the true figures for attendance and graduation would be expected to be somewhat higher than indicated.

Results

1. Impact of Gender, Race, High School Attended, and College Type

Research Hypothesis 1 was that the likelihood that a high school graduate from these two school divisions graduated on-time from either (a) a 2-yr or (b) a 4-yr college respectively was related to either the main effects of gender, race, the high school attended, and whether the student attended a public or private college, or their interactions. By grouping these predictors together into one logit per school division, “high school attended” is being envisaged as a proxy for the socioeconomic level of the school’s catchment area within the school division. Because the schools contributing to each separate logit are in the same school division, other variables with potential relevancy to academic achievement like systemic per-pupil expenditure and educational policy are constant.

1.1 School Division A

1.11 Graduation from 2-yr colleges. Of the 1193 data records in School Division A's file for the high school graduating class of 2003, 382 (32 percent) attended a 2-yr college. There was no indication of the first year of enrolment at the 2-yr college in these data. Of this 382, 182 (47.6 percent) transferred to a 4-yr college prior to graduating from a 2-yr college. Of the remaining 200 students, only 7 were positively identified as graduating in 2005. This is too small a number to support a logistic regression analysis. It is of interest to note that a further 7 students graduated in 2006 (followed by a further 6 students in 2007) for a total of 14 of the 200 students (7.0 percent) who remained focused on a 2-yr college who graduated within 3 years of their high school graduation. This figure is much lower than the 32.3 percent overall graduation figure three years after enrollment at a 2-yr college cited earlier in this paper from Knapp et al. (2008), but this 7 percent is exclusive of those 182 who transferred to 4-yr colleges—some of whom may have graduated from the 2-yr college in which they enrolled. Graduates of all three high schools in Division A were included in each of 2005, 2006, and 2007 college graduation cohorts from 2-yr colleges, with both African-American and White students represented in 2005 and 2006 (only White students in 2007), and both genders being represented in all three years.

1.12 Graduation from 4-yr colleges. A total of 671 (56.2 percent) of the 1193 students who graduated from high school in 2003 in Division A attended a 4-yr college—including the 182 transferees from 2-yr colleges mentioned above. For the purpose of preserving the concept that this study should focus on those who enrolled in further study directly from high school, the date of beginning at a 4-yr college for these students was

not helpful, as the transferees entered at a range of times. As noted above, the year of enrollment in a 2-yr college is not recorded in these data, but it was in the spirit of this study to include students who enrolled in a 2-yr college and then transferred into a 4-yr college, even though they did so at various times. The guiding expectation of this study that it should focus on students who enroll directly in further education after high school graduation was clearly preserved, as signaled by the fact that 86.3 percent of the 671 students were recorded as commencing study at a 4-yr college in 2003. Of these 671 students, 258 (38.45 percent) graduated on-time.

The logistic regression model (using a forward stepwise approach on 70% of the on-time graduates) that emerged from examining the main effects of impact of race, gender, high school attended, and whether the student attended a public or private college and the multi-way interactions of these variables reached statistical significance ($\chi^2 = 7.596$, $df = 2$, $P = .022$; see Table 1). This model incorporated the interaction of gender and high school attended, with the odds of females at one particular schools being almost twice as likely as males at this school to graduate on-time. The predicted logit of on-time graduation was $-0.699 + 0.620 * \text{Gender}(1) \text{ by School}(2)$

Table 1: Logistic Regression Analysis of the On-Time Graduation of 671 School Division A Students Who Enrolled in 4-yr Colleges, Based on Demographic Variables.

Predictor	B	SE _{β}	Wald	df	P	e ^{β}
Constant	-.699	.129	29.344	1	.000	.497
Gender(1) by School(2)	.620	.236	6.880	1	.009	1.859
Test			χ^2	df	P	
Overall model evaluation:			7.596	2	.022	
Goodness-of-fit test: Hosmer & Lemeshow			.000	1	1.000	

Given the single predictor of this classification model, it is not surprising that it failed to improve (in terms of percentage of cases correctly assigned) over the 61.8 percent figure that resulted from arbitrarily assigning all students in the randomly selected 70 percent of cases used to develop the model to the highest frequency group. This failure to improve over the default model was replicated in the remaining 30 percent of cases in the cross-validation sample.

