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Who is Likely to Graduate High School Ready for College?

Jizhi Ling, MS and Justine Radunzel, PhD

Today, a majority of high school graduates aspire to earn a college degree (ACT, 2016). Yet many students are graduating from high school unprepared to do college-level work; and as a result, about one-third of college freshmen enroll in at least one developmental course upon entry to college (Skomsvold, 2014). Because developmental courses are often not credit-bearing, having to take them can delay students' degree completion and increase the cost of their education (Attewell, Lavin, Domina, & Levey, 2006).

To provide students and educators with an empirical definition of what it means to be academically ready for first-year credit-bearing college courses, ACT developed the ACT College Readiness Benchmarks based on college course grade data from 214 two- and four-year institutions (Allen, 2013). The ACT College Readiness Benchmarks are scores on the ACT subject-area tests that represent the level of achievement required for students to have at least a 50% chance of obtaining a B or higher or about a 75% chance of obtaining a C or higher in corresponding credit-bearing first-year college courses. These college courses include English Composition, College Algebra, introductory social science courses, and Biology. The Benchmarks correspond to scores of 18, 22, 22, and 23 on the ACT English, mathematics, reading, and science tests, respectively. Students meeting the ACT Benchmarks are less likely to take remedial courses and more likely to enroll immediately in college after high school, persist in college, earn a college GPA of 3.0 or higher, and complete a college degree as compared to students who do not meet the ACT Benchmarks (ACT, 2010; Radunzel & Noble, 2012).

The goals of the current study were to determine the student and school characteristics that are related to students' chances of meeting each of the individual ACT Benchmarks as well as to their chances of meeting a specific number of Benchmarks. This study is a follow-up to an earlier study by McNeish, Radunzel, and Sanchez (2015) that examined the contributions of students' noncognitive characteristics toward explaining ACT test scores, over and above traditional predictors such as high school grade point average (HSGPA), coursework taken, and school characteristics. The current study was based on the same sample and predictors as those used in the earlier study, but used Benchmark attainment as the outcome instead

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Jizhi Ling is a data analyst in Statistical and Applied Research at ACT and works on postsecondary outcomes research.

Justine Radunzel is a principal research scientist in Statistical and Applied Research at ACT specializing in postsecondary outcomes research and validity evidence for the ACT® test.

of test scores. The earlier study found that the total variance in ACT scores explained by the available student and school characteristics ranged from 44% (reading) to 61% (Composite). HSGPA explained the most variance in ACT scores (20% to 31%). High school coursework explained an additional 8% (reading) to 17% (mathematics) of the variance, high school characteristics accounted for an additional 7% to 9%, and noncognitive characteristics explained an additional 4% to 7%. It was expected that the same predictors that were identified to be related to ACT test scores would be associated with Benchmark attainment. The results from the current study provide an alternative view into college readiness that helps to identify the student and school characteristics associated with greater chances of students' graduating from high school well-prepared for first-year credit-bearing college coursework and thereby associated with lower chances of requiring developmental coursework.

Methods

More than 50,000 randomly selected high school seniors who registered 0to take the ACT test in October and December 2012 were invited by email to complete a supplemental online questionnaire the week following the ACT test administration.[1] They were asked about their high school experience, study and work habits, parental involvement, educational and occupational plans and goals, and college courses taken and/or credits earned in high school. Other student information including the high school coursework taken and grades earned was provided by students at the time they registered to take the ACT. The study sample consisted of 6,440 high school seniors from 4,541 schools who took the ACT, for a response rate of 12%. The school characteristics included in this study were related to the demographic composition of the student body (e.g., percentage of racial/ethnic minority students) and the college-going culture at the school (e.g., percentage of students at school aspiring to a graduate degree).

A blockwise logistic regression model with cluster-robust standard errors was used to predict ACT Benchmark attainment (coded as 1=met Benchmark; 0=not met) from student and school characteristics (White, 1980, 1984). Cluster-robust standard errors were used to account for students being sparsely clustered within high schools. Four separate logistic regression models were developed—one for each Benchmark. Candidate predictor variables were placed into the following five blocks based on the nature of the variables: High school grades earned, courses taken, advanced and/or college-level coursework taken in high school, school characteristics, and other noncognitive characteristics.[2] Once a predictor was included based on statistical significance, it was retained in the model regardless of whether the statistical significance changed after subsequent blocks were added. As for the outcome of the number of ACT Benchmarks met, a multiple-predictor multinomial regression model was estimated. Students who met none of the Benchmarks served as the reference group and the following comparisons were examined: Met all four vs. met none; met three vs. met none; met two vs. met none; and met one vs. met none. Weights were applied in the analyses so that the study data resembled that of all 2012–2013 ACT-tested seniors nationally on student demographics and achievement levels.

