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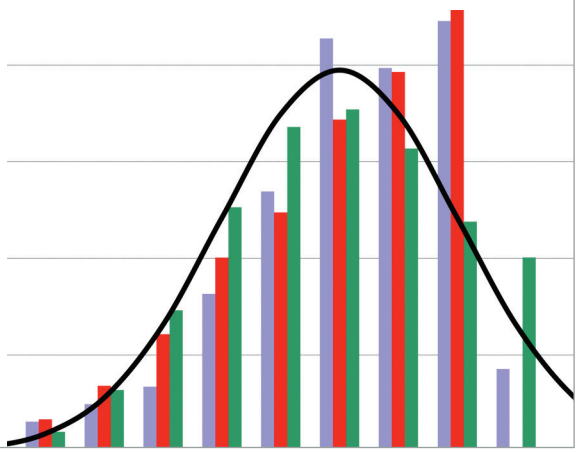

Validity Evidence for ACT Compass® Placement Tests

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Abstract

We examined the validity of using Compass® test scores and high school grade point average (GPA) for placing students in first-year college courses and for identifying students at risk of not succeeding. Consistent with other research, the combination of high school GPA and Compass scores performed better than either measure used alone. Results also indicate that, relative to Compass scores, the predictive strength of high school GPA decays with student age. We recommend using multiple measures for making course placement decisions and identifying students for intervention.

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Validity Evidence for ACT Compass® Placement Tests

Introduction

ACT Compass assessments measure students' skills in reading, writing, and mathematics. They are designed to assist institutions in placing college students in appropriate credit-bearing courses or in developmental or preparation courses. Compass scores can also be used to identify students who are enrolled in credit-bearing courses, but who may need additional academic support, such as tutoring or supplemental instruction. The Compass placement assessments are listed in Table 1, along with the number of assessments given at two- and four-year institutions in the 2011-2012 year (ACT, 2012).

Table 1

Number of Compass Assessments Administered at Two- and Four-Year Institutions, 2011-2012

Compass test	***N***
Writing Skills	1,350,835
Reading	1,456,301
e-Write (writing essay)	185,439
Numerical Skills/Pre-algebra	1,191,390
Algebra	1,212,731
College Algebra	142,892
Trigonometry	72,585
Geometry	25,099

In this study, we evaluate the validity of using Compass placement test scores for making placement decisions and identifying students for additional academic support. We present three types of evidence:

1. Statistical measures of the overall strength of the relationship between the predictors – Compass scores and high school grade point average (HSGPA) – and success in standard first-year courses. This evidence is aligned to predicting success in standard first-year college-level courses.

2. *Accuracy rates* that estimate the proportion of students who are accurately placed into standard courses (likely to succeed in the standard courses) or developmental courses (unlikely to succeed in the standard courses). This evidence is related to placing students in developmental or college-level courses.
3. *Intervention hit rates* that measure the accuracy of identifying the students least likely to succeed in standard courses. This evidence is related to identifying students in college-level courses who are at risk of not succeeding.

We present this evidence for the five most frequently used Compass assessments – Writing Skills, Reading, Numerical Skills/Pre-Algebra, Algebra, and College Algebra.

Previous studies have reported that Compass placement test scores and HSGPA, when used together, provide greater accuracy than either measure used alone (Noble, Schiel, & Sawyer, 2004; Scott-Clayton, 2012). This implies that institutions should use *multiple measures* (e.g., HSGPA and Compass scores), when possible. To accommodate the use of multiple measures for course placement, the Compass system offers a feature for weighting HSGPA and other measures, along with Compass scores, to create an overall placement score (ACT, 2006a). Among the institutions that use Compass, however, many students do not have high school grade information, either because they do not have a high school diploma[1] or because an official high school transcript is not readily available. Thus, single-predictor models are also used in practice and warrant research. This study considers three placement models:

1. Compass subject area score only,
2. HSGPA only, and

[1] Among Compass examinees tested between September 1, 2011 and August 31, 2012 who reported their type of high school certificate, 62% reported having a high school diploma, 20% reported still being in high school, 13% reported having a GED, 4% reported not graduating from high school, and 2% reported having a certificate of completion or foreign secondary certificate (ACT, 2012).