According to Hosmer and Lemeshow (2000), “the classification table is most appropriate [for judging the goodness-of-fit] when classification is a stated goal of the analysis” (p. 160). Given that this study is focused on classification, this model did not fit the data well. Nevertheless, the finding that the interaction of gender and high school attended reached significance, whereas neither gender nor high school attended as main effects, nor race (nor their interactions) contributed to the model, is worthy of note.

1.2 School Division B

1.21 Graduation from 2-yr colleges. Of the 2633 data records in School Division B’s file for the high school graduating class of 2003, 915 attended a 2-yr college. Of these, 201 students enrolled in a 2-yr college in 2003, and had 2005 recorded as their last year of attendance. Unfortunately, this does not mean that these 201 students graduated in 2005. Of these 201, 94 went on to enroll in a 4-yr college, but this cannot be interpreted as an indication of on-time graduation either, since 57 of the 201 are recorded as having their first year of attendance at a 4-yr college as 2003, 4 have 2004, 25 have 2005, and 8 have 2006. In the absence of any way of determining definitively which students from School Division B graduated on-time from 2-yr colleges, the logistic regression analysis was omitted for School Division B.

1.22 Graduation from 4-yr colleges. A total of 1421 students graduated from high schools in School Division B and attended 4-yr colleges. Of these, 597 (42%) graduated by 2007, thus meeting the definition of on-time graduation adopted for this study. This number includes the students who transferred to 4-yr colleges from 2-yr colleges, as noted above.

A statistically significant logistic regression model emerged from the analysis, using a forward stepwise approach on a randomly selected 70% of on-time graduates ($\chi^2 = 145.71$, $df = 11$, $P = .000$; see Table 2). This model incorporated all four of the main effects covariates of school attended, race, gender, and type of college attended (in the order in which they entered the model), but none of the multi-way interaction terms, to correctly identify 65.6 percent of students who attended a 4-yr college, and 69.2 percent of those who did not graduate on-time. The predicted logit of on-time graduation was $-0.748 + 0.549 * \text{Gender}(1) + (-1.092) * \text{Race}(1) + (-1.428) \text{Race}(3) + 0.708 * \text{School}(1) + (-1.010) \text{School}(2) + 0.778 * \text{School}(3) + .395 * \text{College Type}$

These results were cross-validated on the remaining 30% of those who attended 4-yr colleges, and correctly classified 57.6 percent of cases overall, and 63.9 percent of those who did not graduate on-time. The classification obtained from the model was an improvement over the default classification of 55 percent for the test data and 55.8 for the validation data.

Table 2: Logistic Regression Analysis of the On-Time Graduation of 1421 School Division B Students Who Enrolled in 4-yr Colleges, Based on Demographic Variables.

Predictor	β	SE_{β}	Wald	<i>Df</i>	<i>P</i>	e^{β}
Constant	-.748	.215	12.054	1	.001	.473
Gender	.549	.141	15.205	1	.000	1.732
Race(1)	-1.092	.236	21.433	1	.000	.335
Race(3)	-1.429	.676	4.466	1	.035	.240
School(1)	.780	.232	11.339	1	.001	2.182
School(2)	-1.010	.492	4.219	1	.040	.364
School(3)	.778	.254	9.339	1	.002	2.176
College Type	.395	.177	4.981	1	.026	1.485
Test			χ^2	<i>Df</i>	<i>P</i>	
Overall model evaluation:			145.708	11	.000	
Goodness-of-fit test: Hosmer & Lemeshow			5.295	8	.726	

The right-hand column of Table 2 shows the odds-ratio for the various predictors for the students under consideration. The odds of graduating on-time were just over 1.7 times higher for females than for males. The odds of graduating on-time for African-American students were just over a third, and for Hispanic students a little under a quarter of the odds for White students. The odds of graduating on-time for students who came from high schools 1 and 3 were both a little over twice the odds of students at the comparison school. The odds of students graduating from high school 2 graduating college on-time were slightly more than one-third of the odds of students at the comparison school. The odds of graduating on-time for students who attended private colleges were a little less than one-and-a-half times the odds for students attending public colleges.