The adjusted odds ratio (OR) was used to evaluate the strength of the predictor-Benchmark attainment relationship.[3] The OR represents the odds of Benchmark attainment for a certain subgroup of students (i.e., took a mathematics course sequence that included Calculus), compared to the odds of Benchmark attainment for another subgroup of students (i.e., took a mathematics course sequence that included Algebra 1, Geometry, and Algebra 2 only; the latter group is often referred to as the referent or comparison group). In comparison to members in the referent group, an OR greater than 1.0 indicates that students in the subgroup of interest are generally more likely to meet the Benchmark, whereas an OR less than 1.0 indicates that they are less likely to do so. The 99% confidence interval for the OR provides an indication of whether the relationship is statistically significant at the 0.01 level (that being when the interval does not include the null value of 1.0).

[1] For a more detailed description of the study sample and the variables available, see McNeish et al. (2015). The data source used to obtain the high school characteristics are described on page 6.

[2] For a complete list of variables examined within each block, see pages 11 and 12 from McNeish et al. (2015).

[3] For a dichotomized outcome, the odds is the ratio of the probability of experiencing the outcome (such as, meeting the Benchmark) to the probability of not experiencing the outcome (not meeting the Benchmark). For a multinomial outcome, the odds of experiencing a specific outcome (such as, meeting all four Benchmarks) is the ratio of the probability of experiencing the outcome (meeting all four Benchmarks) to the probability of experiencing the base outcome (meeting none of the Benchmarks).

Results

Individual ACT College Readiness Benchmark Attainment

The weighted percentage of students meeting each of the ACT College Readiness Benchmarks was 67% in English, 46% in reading, 45% in mathematics, and 37% in science. Multiple student and school characteristics were found to be related to Benchmark attainment (see Table A1 in the Appendix for adjusted ORs and corresponding 99% confidence intervals). Based on the Nagelkerke-R^2, the percentage of variance explained by the multiple-predictor models for individual Benchmark attainment ranged from 39% (reading) to 55% (mathematics). Moreover, the multiple-predictor models correctly classified Benchmark attainment for 75% (reading) to 80% (English and mathematics) of the students, which represents a 19% (English) to 108% (science) increase over chance.

High school coursework and grades earned. HSGPA was a strong predictor of Benchmark attainment in each of the subject areas. The adjusted OR associated with a one-unit increase in HSGPA ranged from 2.9 in reading and science to 4.4 in mathematics. HSGPA alone accounted for 20% (reading) to 30% (mathematics) of the variance in ACT Benchmark attainment.

Taking higher-level mathematics courses in high school was associated with increased chances of meeting the Benchmarks in every subject area, while taking higher-level science coursework was primarily associated with meeting the ACT Mathematics Benchmark. For example, compared to students who took Algebra 1, Geometry, and Algebra 2, the odds of meeting the ACT Benchmark in mathematics was 1.7 times greater for students who also took either Trigonometry or another advanced mathematics course beyond Algebra 2, and 4.5 to 5.0 times greater for students who took a mathematics course sequence that also included Calculus (Table A1). Additionally, students who took accelerated, advanced, honors, and/or dual-enrollment coursework in high school were more likely to meet the ACT Benchmarks. For example, the odds of meeting the ACT Benchmarks in English and reading were 1.6 to 1.7 times greater for students who took advanced, honors, and/or dual-enrollment courses in English compared to those who did not. Students expecting to earn college credits in high school were more likely than those expecting to earn zero college credits to meet the ACT Benchmarks in mathematics and science (adjusted OR = 1.1 to 1.4 for one to six credits and 1.3 for seven or more credits; Table A1). The coursework taken in high school accounted for between 7% (in reading) and 16% (in mathematics) of additional variance.

School characteristics. School characteristics were also found to be related to students' chances of meeting the individual ACT Benchmarks; they accounted for 5% to 8% of additional variance beyond HSGPA and coursework taken. Characteristics measuring the college-going culture of the school, such as the percentage of students at the school intending to pursue a graduate degree and the college enrollment rate, were positively related to individual Benchmark attainment. The wealth of the school neighborhood was also found to be positively related to Benchmark attainment. For example, the odds of meeting an individual ACT Benchmark was 1.4 to 1.6 times greater for students who attended schools located in zip code areas associated with high median household income values than for students from neighborhoods with low values for median household income (Table A1). In contrast, the percentage of racial/ethnic minority students attending the school was negatively related to Benchmark attainment (adjusted ORs ranged from 0.3 to 0.5 across individual ACT Benchmarks for schools with a high percentage of minority students vs. schools with a low percentage of minority students).

Noncognitive characteristics. The block of noncognitive characteristics accounted for between 3% and 6% of additional variance in individual ACT Benchmark attainment. Some example findings from this block included that students who took the ACT test during their junior year and had higher educational aspirations were more likely than their counterparts to meet some of the individual Benchmarks (adjusted ORs = 1.4 to 1.9). In contrast, students who indicated that they needed help with improving their reading comprehension and math skills were less likely to do so (adjusted ORs = 0.3 to 0.6). Moreover, ACT Benchmark attainment in all four subject areas was negatively related to the frequency at which students felt challenged by their high school coursework (adjusted ORs = 0.8) as well as to the frequency at which students indicated that their parents checked that their assignments were completed (adjusted ORs = 0.9).