3. Compass subject area score and HSGPA.

As noted above, many incoming students do not have high school grade information. This lack of information is more common among adults who are entering or re-entering college several years after high school. Among Compass tests administered in 2011-2012 at two-year colleges, 31% of the examinees were 20 to 29 years old, and another 21% were age 30 or older (ACT, 2012). Because the predictive strength of the Compass placement tests and HSGPA might vary by student age, we compared results for traditional students (age 19 and under) and nontraditional students (age 20 and older).

Data and Methods

The study used course grade data collected from postsecondary institutions (two- and four-year colleges) on Compass examinees. The course grade data were obtained through ACT's Course Placement Service, ACT's Prediction Research Service, and other research partnerships with postsecondary institutions.[2] Several years of Compass and course grade data are included in the study.[3]

When submitting course grade data to ACT, institutions provide a course content code that indicates the course type (e.g., English Composition 1, Elementary Algebra, or Psychology). Institutions also indicate whether the course is standard, developmental (not credit-bearing), or honors. We excluded from the analysis courses that institutions classified as developmental or honors. Note that some institutions consider Arithmetic Skills, Elementary Algebra, and Intermediate Algebra to be developmental courses, but other institutions consider them to be

[2] For more information on ACT's Course Placement Service, please see http://www.act.org/research/services/crsplace/. ACT's Prediction Service is based on students who took the ACT Assessment; some of these students also took Compass. For more information on ACT's Prediction Service, please see http://www.act.org/research/services/predict/, (ACT, 2006b).

[3] Individuals included in the study took Compass between 1995 and 2009.

standard courses. We included these three lower-level mathematics courses in the analyses when the institutions identified them as standard courses.

We paired each course type with a Compass placement test commonly used for placement into the course. For each standard course, students were included in the analysis if they had grade data and a Compass score in the relevant subject. Table 2 contains the overall sample sizes for each course, as well as the Compass placement test that was used for each course. Institutions with fewer than 30 students were excluded from the analysis for each placement model.[4] This minimum number of student records ensured that the statistical models converged.

[4] Because of the minimum sample size requirement, the institutions used for model 2 (HSGPA only) and model 3 (Compass & HSGPA) are a subset of the institutions used for model 1 (Compass only). Therefore, some of the differences across models may be due to sample differences.

Table 2

Sample Size by Course Type and Predictor Set

Course type	Predictor set (see Note 1)	*N* Students			*N* Plac. group (see Note 2)	*N* Inst.
		Overall	Trad.	Non-trad.		
English Composition 1	WS	100,439	53,719	24,405	2,492,578	208
	WS & HSGPA	40,182	29,848	10,448	771,598	
Speech/ Rhetoric	WS	7,040	3,719	2,384	496,359	32
	WS & HSGPA	4,183	2,937	1,176	194,695	
American History	R	7,560	4,096	2,912	607,893	38
	R & HSGPA	3,426	2,091	1,311	221,956	
Other History	R	4,820	2,656	1,108	324,956	22
	R & HSGPA	2,312	1,705	580	102,651	
Psychology	R	29,855	18,030	9,627	1,457,615	101
	R & HSGPA	16,640	12,106	4,393	459,977	
Sociology	R	9,258	5,125	3,119	689,489	35
	R & HSGPA	5,240	3,474	1,678	280,052	
Biology	R	5,937	4,001	1,303	802,400	56
	R & HSGPA	3,573	2,793	744	243,500	
Arithmetic Skills	PA	3,413	1,420	1,642	206,016	13
	PA & HSGPA	1,184	632	547	46,456	
Elementary Algebra	PA	12,965	6,694	2,667	642,579	49
	PA & HSGPA	6,290	4,495	1,390	266,143	
Intermediate Algebra	AL	10,452	5,898	2,358	611,478	44
	AL & HSGPA	4,834	3,699	1,074	206,576	
College Algebra	AL	15,843	8,869	2,943	1,212,720	92
	AL & HSGPA	6,619	4,751	1,537	309,463	
College Algebra	CA	6,261	3,689	619	190,559	44
	CA & HSGPA	2,451	2,005	315	65,276	

Notes.

1. WS = Writing Skills; R = Reading; PA = Pre-Algebra; AL = Algebra; CA = College Algebra; HSGPA = high school grade point average.
2. The "Placement group" consisted of the total number of examinees who completed Compass at an institution, even if the examinee did not later enroll at the institution.

For each course, we examined the Compass-only predictor model for the overall sample. We examined the HSGPA-only and the Compass & HSGPA models for the subsample of students who reported their HSGPA when they took either Compass or the ACT® Assessment.