2. Academic Performance Variables

Research Hypothesis 2 was that the likelihood that a high school graduate from these two school divisions graduated on-time from either (a) a 2-yr or (b) a 4-yr college respectively was related to the student's GPA, Verbal/Math SAT scores, AP status,

school absence, diploma type and dual enrolment status, and the interaction among these variables. School absence was taken into account by generating a variable called absence ratio, which represented the number of days absent from school as a fraction of the days the students had been in the respective school divisions.

The major issue with the academic performance variables available for this study was the inherent redundancy among them. For example, class rank data were also available in the data set, but given the intentional link between class rank and GPA (and correlations exceeding 0.9), class rank was redundant for logistic regression purposes. Similarly, during the analysis, the AP and GPA interaction was reduced to GPA, and then the main effect of GPA was dropped from the analysis due to redundancy. The following findings are based on the non-redundant predictors in each of the Divisions.

2.1 School Division A

2.11 Graduation from 2-year colleges. As discussed above, the small number of actual graduates from 2-yr colleges in the data from Division A precludes the construction of a logistic regression model.

2.12 Graduation from 4-year colleges. A statistically significant logistic regression model emerged from the analysis, using a forward stepwise approach on a randomly selected 70% of on-time graduates ($\chi^2 = 115.369$, $df = 1$, $P = .000$; see Table 3). This model incorporated only the student's GPA. None of the main effects of school attendance, SAT Verbal and Math scores, Advanced Placement, and dual enrollment status contributed to the model. The model correctly classified 73.1 percent overall, and 81.6 percent of those who did not graduate on-time. The predicted logit of on-time graduation was

$$-7.552 + 2.044 * \text{GPA}$$

The model was validated on the 30 percent of students reserved for this purpose, correctly classifying 69.2 percent overall, and 79 percent of those who did not graduate on-time. From the classification perspective, the model was a considerable improvement over the 60.3 percent default correct for the test sample and 61 percent default for the validation sample.

Table 3: Logistic Regression Analysis of the On-Time Graduation of 1421 School Division E Students Who Enrolled in 4-yr Colleges, Based on Academic Variables.

Predictor	β	SE_{β}	Wald	df	P	e^{β}
Constant	-7.552	.817	85.506	1	.000	.001
GPA	2.044	.227	80.920	1	.000	7.722
Test			χ^2	df	P	
Overall model evaluation:			115.369	1	.000	
Goodness-of-fit test: Hosmer & Lemeshow			1.464	8	.813	

The right-hand column of Table 3 shows that for a unit increase in GPA, the odds of graduating on time increases by a factor of 7.7. This is strong endorsement of the GPA, which notionally refers to the students' academic prowess, as an indicator of on-time graduation from 4-yr colleges for students who graduate from high schools in Division A.

2.2 School Division B

2.2a Graduation from 2-year colleges. As mentioned above, difficulties associated with identifying on-time graduation among these data precluded analysis of the data relating to students who remained at 2-yr colleges.

2.2b Graduation from 4-year colleges. A statistically significant logistic regression model emerged from the analysis, using a forward stepwise approach on a randomly selected 70% of those who attended 4-yr colleges ($\chi^2 = 243.990$, $df = 2$, $P =$

.000; see Table 4). This model incorporated the students' GPA, and the interaction between GPA and SAT Verbal score, but none of the other main effect or interaction terms, to correctly classify 73.1 percent of students overall, and 78.8 percent of those who did not graduate on-time. The predicted logit of on-time graduation was

$$-4.894 + 0.815 * \text{GPA} + (0.001) * \text{GPA by SAT Verbal}$$

These results were cross-validated on the remainder of the complete data set who attended 4-yr colleges, and correctly classified 70.5 percent of cases overall, and 75.5 percent of those who did not graduate on-time. Again, from the classification perspective, the model was a considerable improvement over the 55 percent default correct for the test sample and 55.8 default for the validation sample.