Number of ACT College Readiness Benchmark Met

The weighted percentages for the number of ACT College Readiness Benchmarks met by students in the sample were 26% for meeting all four, 14% for meeting three, 16% for meeting two, 16% for meeting one, and 27% for meeting none of the Benchmarks (see Table A2 in the Appendix for adjusted ORs and corresponding 99% confidence intervals). The percentage of variance explained by the multiple-predictor model was 54%.

For the most part, the same predictors identified for individual ACT Benchmark attainment were also found to be related to the multinomial outcome of the number of ACT Benchmarks met. There were a few variables related to individual Benchmark attainment that did not enter the model for the number of Benchmarks met. These included the social science courses taken in high school (Psychology and Other History courses), the number of college credits earned in high school, and college enrollment rate for the school attended.

High school coursework and grades earned. Similar to the results for individual Benchmark attainment, HSGPA was a strong predictor for the number of ACT Benchmarks met; HSGPA alone accounted for 29% of the variance. The adjusted OR associated with a one-unit increase in HSGPA ranged from 2.0 for meeting one Benchmark to 12.6 for meeting all four Benchmarks compared to meeting none of the Benchmarks. Figure 1 provides an example of students' chances of meeting a specific number of ACT Benchmarks for three different values of HSGPA (3.0, 3.5, and 4.0), holding the other predictors constant at their sample means. The figure illustrates how students' chances of meeting more of the Benchmarks (three or four) increases as HSGPA increases. For example, students' chances of meeting all four Benchmarks increased from 9% to 33% as HSGPA increased from 3.0 to 4.0, holding all other predictors constant at their sample means. Additionally, for this example, among students with a HSGPA of 3.0, the highest probability was associated with meeting none of the Benchmarks (27%). In comparison, among students with a HSGPA of 4.0, the highest probability was associated with meeting all four Benchmarks (33%).

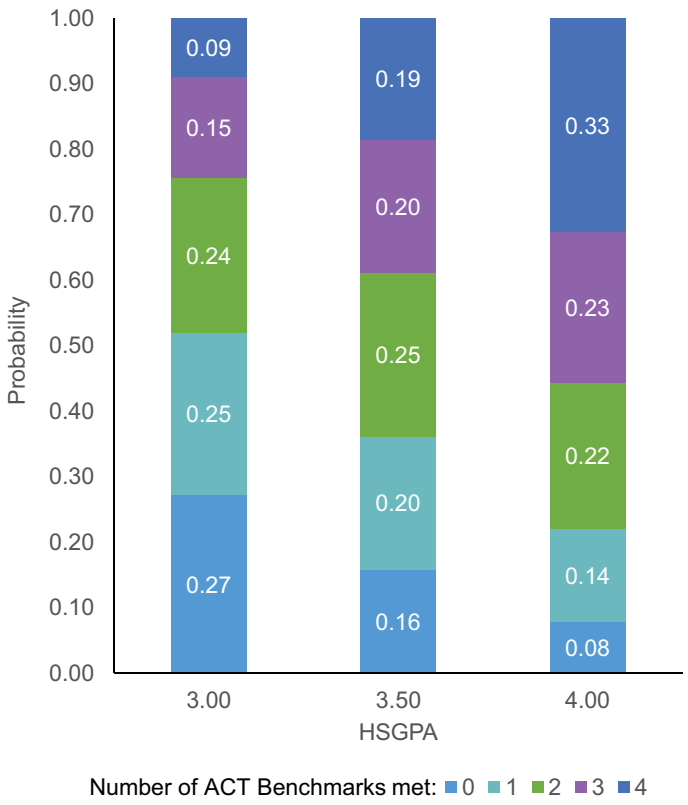

Figure 1. Probability of meeting a specific number of ACT Benchmarks by HSGPA.

Taking higher-level mathematics and science courses was also associated with increased chances of meeting three or four Benchmarks as compared to meeting no Benchmarks. For example, compared to students who took Algebra 1, Algebra 2 and Geometry, the odds of meeting three Benchmarks was 1.2 to 2.8 times greater for students who took a mathematics course sequence that included coursework beyond Algebra 2. The corresponding odds of meeting four Benchmarks ranged from 2.3 to 7.7. Figure 2 provides an example of students' chances of meeting a specific number of ACT Benchmarks by the mathematics course sequence taken in high school, holding the other predictors constant at their sample means. For this example, students' chances of meeting all four Benchmarks increased from 4% for those taking less than Algebra 1, Algebra 2, and Geometry to 28% for those who took a sequence that included Calculus. In science, students who took Biology, Chemistry, and Physics were more likely to meet three or four of the Benchmarks than those who took Biology but not Chemistry and Physics (adjusted OR = 1.8 for meeting four Benchmarks and 2.0 for meeting three Benchmarks; Table A2).