We also fit separate predictive models for traditional and nontraditional students. From these models, we derived subgroup-specific logistic regression coefficients, accuracy rates, and intervention hit rates.

From Table 2, we note that each course type, with the exception of Arithmetic Skills, included more traditional students than nontraditional students. In English Composition, for example, 69% of the students with known age were traditional. This distribution is not reflective of the entire Compass-tested population (for which 52% of students are nontraditional). We also note that nontraditional students were less likely to have HSGPA data available. For example, for Intermediate Algebra, 63% of the traditional students had HSGPA data available compared to only 46% for the nontraditional students.

Defining Course Success

We defined success as earning a grade of B or higher; students earning C, D, or F grades, or who withdrew from the course, were classified as unsuccessful.[5] This dichotomization causes some loss of information (e.g., "A" grades are not distinguished from "B"s), but it corresponds to how student achievement is generally viewed: Is a student performing well? Over the years we have found that the distributions of first-year course grades, conditional on predictors, are generally not bell-shaped. Course grades below "C" are not assigned with much frequency, and the B criterion better reflects the grading practices college faculty use to discriminate student performance. In contrast, passing course grades of "C" and "D" indicate that students are "getting by" rather than performing well.

In addition to this distinction between getting by and doing well, this definition of success was chosen because students who earn first-year grades of B or higher, on average, are much more likely to complete a postsecondary degree (Radunzel & Noble, 2012). For example, among 4-year students who earn a first-year GPA of at least 3.00 (B or higher grades, on average), 64% earned a Bachelor's degree within six years versus just 27% for 4-year students

[5] In rare cases, colleges used a pass/fail grading system for a credit-bearing course. In these cases, "pass" was treated as successful and "fail" was treated as unsuccessful.

whose first-year GPA is less than 3.00. Similarly, among 2-year students who earn a first-year GPA of at least 3.00, 51% earned an Associate's or Bachelor's degree within six years versus just 19% for 2-year students whose first-year GPA is less than 3.00.[6] Another reason for using this definition of success is that research (Noble & Sawyer, 2013) has shown that students who do not earn a B or higher in developmental courses do not benefit from taking them.

Table 3 contains the proportions of students who were successful, by course type. Consistent with research on ACT-tested students (Allen, 2013), the success rates are highest in English courses (English Composition I and Speech/Rhetoric) and lowest in Biology. Relative to ACT-tested students, however, Compass-tested students typically have lower success rates in English Composition I (49% vs. 59%), College Algebra (42% to 47% vs. 49%), social science courses (41% to 48% vs. 53%), and Biology (35% vs. 47%). These differences are likely caused by differences between ACT-tested students and Compass-tested students in their level of academic preparation.

Table 3

B or Higher Success Rates, by Course

		Proportion successful	
Course type	**Compass test**	**Overall**	**Median***
English Composition 1	Writing Skills	0.49	0.49
Speech/ Rhetoric	Writing Skills	0.54	0.54
American History	Reading	0.42	0.32
Other History	Reading	0.41	0.42
Psychology	Reading	0.45	0.42
Sociology	Reading	0.48	0.41
Biology	Reading	0.35	0.32
Arithmetic Skills	Pre-Algebra	0.43	0.47
Elementary Algebra	Pre-Algebra	0.38	0.36
Intermediate Algebra	Algebra	0.43	0.43
College Algebra	Algebra	0.42	0.42
College Algebra	College Algebra	0.47	0.49

*This is the median success rate across institutions.

[6] The degree completion percentages are obtained from the data set described in Radunzel and Noble (2012).

Statistical Modeling and Validity Measures

Because of the hierarchical nature of the data (students nested within institutions), we used hierarchical logistic regression models to relate the predictors (Compass scores and HSGPA) to the dichotomous success criterion. The hierarchical model allows the intercept and slope to vary across institutions, which is an expected consequence of the variation across colleges in course content and grading standards. We then used the results of the logistic regression models to calculate three validity measures for each course and each institution: the logistic *R*, the accuracy rate, and the intervention hit rate.