Table 4: Logistic Regression Analysis of the On-Time Graduation of 1421 School Division B Students Who Enrolled in 4-yr Colleges, Based on Academic Variables.

Predictor	β	SE_{β}	Wald	<i>df</i>	<i>P</i>	e^{β}
Constant	-4.894	.510	92.152	1	.000	.007
GPA	.815	.271	9.044	1	.003	2.260
GPA by SAT Verbal	.001	.000	11.869	1	.001	1.001
Test			χ^2	<i>df</i>	<i>P</i>	
Overall model evaluation:			243.990	2	.000	
Goodness-of-fit test: Hosmer & Lemeshow			12.504	8	.130	

The right-hand column of Table 2 shows that for a unit increase in GPA, the odds of graduating on time more than doubles (2.260). This is consistent with the purpose of the GPA, which notionally refers to the students' academic prowess. The interaction between GPA and SAT Verbal has a small positive effect on the odds of graduating on-time.

Discussion

The motivation for this study emerged from a desire to use newly available data to more accurately discern the effectiveness of the preparedness of graduates from two school divisions in Virginia for both 2-yr and 4-yr college study. The findings from national outcome studies are no substitute for comprehensive studies of academic achievement at the local level—a truth which underlies the accountability provisions of the current *No Child Left Behind Act of 2001* (NCLB, 2002). In the face of many factors over which high schools have no control, there is a national expectation that the effectiveness of high schools will be reflected in their graduates' preparedness for the college experience.

A myriad of personal factors play critical roles in determining what actions individuals take in relation to study and career choices. Miller and Herreid (2008) captured this forcefully in declaring that “students make decisions about matriculation (to stay or depart) based upon...complex factors that have unique meaning to the individual...[that] are impossible to treat in the aggregate” (p. 11). While aggregation is an unavoidable part of statistical analysis, the proximity of these findings to the participant school divisions enhances their value beyond findings developed at either the national or state level. The two school divisions that contributed data for this study showed that they appreciate the importance of utilizing recently available data of enhanced quality to shed light on the effectiveness of the preparation of their high school graduates for college.

Two-year Colleges

As discussed above, there were aspects of these data that obstructed their use to investigate on-time graduation of students who attended 2-yr colleges. A more operational definition of what constitutes on-time graduation for these students, and tighter control over the fields included in the data set would result in a useful perspective on this important segment of high school graduates. For example, the data professional from one of the participating school divisions suggested that the numbers of students recorded in *StudentTracker* considerably underestimated the number of students who attend 2-yr colleges. This would suggest that a culling of the data set to remove from consideration those who attend 2-yr colleges but are not in the *StudentTracker* data would be warranted.

The quality of the data will hopefully improve as *StudentTracker* extends the reach of its cooperating colleges. Given the growing importance of 2-yr colleges—the National Commission on Community Colleges (2008) described them as the “Ellis Island of American higher education, the crossroads at which K-12 education meets colleges and universities, and the institutions that give many students the tools to navigate the modern world” (p. 5), and Marklein (2008) heralded an imminent “turning point” in the purview of community colleges—the task of preparing students to graduate on-time from 2-yr colleges deserves close attention at the school division level.

Four-year Colleges

Demographic variables. Considering the variables notionally designated as demographic in this study (gender, race, school attended, and type of college attended), the hint that females at one school in Division A may have enhanced odds of graduating on-time deserves follow-up. It may be that some factors inherent in the situation account

for this increase in odds, but, in the face of the lack of effect of other demographic variables, it would seem potentially valuable to investigate this further.

The situation is more complex in Division B. Here all of gender, race, school and type of college attended enter into a model. In this model, females have enhanced odds of graduating on-time over males, African-American and Hispanic students' odds of graduating on-time are less than the odds of White students, and students at two high schools have enhanced odds, while students at a third school have decreased odds of graduating on-time. Students from Division B who enroll in private colleges have enhanced odds of graduating on-time.