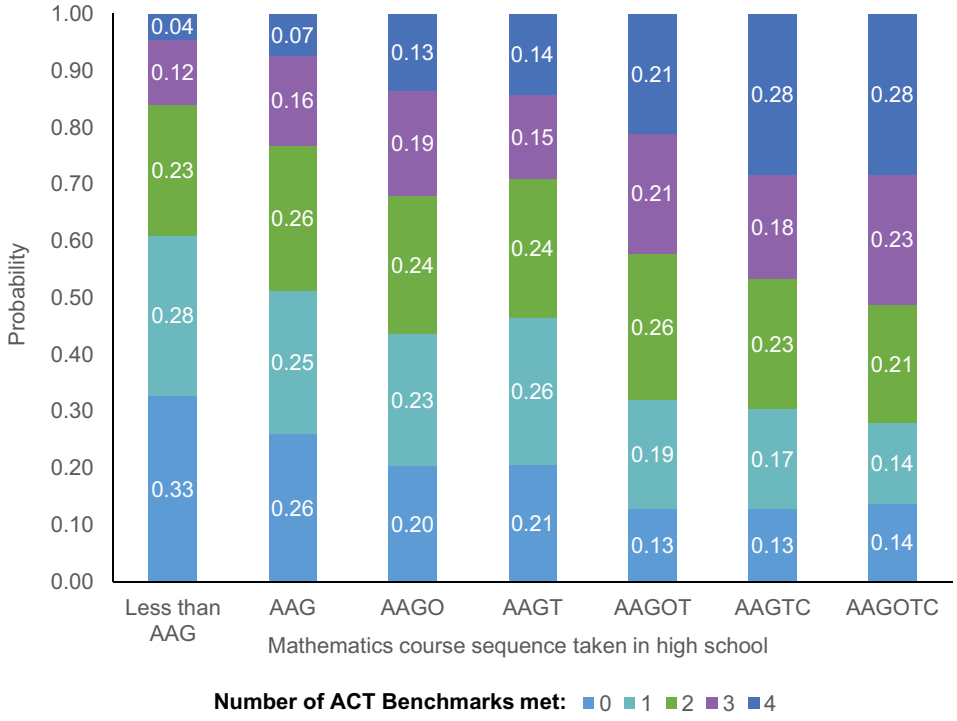

Figure 2. Probability of meeting a specific number of ACT Benchmarks by mathematics course sequence.[4]

Additionally, students who took accelerated, advanced, honors, and/or dual-enrollment coursework in high school were more likely to meet more of the ACT Benchmarks. For the met 4 vs. met 0 comparison, the strongest relationship was associated with advanced coursework in mathematics (adjusted OR = 2.4 vs. 1.7 to 2.0; Table A2). The coursework taken in high school accounted for 12% of additional variance.

School characteristics. School characteristics were also related to students' chances of meeting more of the ACT Benchmarks; they accounted for 8% of additional variance beyond HSGPA and coursework. As illustrated in Figure 3, the percentage of students at the school intending to pursue a graduate degree was positively related to meeting more of the Benchmarks. For the example

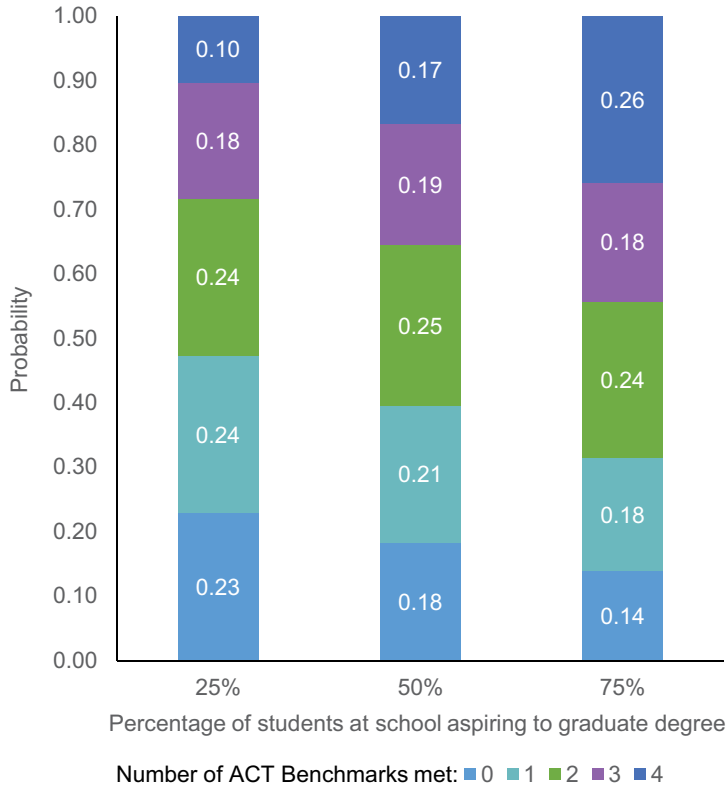

Figure 3. Probability of meeting a specific number of ACT Benchmarks by percentage of students at school aspiring to a graduate degree.

[4] AAG = Algebra 1, Algebra 2, and Geometry. O is for other advanced mathematics course beyond Algebra 2. T is for Trigonometry. C is for Calculus.

shown, students' chances of meeting all four Benchmarks increased from 10% to 26% as the percentage of students at the school aspiring to a graduate degree increased from 25% to 75%, holding all other predictors constant at their sample means.