The logistic *R* measures the overall predictive strength of the model. This measure is derived in a way that is analogous to multiple *R* for multiple linear regression[7], but is appropriate for logistic regression models. Logistic *R* is defined as the standard deviation of the estimated logit function (Allen & Le, 2008). The higher the logistic *R* is, the stronger the relationship is between the predictors and success in the course. We also present logistic regression coefficients for each predictor.[8]

The accuracy rate estimates the proportion of students who are correctly placed into either standard or developmental courses. The logistic regression model yields a predicted probability of success for each student. Students with a predicted probability of 0.50 or more are treated as placed in the standard course, and students with a predicted probability less than 0.50 are treated as placed in the developmental course. The accuracy rate is estimated as the proportion of students who are placed either in the standard course and are predicted to be successful, or in the developmental course and are predicted to be unsuccessful in the standard course.

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[7] Note that multiple *R* is the square root of R^2, the coefficient of determination.

[8] In a hierarchical model, the coefficients vary across institutions. We present the estimated typical value of each coefficient across institutions.

Dichotomizing the success criterion and setting a cutoff score on the predictor creates four categories of students: those above the cutoff score that are successful (true positives), those above the cutoff score that are not successful (false positives), those below the cutoff score that would be unsuccessful (true negatives), and those below the cutoff score that would be successful (false negatives). In practice, the outcome for students below the cutoff score is not observed, but statistical models like logistic regression allows researchers to estimate the probability of success in the standard course for all tested students. Summing the proportions of correctly placed students (the true positives and the true negatives) yields the accuracy rate (AR). AR is maximized at the score point associated with a 0.50 probability of success; this is known as the *optimal cutoff score.* For more details on the theoretical basis of the accuracy rate and how it is computed, we refer you to previous studies (ACT, 2004; Sawyer, 1996).

The intervention hit rate measures the accuracy of predicting which students are least likely to succeed in standard courses. We defined the intervention hit rate as the proportion of students who are unsuccessful (do not earn a B or higher), among those ranking in the bottom 10% on the placement test scores. This measure is helpful for understanding how effective the predictors are at identifying students for intervention. Similar to logistic *R* and the accuracy rate, a higher intervention hit rate is desirable. However, while increasing the percentage of students flagged increases the intervention hit rate, it also increases the percentage of students incorrectly identified as being in need of intervention. Previous research (Casillas, Allen, Kuo, Pappas, Hanson, & Robbins, 2011) examined intervention hit rates when different percentages (5, 10, 25) of bottom ranked students were flagged for intervention. The percentage flagged for additional academic support depends on institutional capacity. As the intensity and expense of the additional support increases, a lower percentage flagged should be used because institutional

capacity for delivering the additional support would be lower. For this analysis, we decided that flagging the bottom 10% was reasonable and reflects the situation where an institution can provide additional academic support for 10% of the students enrolled in a credit-bearing course. This percentage also provides a reasonable tradeoff between obtaining a high intervention hit rate and misidentifying students as being in need of intervention.

Each validity measure is based on predicted probabilities from a logistic regression model. The sample of students who took each standard first-year course is not the same as the entire group of students at each institution that could potentially be placed into the course. The larger group is known as the *placement group* and includes students who were placed in developmental courses. The validity statistics should be calculated with respect to the placement group, as this is the group of students for whom placement and intervention decisions are made. To approximate the placement group for each college and each course, we included predicted probabilities for all Compass examinees at each college in the study – not just the examinees with grade data from credit-bearing courses. Table 2 includes the placement group sample sizes.

For each course, each validity measure potentially varies by institution. To summarize the results, we present the median of each validity measure across institutions.

As discussed earlier, we completed separate analyses for the overall group of students, for traditional students, and for non-traditional students. The figures for the traditional and nontraditional students allow us to examine what would happen if institutions actually used age-specific placement models. This approach supplements the approach taken in other studies (e.g., Radunzel & Noble, 2013; Sanchez, 2013) in which total group models were used to examine whether subgroup performances were overestimated or underestimated when the total group figures were used.

Limitations

There are limitations of this study that should be understood before interpreting the results. First, although the sample sizes of institutions and students are generally large, the samples were not randomly drawn from the population of students who might enroll in developmental courses. Moreover, the student samples generally included a greater share of traditional students relative to nontraditional students, which is not reflective of the Compass-tested population.

Second, we included institutions that had 30 or more students for each model. The institutions used for model 2 (HSGPA only) and model 3 (Compass & HSGPA) are a subset of the institutions used for model 1 (Compass only). Therefore, some of the differences across models may be due to sample differences rather than to the predictive strength of the model. Also, the sample sizes for the subgroup analyses (traditional and nontraditional students) at some institutions were small. Restricting the analysis to institutions that had at least 30 students in each group with full data (traditional and nontraditional students with both Compass scores and HSGPA) would have resulted in the same set of institutions used for each subgroup and each model. Doing so would have meant ignoring much of our data, however. For example, we had 208 institutions with 30 or more students for the Composition 1 course analyses for Compass Writing Skills scores (Table 2); however, among those 208 institutions, there were only 117 institutions with at least 30 traditional students and at least 30 nontraditional students. Limiting the analyses to those 117 institutions would have meant the exclusion of data from 91 institutions.