Fruitful discussion could be held by those involved in Division B to discuss the every-day correlates of these findings. For example, if it is true that the schools across the comparatively economically diverse Division B reflect the SES of their feeder zones, then perhaps a differential allocation of Division B resources across the Division could be considered. Only those intimately acquainted with the educational and political realities of Division B are qualified to discern the best way to move forward in relation to these findings, but Olson (2008) described a seemingly successful current approach in which one high-profile superintendent addressed a similar type of disparity across a district by giving economic priority to "red zone" schools.

Finally, in terms of demographic variables, Division A may be encouraged by the findings that race and school attended did not enter into the model to consider how action can be taken to preserve the comparative parity of outcomes (in terms of on-time graduation) as greater diversity becomes evident in that community.

Academic variables. In what is clearly a positive finding, data from both school divisions implicated GPA as an indicator of on-time college graduation. An increase in the GPA strongly improved the odds of on-time graduation of high school graduates at 4-yr colleges. Students who do well in school courses tend to graduate on-time (Eggens et al., 2008). In Division B, this was modulated by the interaction between GPA and the students' verbal score on the SAT, but this in no way lessens the educational malleability of the characteristics that lead to on-time graduation. The logistic regression models based on the academic variables in both divisions were a reassuring 10 or more percentage points better at the classification task than the default models.

The logistic regression model for Division A highlighted the role played by GPA in enhancing the odds of on-time graduation for its graduates—even beyond the corresponding role of GPA in Division B. The GPA is a global measure of academic prowess at the high school level. Conceptually, it does not set out to indicate the likelihood of graduating on-time from college, although in both these divisions it does so quite strongly. Nurturing and refining the processes associated with the generation of the GPA in these two divisions, as well as making students aware of the effectiveness of the GPA as an indicator of future success would seem to be appropriate responses to this finding.

An avenue of useful discussion for both school divisions as a result of this finding could embrace the role of some resource-intensive initiatives (for example, dual enrollment programs) that may have been instituted with an eye to promoting the likelihood of on-time graduation, but which did not enter into the logistic regression models. Discussion could, on the one hand, reinforce the educational value of such

initiatives distinct from any pragmatic emphasis, or, on the other hand, could give impetus to re-thinking the implementation of such programs with an eye to enhancing their contribution towards on-time graduation or some other measure of effectiveness.

Conclusion

In the face of increasing expectation for better preparation of more high school graduates for “college-level work,” and the fact that “exactly what constitutes ‘college-level work’ is by no means clear” (Attewell et al., 2006, p. 887), Eggens et al. (2008) recently pointed out that what happens in high schools currently does make a difference, since “the most straightforward determinants of student performance in higher education are the results that students previously attained” (p. 554). A number of studies support Eggens et al. in finding that students who do well in high school tend to do well in college (Jansen, 2004; McKenzie & Schweitzer, 2001; Murtaugh, Burns & Schuster, 1999; Pustjens et al., 2004; Smith & Naylor, 2001; Szafran, 2001; Zeegers, 2004). Appendix A lists a selection of recent reports on factors associated with college graduation.

The comparatively high quality of the data recently available from *StudentTracker* supports increasingly meaningful analyses at the school division level related to the antecedents of on-time graduation from college. Such studies at the local level are an appropriate way of responding to the increasing emphasis nationally on the adequate preparation of school graduates for college.

Some of the factors involved with successful transition to college are arguably beyond the direct purview of high school education. For example, Eggens et al. (2008) highlighted the scale of the adjustment faced by high school graduates as they move away

from the only support structures they have known to colleges, where they “need to develop new or increased capacity for self-regulation and must learn to cope with the time pressure that is inherent in going to college” (p. 553).

Studying both the demographic and academic high school antecedents of on-time college graduation in particular divisions highlights strengths and issues inherent the local community. Fine-grained, high-quality data are invaluable in enabling school divisions to free themselves from “national average” typology and “perfect storm” gloom. By empowering individual school districts to ask and seek answers to locally meaningful questions, analyses of such data can be part of a perceptive response to national imperatives.