The wealth of the school neighborhood was another school-level predictor that was positively associated with meeting more of the ACT Benchmarks. For example, compared to meeting none of the Benchmarks, the odds of meeting three or four Benchmarks was 1.6 to 2.1 times greater for students who attended schools located in zip code areas associated with high median household income values than for students from neighborhoods with low values for median household income. In contrast, the percentage of racial/ethnic minority students attending the school and the percentage of students on free/reduced lunch were both negatively related to students' chances of meeting more of the Benchmarks. The adjusted ORs for meeting all four vs. meeting none of the Benchmarks was 0.5 for high vs. low values for the percentage of students at school on free/reduced lunch and 0.1 for high vs. low values for the percentage of racial/ethnic minority students attending the school (Table A2).

Noncognitive characteristics. The block of noncognitive characteristics accounted for 6% of additional variance in the number of ACT Benchmarks met. Three of the seven noncognitive characteristics were positively related to students' chances of meeting more of the Benchmarks; the remaining four were negatively related. Students who had educational aspirations beyond a bachelor's degree, took the ACT prior to their senior year, and described their high school coursework as a college preparatory

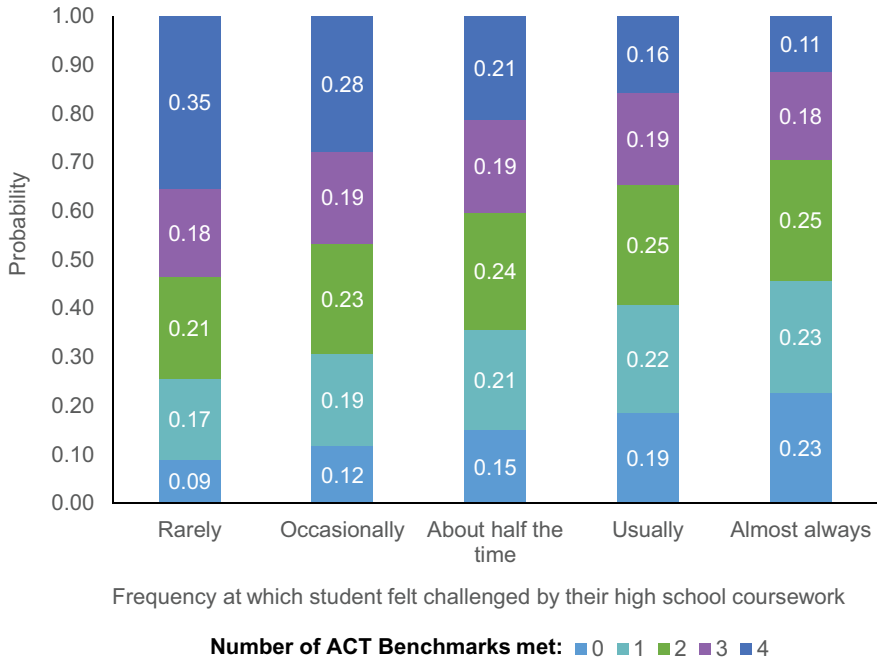

Figure 4. Probability of meeting a specific number of ACT Benchmarks by frequency at which students felt challenged by their high school coursework.

curriculum were more likely than their corresponding peers to meet more of the ACT Benchmarks (adj-OR for met 4 vs. met 0 = 2.6, 2.5, and 1.5, respectively; Table A2). In contrast, students who indicated that they need help with their reading skills, need help with their math skills, are more frequently challenged by their high school coursework, and whose parents more frequently check their assignments were less likely to meet more Benchmarks than their corresponding peers (adj-OR for met 4 vs. met 0 = 0.2, 0.5, 0.6, and 0.8, respectively; Table A2). Figure 4 provides an example of students' chances of meeting a specific number of ACT Benchmarks by frequency at which students felt challenged by their high school coursework, holding the other predictors constant at their sample means. In this example, the chances of meeting all four Benchmarks was 11% for students who indicated that they almost always felt challenged by their high school coursework as compared to 35% for students who indicated that they rarely did.

Summary

The study findings suggest that in order for students to meet the ACT Benchmarks, and thus be better prepared academically for first-year college courses, they need to take rigorous courses in high school and earn good grades. In addition to high school coursework and grades, a number of school characteristics and noncognitive characteristics were found to be related to ACT Benchmark attainment. The predictors found to be related to ACT Benchmark attainment in the current study were generally consistent with those identified as predictive of ACT test scores in an earlier study (McNeish et al., 2015).[5] This is not surprising given that the only difference between the two studies was the way that the outcome variable was treated and analyzed. In the earlier study (McNeish et al., 2015), ACT scores were examined as a continuous measure on the

[5] The reader is referred to the McNeish et al. (2015) report for a more thorough discussion of the relevance of the individual predictors identified in the study.

1 to 36 score scale using linear regression. In the current study, ACT scores were coded as a dichotomous outcome in terms of ACT Benchmark attainment (met/not met) and then analyzed using logistic regression. The number of Benchmarks met was treated as a nominal outcome and modeled using multinomial regression. As such, the results are reported in terms of the odds and the likelihood of students' meeting the ACT Benchmarks. These results provide an alternative way to evaluate the factors previously identified and how they contribute to students' chances of graduating from high school sufficiently prepared for typical first-year credit-bearing college courses.