Third, we only report median validity statistics (logistic *R*, accuracy rates, and intervention hit rates) across institutions, focusing on "typical" results. Readers should keep in

mind that results vary across institutions due to sampling variability as well as systematic differences in course content, grading practices, and student performance. The full distributions of validity statistics are available upon request.

Fourth, we used student-reported HSGPA rather than actual high school grades. We would expect that HSGPA obtained from official high school transcripts would have greater predictive strength than a self-report measure. However, prior research has shown that the self-reported course work and grades collected on the ACT are generally accurate relative to the actual information provided on student transcripts (ACT, 2013; Sawyer, Laing, & Houston, 1988). Thus, the loss of predictive strength is not likely to be substantial. Furthermore, research has found that most institutions use only placement test scores to make placement decisions (Fields & Parsad, 2012). Only 21% of post-secondary institutions use other criteria, to include high school grades, when placing students into mathematics courses. For reading courses, only 13% of institutions used other criteria.

A fifth limitation is that we only examined models using Compass scores and HSGPA. Additional measures could yield greater predictive strength. Course or subject-specific high school grades, as well as level of high school courses taken, could provide more information than overall HSGPA. Measures of psychosocial factors have also been shown to be incrementally predictive of college course grades in models that include HSGPA and placement test scores (Robbins, Allen, Casillas, Peterson, & Le, 2006). Measuring multiple domains of academic and behavioral readiness has potential to improve the alignment of intervention and student services to student need (Allen, Robbins, & Sawyer, 2010).

Results

In the pages that follow, we present results for the overall predictive strength of the three placement models, the predictive strength separately for traditional and nontraditional students, the conditional probabilities of success at various Compass scores and levels of HSGPA, course placement accuracy rates, and intervention hit rates. Results are presented for each course.

Median Logistic *R*

Table 4 presents the median logistic *R* for the three placement models for eleven first-year courses for the overall group of students. In most cases, the median logistic *R* for HSGPA is higher than that for Compass scores. In all cases, the predictive strength is highest when Compass scores and HSGPA are used jointly. For example, in Psychology courses, the median logistic *R* for Compass Reading scores is 0.47 and for HSGPA it is 0.63, but together the median logistic *R* is 0.77.

Table 4

Overall Predictive Strength, Median Logistic R

		Predictor set		
Course type	**Compass test**	**Compass**	**HSGPA**	**Compass & HSGPA**
English Composition 1	Writing Skills	0.31	0.57	0.62
Speech/ Rhetoric	Writing Skills	0.36	0.69	0.75
American History	Reading	0.40	0.69	0.80
Other History	Reading	0.47	0.67	0.81
Psychology	Reading	0.47	0.63	0.77
Sociology	Reading	0.54	0.60	0.77
Biology	Reading	0.57	0.79	0.92
Arithmetic Skills	Pre-Algebra	0.57	0.34	0.66
Elementary Algebra	Pre-Algebra	0.36	0.65	0.80
Intermediate Algebra	Algebra	0.47	0.66	0.84
College Algebra	Algebra	0.41	0.76	0.88
College Algebra	College Algebra	0.51	0.76	0.94

The results in Table 4 indicate variability in the relative predictive strength of Compass scores and HSGPA across different types of college courses. There is also variability across institutions, but only the median results are given here.

The greatest increase in predictive strength due to the inclusion of HSGPA is observed for Elementary Algebra, where the median logistic R increased from 0.36 (for the Compass only model) to 0.80 (for the Compass + HSGPA model) – an increase of 122%. The greatest increase in predictive strength due to the inclusion of Compass score is observed for Arithmetic Skills, where the median logistic R increased from 0.34 (for the HSGPA only model) to 0.66 (for the Compass + HSGPA model) – an increase of 94%.

The predictive strength of the multiple measure model ranged from a low of 0.62 in English Composition to a high of 0.94 in College Algebra. Across the different course types, the median predictive strength was 0.47 for Compass, 0.67 for HSGPA, and 0.80 for the multiple measures model.