Footnote

1. *StudentTracker* is a service provided by the National Student Clearinghouse (NSC)—a non-profit organization that has provided verification of student academic achievement to colleges and high schools since 1993. NSC enjoys the cooperation of over 3000 colleges in the U.S. in recording the progress to graduation of their undergraduate population (among other things). For a fee, using the *StudentTracker* service, school divisions can obtain information at an individual student level on the progress through college of their high school graduates, provided those graduates attend one of the National Student Clearinghouse's cooperating colleges. While this limitation by no means ensures comprehensive coverage of all their college-attending graduates, compared to traditional methods of longitudinally following high school graduates, *StudentTracker* presents a cost-competitive, FERPA-approved and much more complete picture.

Appendix A: Some recent studies of factors associated with college graduation

Author(s)	Factor	Levels of Factor
U.S. Department of Education, National Center for Education Statistics (NCES, 2001)	Age (at entry into postsecondary education)	18 years or younger 19-24 years 25-29 years 30 years or older
Gong & Presley (2006); NCES (2001)	Gender	Male/Female
Gong & Presley (2006); NCES (2001)	Race/Ethnicity	Black (non-Hispanic) Latino Asian/Pacific Islander Native American White (non-Hispanic) Other/Multicultural
Gong & Presley (2006); NCES (2001); Ohio Board of Regents (2005)	Family Income/SES	Low Middle High
NCES (2001)	Marital Status	Not married Married Separated
Gong & Presley (2006)	College Readiness	Not/Least Ready Marginally Ready Somewhat Ready More Ready Most Ready
Gong & Presley (2006)	Highest Level Math	No Math Algebra I Geometry Algebra II Trig/Other Adv Math Calculus
Gong & Presley (2006)	ACT-Recommended Core Courses	Yes/No
Ohio Board of Regents (2004 a); Ohio Board of Regents (2004 b); Ohio Board of Regents (2005); U.S. Department of Education (2000); Achieve, Inc. (2007)	Type of High School Curriculum	Complete Core of High School Curriculum (4 yrs of English, math, social studies, with at least 3 science courses—including biology, chemistry, and/or physics)
American Diploma Project Network (2007)	Type of High School Curriculum	Minimum Core (4 yrs of English & 3 courses in math, social studies, & science OR 4 yrs of English and 3 yrs each of math, social

Author(s)	Factor	Levels of Factor
		studies, & science) Less than Minimum
NCES (2001).	Type of High School Curriculum	Core New Basics (4 yrs of English & 3 courses in math, social studies, & science) Beyond New Basics I (Core plus 2/3 science course—biology, chemistry, or physics—and algebra I, geometry and 1 yr of foreign language) Beyond New Basics II (Core plus advanced science—biology, chemistry, or physics—and adv math—including algebra I, geometry, algebra II—and 2 yrs of foreign language) Rigorous (Core plus advanced science, 4 years of math, plus 3 years of foreign language and one honors/Advanced Placement course or Advanced Placement test score)
Ohio Board of Regents (2004 b); Ohio Board of Regents (2005); U.S. Department of Education (2000); NCES (2001)	AP courses	Yes/No
Ohio Board of Regents (2004 b); Ohio Board of Regents (2005).	Dual Enrollment Courses	Yes/No
Gong, & Presley (2006); Ohio Board of Regents (2004 b); Ohio Board of Regents (2005).	High School Location (All in central Virginia)	Rural Suburb Town Urban
Gong, & Presley (2006); NCES (2001)	College type	2 year (public/private) 4 year (public/private) In state (public/private) Out of state

Author(s)	Factor	Levels of Factor (public/private)
NCES (2001)	Carnegie classification of initial institution	Research/doctoral universities Comprehensive universities Baccalaureate Other
Ohio Board of Regents (2004 b); Ohio Board of Regents (2005).	Institution type	University main campus University regional campus Community College State community College Technical College Independent Colleges and Universities
Ohio Board of Regents (2004 b); Ohio Board of Regents (2005); NCES (2001)	Enrollment status	Full-time Part-time
NCES (2001)	Employment status	Did not work while enrolled Worked part-time while enrolled Worked full time while enrolled
Ohio Board of Regents (2004 b); NCES (2001)	Taking remedial coursework (courses in reading, writing, or math taken by college students who lack the skills required to perform college-level coursework at the institution's required level)	Yes (#)/No
Ohio Board of Regents (2005); American Diploma Project Network (2007)	Taking remedial coursework	Math English Writing
Ohio Board of Regents (2004 b); Ohio Board of Regents (2005).	Returning to college second year	Same institution Another institution
NCES (2001)	Persistence and Attainment	Still enrolled or attained degree Transferred to another institution Left postsecondary education Degree attainment