In conclusion, monitoring student progress to college readiness early and intervening with students who are not on target can help to ensure readiness before a student graduates from high school and thereby reduce the need for developmental courses and supplemental instruction in college (ACT, 2012, 2013; Savitz-Romer, Jager-Hyman, & Coles, 2009). Findings from this and other studies (O'Brennan & Bradshaw, 2013; Oseguera, 2013) also suggest that positive school climates featuring college-going behaviors and high academic expectations can play a role in improving students' college readiness levels. Students also need to develop strong academic behaviors and study skills in high school to succeed and persist in college (Conley, 2007; Mattern et al., 2014).

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Appendix

Table A1: Blockwise Logistic Regression Model Results for Individual ACT Benchmark Attainment

Block	Predictor	ACT English			ACT Reading			ACT Mathematics			ACT Science		
		OR	99% CI		OR	99% CI		OR	99% CI		OR	99% CI	
1	Overall GPA	3.35	2.68	4.19	2.94	2.36	3.67	4.44	3.52	5.60	2.91	2.34	3.62
2	Math Course Sequence												
	Less than AAG	0.90	0.54	1.50	0.65	0.37	1.13	0.69	0.34	1.39	0.59	0.28	1.26
	AAG (referent)												
	AAGO	1.38	1.06	1.81	1.19	0.93	1.53	1.70	1.28	2.25	1.47	1.10	1.95
	AAGT	1.28	0.91	1.81	1.14	0.84	1.54	1.69	1.22	2.34	1.42	1.03	1.95
	AAGOT	2.07	1.43	2.98	1.58	1.19	2.10	3.09	2.24	4.25	2.21	1.63	2.99
	AAGTC	1.73	1.04	2.90	2.05	1.42	2.96	4.52	2.90	7.03	3.02	2.05	4.45
	AAGOTC	1.92	1.30	2.85	2.07	1.56	2.77	5.00	3.49	7.17	3.34	2.41	4.62
	Other (>= 3 yrs)	1.22	0.69	2.15	1.14	0.65	1.99	3.40	1.94	5.96	1.77	1.00	3.11
	Other (< 3 yrs)	1.37	0.61	3.11	1.14	0.50	2.64	1.59	0.69	3.70	0.97	0.36	2.63
	Science Course Sequence												
	Less than Biology	1.07	0.45	2.55	—-	—-	—-	2.35*	0.99	5.60	1.29	0.61	2.73
	Biology (referent)												
	Biology, Chemistry	1.28	0.92	1.78	—-	—-	—-	1.73	1.19	2.52	1.12	0.76	1.65
	Bio, Chemistry, Physics	1.29	0.90	1.84	—-	—-	—-	2.31	1.57	3.40	1.42	0.95	2.12
	Other 3-year sequence	1.14	0.61	2.15	—-	—-	—-	1.81	0.92	3.53	1.22	0.67	2.22
	Psychology	1.17	0.93	1.46	1.07	0.90	1.28	—-	—-	—-	—-	—-	—-
	Other History Courses	1.10	0.87	1.39	1.15	0.95	1.39	—-	—-	—-	—-	—-	—-
3	Advanced English	1.63	1.29	2.07	1.73	1.40	2.13	0.88	0.69	1.11	—-	—-	—-
	Advanced Math	1.33	1.04	1.72	—-	—-	—-	2.13	1.70	2.67	1.66	1.36	2.04
	Advanced Nat Science	1.29*	1.00	1.67	—-	—-	—-	1.48	1.18	1.85	1.60	1.32	1.96
	Advanced Social Studies	1.34	1.05	1.71	1.62	1.33	1.98	1.39	1.10	1.75	—-	—-	—-
	College Credits Earned in HS												
	0 (referent)												
	1–6	—-	—-	—-	—-	—-	—-	1.39	1.09	1.77	1.09	0.87	1.38
	7+	—-	—-	—-	—-	—-	—-	1.32	1.01	1.73	1.28	1.01	1.62

continued

—- indicates the predictor was not significant for the particular outcome variable.

* indicates a p-value between 0.010 and 0.015 in the final model.

Gray shading indicates that the predictor was not statistically significant upon entry but was retained as part of a factor. Blue shading indicates the predictor was statistically significant at entry but was no longer significant in the final model.

The parameter estimates can be obtained by taking the natural logarithm of the adjusted ORs. The intercepts are 0.58, 0.05, -0.79 and -0.72 for Benchmark attainment in English, reading, mathematics, and science, respectively.

AAG = Algebra 1, Algebra 2, and Geometry. O is for other advanced mathematics course beyond Algebra 2. T is for Trigonometry. C is for Calculus.