Standardized Logistic Regression Coefficients

Table 5 presents standardized logistic regression coefficients for Compass scores and HSGPA when they are used singularly and jointly.[9] Results are presented separately for the overall group, traditional students, and nontraditional students. Note that the coefficients for HSGPA are typically higher for the traditional students than they are for the nontraditional students. Furthermore, the coefficients for Compass scores are often higher than those for HSGPA for the nontraditional students, a reversal of the pattern seen among the traditional students. For example, for traditional students enrolled in American History courses, the coefficient for Compass Reading scores in the single predictor model is 0.33 and the coefficient

[9] The results in Table 5 are fixed effects in the hierarchical model; they represent the results at typical institutions.

for HSGPA in the same model is 0.99. In contrast, the coefficient for Compass Reading scores is 0.47 and the coefficient for HSGPA is 0.43 for the nontraditional students.

Table 5

Standardized Logistic Regression Coefficients

Course type (Compass test)	Subgroup	Single-pred. models		Two-pred. model	
		Compass	HSGPA	Compass	HSGPA
English Composition 1 (Writing Skills)	Overall	0.34	0.64	0.22	0.61
	Traditional	0.36	0.76	0.25	0.72
	Nontraditional	0.33	0.38	0.21	0.36
Speech/ Rhetoric (Writing Skills)	Overall	0.36	0.74	0.30	0.69
	Traditional	0.38	0.88	0.29	0.82
	Nontraditional	0.34	0.34	0.30	0.31
American History (Reading)	Overall	0.41	0.80	0.39	0.76
	Traditional	0.33	0.99	0.29	0.96
	Nontraditional	0.47	0.43	0.48	0.38
Other History (Reading)	Overall	0.53	0.72	0.51	0.69
	Traditional	0.54	0.92	0.52	0.89
	Nontraditional	0.60	0.38	0.72	0.35
Psychology (Reading)	Overall	0.49	0.68	0.44	0.63
	Traditional	0.48	0.82	0.39	0.77
	Nontraditional	0.52	0.36	0.47	0.32
Sociology (Reading)	Overall	0.60	0.65	0.51	0.60
	Traditional	0.55	0.81	0.41	0.75
	Nontraditional	0.64	0.40	0.62	0.34
Biology (Reading)	Overall	0.59	0.88	0.52	0.81
	Traditional	0.64	0.94	0.50	0.86
	Nontraditional	0.70	0.63	0.83	0.56
Arithmetic Skills (Pre-Algebra)	Overall	0.60	0.38	0.54	0.30
	Traditional	0.66	0.62	0.67	0.51
	Nontraditional	0.67	0.15[a]	0.43	0.08[b]
Elementary Algebra (Pre-Algebra)	Overall	0.42	0.68	0.38	0.64
	Traditional	0.47	0.81	0.43	0.78
	Nontraditional	0.41	0.51	0.32	0.47
Intermediate Algebra (Algebra)	Overall	0.52	0.71	0.48	0.64
	Traditional	0.61	0.82	0.52	0.76
	Nontraditional	0.54	0.36	0.44	0.25
College Algebra (Algebra)	Overall	0.44	0.89	0.39	0.81
	Traditional	0.45	0.95	0.36	0.88
	Nontraditional	0.51	0.65	0.43	0.59
College Algebra (College Algebra)	Overall	0.56	0.78	0.47	0.74
	Traditional	0.61	0.87	0.50	0.82
	Nontraditional	0.42	0.50	0.26[c]	0.47

Note. [a] p=.16; [b] p=.45; [c] p=.12

The hierarchical logistic regression model also provides estimates of the variation in the regression coefficients across institutions. The estimated variances (and their standard errors) are shown in Tables A1 and A2 in the appendix. In these tables it is clear that in most cases the standardized logistic regression coefficients varied across institutions. When looking at the results in Table 5, the standardized coefficient may be larger for one predictor than it is for the other predictor at the "typical" institution. However, the size of each coefficient varies by institution. For example, for the English Composition I overall two-predictor model, the typical size of the Compass Writing Skills coefficient is 0.22 with a standard deviation of 0.17 across institutions while the typical size of the HSGPA coefficient is 0.61 with a standard deviation of 0.15 across institutions.

The unstandardized coefficients and their standard errors are presented Table A3 in the appendix.