Author(s)	Factor	Levels of Factor
Ohio Board of Regents (2004 b); Ohio Board of Regents (2005); Noble & Sawyer (2002); NCES (2001)	College GPA	First term GPA
Gong & Presley (2006)	Degree Earned	Associate Bachelors Masters
Gong & Presley (2006)	Characteristics of four-year college	Non/less competitive Competitive Very competitive Most/highly competitive
Gong & Presley (2006)	Characteristics of high school	# of extra curricular activities % of graduates in any college % of graduates in four-year college % of graduates in more competitive four-year college
Ohio Board of Regents (2004 b); Ohio Board of Regents (2005).	Total first-time freshmen (First-time, first year, degree-seeking freshman enrolled in college within 12 months of high school graduation)	Recent high school graduates Earlier high school graduates
Ohio Board of Regents (2004 b); Ohio Board of Regents (2005); U.S. Department of Education (2000); Noble & Sawyer (2002); NCES (2001)	ACT/SAT scores	Yes/No Average college entrance exam score
Ohio Board of Regents (2004 b); Ohio Board of Regents (2005); NCES (2001)	First Generation College (A college student both of whose parents' highest level of education completed was less than college)	Yes/No
Hughes, Karp, Fermin, & Bailey (2006); Plucker, Chain, & Zaman (2006).	Credit-Based Transition Programs	
U.S. Department of Education (2000).	Extra Curricular Activities	
U.S. Department of	Work experience/	

Author(s)	Factor	Levels of Factor
Education (2000).	community service	
NCES (2001)	Place of Birth	Born in U.S. Born outside U.S.
NCES (2001)	Language spoken at home	English Other than English
NCES (2001)	Percentage enrollment of underrepresented minority	0-25 percent 26-50 percent 51-75 percent 76-100 percent
NCES (2001)	Type of college major	Undeclared/no major Humanities Social/Behavioral sciences Life sciences Physical sciences/Mathematics Computer/Information science Education Engineering Business/Management Health Vocational/Technical Other technical/Professional

Appendix B: Overview statistics of both participating School Divisions

Variables	Division A	Division B
Number of regular high schools	3	7
High school graduating class size	1223 (352 smallest, 434 largest regular high school graduating class size)	2634 (247 smallest, 482 largest regular high school graduating class size)
Gender (percent)	Male: 45.4 Female: 52.6	Male: 49.0 Female: 50.9
Racial (percent; top four categories)	White: 84.9 Black: 10.0 Asian: 1.5 Hispanic: 1.2	White: 61.9 Black: 30.6 Asian: 4.9 Hispanic: 2.0
Special Education (percent)	9.7	13.1
Limited English proficient (percent)	0.2	0.9
Diploma (percent)	Advanced: 49.7 Standard: 42.8 Special: 1.6	Advanced: 46.5 Standard: 46.8 Special: 3.6
AP course/test taken (percent)	30.5 (Dual enrollment: 26.7)	27.9
GPA: mean (standard deviation)	2.9 (0.9)	2.8 (0.9)
SAT: mean (standard deviation)	Verbal: 515.6 (96.2) Math: 514.6 (91.0)	Verbal: 528.5 (106.4) Math: 518.1 (112.1)
Number of days in division: mean (standard deviation)	169.8 (15.7)	170.2 (11.9)
Number of days absent: mean (standard deviation)	8.2 (8.4)	11.8 (9.4)
Attended 2-yr college: percent overall (percent public)	31.2 (28.5)	34.7 (31.5)
Attended 4-yr college: percent overall (percent public)	55.3 (44.8)	54.4 (44.1)

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(Note: References marked with * are studies included in the Appendix listing of selected recent studies of factors associated with college graduation.)

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