Table A1: Blockwise Logistic Regression Model Results for Individual ACT Benchmark Attainment *(continued)*

Block	Predictor	ACT English			ACT Reading			ACT Mathematics			ACT Science		
		OR	99% CI		OR	99% CI		OR	99% CI		OR	99% CI	
4	%Intending Graduate Degree	1.01	1.00	1.02	1.02	1.01	1.03	1.02	1.01	1.03	1.01	1.00	1.02
	Non-Public School Indicator	1.12	0.70	1.79	1.12	0.71	1.75	0.79	0.53	1.17	0.94	0.67	1.31
	%College Enrollment	—-	—-	—-	—-	—-	—-	1.01	1.00	1.02	1.01	1.00	1.02
	%Free/Reduced Lunch												
	Low [< 25%] (referent)												
	Medium [25%–50%]	—-	—-	—-	—-	—-	—-	0.93	0.70	1.24	—-	—-	—-
	High [> 50%]	—-	—-	—-	—-	—-	—-	0.68	0.49	0.95	—-	—-	—-
	Median Zip Code Income												
	Low [< $35,421] (referent)												
	Medium [$35,421–$47,852]	1.37	1.08	1.74	1.21	0.97	1.51	1.29	1.02	1.64	1.27	1.02	1.57
	High [> $47,852]	1.52	1.16	2.00	1.46	1.16	1.84	1.44	1.10	1.90	1.55	1.24	1.95
	%Minority												
	Low [< 9%] (referent)												
	Medium [9%–36%]	0.65	0.48	0.87	0.80	0.63	1.02	0.78	0.60	1.02	0.95	0.75	1. 20
	High [> 36%]	0.26	0.19	0.35	0.39	0.30	0.49	0.38	0.28	0.51	0.47	0.36	0.60
5	College Prep Course Curriculum	1.28	1.04	1.58	1.21	1.00	1.47	—-	—-	—-	—-	—-	—-
	Expected Ed. Attainment												
	Below Bachelor's (referent)												
	Bachelor's Degree	1.17	0.76	1.82	—-	—-	—-	—-	—-	—-	—-	—-	—-
	Beyond Bachelor's Degree	1.68	1.06	2.67	—-	—-	—-	—-	—-	—-	—-	—-	—-
	Need Help-Reading Skills	0.37	0.30	0.46	0.31	0.26	0.38	—-	—-	—-	0.53	0.43	0.65
	Need Help-Math Skills	—-	—-	—-				0.38	0.31	0.46	0.59	0.49	0.72
	Parents Check Assignments	0.85	0.80	0.91	0.89	0.84	0.94	0.90	0.85	0.95	0.92	0.87	0.97
	Student Challenged by School	0.83	0.74	0.94	0.81	0.74	0.89	0.81	0.72	0.90	0.75	0.68	0.83
	Tested in Junior Year	1.92	1.56	2.37	1.37	1.14	1.64	—-	—-	—-	1.54	1.28	1.86

—- indicates the predictor was not significant for the particular outcome variable.

* indicates a p-value between 0.010 and 0.015 in the final model.

Gray shading indicates that the predictor was not statistically significant upon entry but was retained as part of a factor. Blue shading indicates the predictor was statistically significant at entry but was no longer significant in the final model.

The parameter estimates can be obtained by taking the natural logarithm of the adjusted ORs. The intercepts are 0.58, 0.05, -0.79 and -0.72 for Benchmark attainment in English, reading, mathematics, and science, respectively.

AAG = Algebra 1, Algebra 2, and Geometry. O is for other advanced mathematics course beyond Algebra 2. T is for Trigonometry. C is for Calculus.

Table A2: Blockwise Multinomial Regression Model Results for Number of ACT Benchmarks Met

Block	Predictor	1 vs 0			2 vs 0			3 vs 0			4 vs 0		
		OR	99% CI		OR	99% CI		OR	99% CI		OR	99% CI	
1	Overall GPA	1.97	1.58	2.47	3.27	2.54	4.20	5.17	3.86	6.92	12.56	9.14	17.25
2	Math Course Sequence												
	Less than AAG	0.90	0.55	1.45	0.71	0.39	1.30	0.58	0.25	1.31	0.48	0.16	1.45
	AAG (referent)												
	AAGO	1.18	0.89	1.57	1.20	0.88	1.64	1.51	1.06	2.15	2.33	1.55	3.50
	AAGT	1.31	0.92	1.88	1.20	0.81	1.77	1.20	0.77	1.88	2.43	1.51	3.91
	AAGOT	1.53*	0.99	2.36	2.02	1.30	3.12	2.69	1.68	4.32	5.74	3.49	9.43
	AAGTC	1.40	0.72	2.74	1.80	0.93	3.48	2.34	1.17	4.68	7.73	3.93	15.18
	AAGOTC	1.07	0.62	1.83	1.52	0.91	2.55	2.75	1.62	4.67	7.20	4.18	12.40
	Other(>= 3 yrs)	1.35	0.66	2.79	1.10	0.50	2.45	1.83	0.81	4.11	3.52	1.55	7.99
	Other(< 3 yrs)	0.91	0.37	2.25	1.21	0.47	3.11	1.72	0.59	4.97	1.21	0.30	4.90
	Science Course Sequence												
	Less than Biology	0.97	0.42	2.19	0.97	0.36	2.60	2.41	0.85	6.80	1.38	0.43	4.43
	Biology (referent)												
	Biology, Chemistry	1.02	0.73	1.43	1.21	0.82	1.78	1.92	1.15	3.21	1.24	0.73	2.12
	Bio, Chemistry, Physics	1.01	0.70	1.45	1.33	0.88	2.02	1.97	1.15	3.36	1.81	1.05	3.15
	Other 3-year sequence	1.06	0.55	2.03	1.05	0.49	2.22	2.09	0.91	4.83	1.44	0.60	3.46
3	Advanced English	1.29*	0.98	1.70	1.77	1.33	2.36	1.68	1.22	2.31	1.67	1.21	2.38
	Advanced Math	1.16	0.87	1.55	1.40	1.04	1.88	1.61	1.17	2.23	2.44	1.76	3.39
	Advanced Nat Science	1.17	0.87	1.57	1.29	0.95	1.74	1.55	1.12	2.13	1.69	1.22	2.33
	Advanced Social Studies	1.38	1.03	1.84	1.40	1.04	1.88	1.37*	0.99	1.88	2.01	1.45	2.77