Conditional Probabilities of Success

Because Compass scores and HSGPA are jointly predictive of success, the probability of success varies across levels of Compass scores and HSGPA. Table 6 shows the conditional probabilities of success when using five levels of Compass scores and three levels of HSGPA for the overall group of students across institutions. For example, in English Composition 1, students with a Writing Skills score of 30 and HSGPA of 2.0 have only a 0.23 probability of earning a grade of B or higher, but students with the same Writing Skills score and a HSGPA of 4.0 have a 0.65 probability of earning a grade of B or higher. Note that these are median figures calculated using data from multiple institutions. These figures vary across institutions.

Table 6

Conditional Success Probabilities by Compass Score and HSGPA

			Compass score						
Course type	**Compass test**	**HSGPA**	**30**	**40**	**50**	**60**	**70**	**80**	**90**
English Composition 1	Writing Skills	2.00	0.23	0.24	0.26	0.28	0.29	0.31	0.32
		3.00	0.43	0.45	0.47	0.49	0.51	0.53	0.55
		4.00	0.65	0.67	0.69	0.70	0.72	0.74	0.75
Speech/ Rhetoric	Writing Skills	2.00	0.26	0.28	0.30	0.33	0.35	0.37	0.40
		3.00	0.49	0.51	0.54	0.57	0.59	0.62	0.64
		4.00	0.72	0.74	0.76	0.78	0.80	0.81	0.83
American History	Reading	2.00	0.05	0.07	0.09	0.11	0.14	0.17	0.21
		3.00	0.13	0.16	0.20	0.24	0.29	0.34	0.40
		4.00	0.27	0.32	0.38	0.44	0.51	0.57	0.63
Other History	Reading	2.00	0.05	0.06	0.08	0.10	0.13	0.17	0.21
		3.00	0.13	0.16	0.20	0.25	0.30	0.36	0.43
		4.00	0.30	0.36	0.42	0.49	0.55	0.62	0.68
Psychology	Reading	2.00	0.07	0.09	0.11	0.14	0.18	0.23	0.28
		3.00	0.16	0.20	0.24	0.30	0.36	0.42	0.49
		4.00	0.32	0.38	0.45	0.52	0.59	0.65	0.71
Sociology	Reading	2.00	0.07	0.09	0.12	0.15	0.20	0.25	0.31
		3.00	0.14	0.18	0.23	0.29	0.36	0.43	0.51
		4.00	0.27	0.33	0.40	0.48	0.56	0.63	0.70
Biology	Reading	2.00	0.02	0.03	0.04	0.06	0.08	0.10	0.14
		3.00	0.07	0.09	0.12	0.16	0.22	0.28	0.35
		4.00	0.19	0.25	0.32	0.40	0.48	0.56	0.65
Arithmetic Skills	Pre-Algebra	2.00	0.33	0.39	0.45	0.52	0.58	0.64	0.70
		3.00	0.42	0.49	0.55	0.61	0.67	0.72	0.77
		4.00	0.52	0.59	0.65	0.70	0.75	0.80	0.83
Elementary Algebra	Pre-Algebra	2.00	0.15	0.17	0.20	0.23	0.27	0.30	0.34
		3.00	0.32	0.36	0.40	0.45	0.49	0.54	0.58
		4.00	0.56	0.60	0.64	0.69	0.72	0.76	0.79
Intermediate Algebra	Algebra	2.00	0.16	0.20	0.24	0.28	0.33	0.39	0.45
		3.00	0.34	0.40	0.46	0.52	0.58	0.64	0.69
		4.00	0.59	0.64	0.70	0.75	0.79	0.83	0.86
College Algebra	Algebra	2.00	0.10	0.12	0.14	0.17	0.20	0.23	0.27
		3.00	0.27	0.31	0.35	0.40	0.45	0.50	0.55
		4.00	0.55	0.60	0.64	0.69	0.73	0.77	0.80
College Algebra	College Algebra	2.00	0.12	0.15	0.19	0.23	0.27	0.32	0.38
		3.00	0.34	0.40	0.46	0.52	0.58	0.64	0.69
		4.00	0.65	0.71	0.76	0.80	0.84	0.87	0.89

Median Accuracy Rates

Table 7, on page 20, shows the median accuracy rates for the base rate and three predictor sets applied to the overall samples:

1. No placement variables used and all students placed into the standard (non-developmental) course (this is the base rate),
2. Compass score only,
3. HSGPA only, and
4. Compass and HSGPA used jointly.