continued

* indicates a p-value between 0.010 and 0.015 in the final model.

Gray shading indicates that the predictor was not statistically significant upon entry but was retained as part of a factor. Blue shading indicates the predictor was statistically significant at entry but was no longer significant in the final model.

The parameter estimates can be obtained by taking the natural logarithm of the adjusted ORs. The intercepts are 0.42, -0.02, -0.38 and -0.44 for 1 vs. 0, 2 vs. 0, 3 vs. 0, and 4 vs. 0, respectively.

AAG = Algebra 1, Algebra 2, and Geometry. O is for other advanced mathematics course beyond Algebra 2. T is for Trigonometry. C is for Calculus.

Table A2: Blockwise Multinomial Regression Model Results for Number of ACT Benchmarks Met *(continued)*

Block	Predictor	1 vs 0			2 vs 0			3 vs 0			4 vs 0		
		OR	99% CI		OR	99% CI		OR	99% CI		OR	99% CI	
4	%Intending Graduate Degree	1.00	0.99	1.02	1.01	1.00	1.02	1.01	1.00	1.02	1.03	1.02	1.04
	Non-Public School Indicator	0.71	0.43	1.18	0.90	0.54	1.53	0.64	0.37	1.12	0.79	0.45	1.36
	%Free/Reduced Lunch												
	Low [< 25%] (referent)												
	Medium [25%–50%]	0.88	0.61	1.25	0.90	0.62	1.30	0.81	0.55	1.19	0.81	0.55	1.19
	High [> 50%]	0.65	0.44	0.97	0.71	0.47	1.08	0.47	0.30	0.74	0.51	0.32	0.80
	Median Zip Code Income												
	Low [< $35,421] (referent)												
	Medium [$35,421–$47,852]	1.11	0.86	1.44	1.40	1.06	1.85	1.39	1.02	1.90	1.66	1.21	2.28
	High [> $47,852]	1.15	0.83	1.57	1.41	1.01	1.97	1.57	1.09	2.26	2.13	1.47	3.08
	%Minority												
	Low [< 9%] (referent)												
	Medium [9%–36%]	0.63	0.45	0.87	0.78	0.55	1.09	0.55	0.38	0.80	0.57	0.39	0.82
	High [> 36%]	0.36	0.26	0.51	0.26	0.18	0.39	0.22	0.15	0.33	0.12	0.08	0.18
5	College Prep Course Curriculum	1.21	0.96	1.52	1.30	1.02	1.67	1.39	1.06	1.84	1.45	1.09	1.94
	Expected Ed. Attainment												
	Below Bachelor's (referent)												
	Bachelor's Degree	1.07	0.71	1.61	1.46	0.87	2.44	1.28	0.69	2.36	1.41	0.68	2.92
	Beyond Bachelor's Degree	1.39	0.89	2.16	1.91	1.11	3.27	1.90	1.00	3.58	2.59	1.24	5.42
	Need Help-Reading Skills	0.61	0.49	0.78	0.41	0.31	0.53	0.36	0.27	0.48	0.19	0.14	0.26
	Need Help-Math Skills	1.00	0.80	1.26	0.85	0.66	1.08	0.68	0.52	0.90	0.45	0.34	0.61
	Parents Check Assignments	0.92	0.86	1.00	0.83	0.76	0.89	0.80	0.74	0.87	0.80	0.73	0.87
	Student Challenged by School	0.86	0.75	0.98	0.83	0.72	0.95	0.79	0.68	0.92	0.60	0.51	0.70
	Tested in Junior Year	1.62	1.29	2.03	1.55	1.22	1.97	1.74	1.33	2.28	2.48	1.89	3.26

* indicates a p-value between 0.010 and 0.015 in the final model.

Gray shading indicates that the predictor was not statistically significant upon entry but was retained as part of a factor. Blue shading indicates the predictor was statistically significant at entry but was no longer significant in the final model.

The parameter estimates can be obtained by taking the natural logarithm of the adjusted ORs. The intercepts are 0.42, -0.02, -0.38 and -0.44 for 1 vs. 0, 2 vs. 0, 3 vs. 0, and 4 vs. 0, respectively.

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