The general trend is that the accuracy rates for HSGPA are slightly higher than those for Compass scores, but using Compass scores and HSGPA together produces the highest accuracy rates. Using English Composition 1 as an example, the base rate indicates that the estimated probability of success in the course is 0.46 without using any placement variables. When using Compass Writing Skills scores, the accuracy rate increases to 0.61, 0.15 higher than the base rate, and when using HSGPA, the accuracy rate is 0.63, an increase of 0.17 over the base rate. When using Compass Writing Skills scores and HSGPA jointly, the accuracy rate increases to 0.64, an increase of 0.18 over the base rate.

Note that the base rates in Table 7 are generally lower than the success rates reported in Table 3. This result occurs because the base rates are calculated using the placement group (see Table 2), but the success rates are calculated using only the students with course grade data.

Table 7

Median Accuracy Rates, All Students

Course type	Compass test	Base rate	Predictor set		
			Compass	HSGPA	Compass & HSGPA
English Composition 1	Writing Skills	0.46	0.61	0.63	0.64
Speech/ Rhetoric	Writing Skills	0.53	0.59	0.65	0.65
American History	Reading	0.32	0.68	0.68	0.70
Other History	Reading	0.35	0.66	0.67	0.70
Psychology	Reading	0.40	0.63	0.66	0.68
Sociology	Reading	0.38	0.65	0.64	0.67
Biology	Reading	0.30	0.70	0.73	0.74
Arithmetic Skills	Pre-Algebra	0.46	0.64	0.58	0.64
Elementary Algebra	Pre-Algebra	0.35	0.66	0.67	0.69
Intermediate Algebra	Algebra	0.38	0.65	0.66	0.69
College Algebra	Algebra	0.35	0.67	0.70	0.73
College Algebra	College Algebra	0.53	0.63	0.66	0.69

Table 8 presents median accuracy rates, by predictor set, for the traditional students. Their accuracy rates tend to be slightly lower for Compass scores and higher for HSGPA than the results found in the overall analyses (Table 7), but the median accuracy rates for the joint use of Compass scores and HSGPA are quite similar to the overall analyses, with four higher, four lower, and four unchanged.

Table 8

Median Accuracy Rates, Traditional Students

Course type	Compass placement test	Base rate	Predictor set		
			Compass	HSGPA	Compass & HSGPA
English Composition 1	Writing Skills	0.47	0.60	0.64	0.64
Speech/ Rhetoric	Writing Skills	0.51	0.58	0.65	0.65
American History	Reading	0.34	0.66	0.70	0.71
Other History	Reading	0.36	0.64	0.68	0.69
Psychology	Reading	0.39	0.62	0.66	0.67
Sociology	Reading	0.37	0.65	0.66	0.68
Biology	Reading	0.33	0.67	0.69	0.70
Arithmetic Skills	Pre-Algebra	0.37	0.66	0.63	0.67
Elementary Algebra	Pre-Algebra	0.34	0.66	0.69	0.69
Intermediate Algebra	Algebra	0.41	0.63	0.64	0.66
College Algebra	Algebra	0.41	0.63	0.67	0.69
College Algebra	College Algebra	0.49	0.62	0.67	0.69

Table 9 shows accuracy rates, by predictor set, for the nontraditional students. Jointly using Compass scores and HSGPA generally produced the highest median accuracy rates for the nontraditional students as well, but the results in Table 9 yield four interesting patterns. First, all twelve median base accuracy rates in the nontraditional student analyses are higher than those seen in the overall analyses (Table 7), and ten of the twelve are higher than those in the traditional student analyses (Table 8). What this means is that the older, nontraditional students have a higher estimated probability of success in these courses than do the younger, traditional students.

Table 9

Median Accuracy Rates, Nontraditional Students

Course type	Compass placement test	Base rate	Predictor set		
			Compass	HSGPA	Compass & HSGPA
English Composition 1	Writing Skills	0.49	0.58	0.60	0.60
Speech/ Rhetoric	Writing Skills	0.55	0.59	0.57	0.60
American History	Reading	0.39	0.63	0.66	0.67
Other History	Reading	0.42	0.61	0.66	0.66
Psychology	Reading	0.44	0.61	0.61	0.63
Sociology	Reading	0.45	0.63	0.60	0.65
Biology	Reading	0.31	0.69	0.72	0.72
Arithmetic Skills	Pre-Algebra	0.52	0.62	0.57	0.58
Elementary Algebra	Pre-Algebra	0.41	0.63	0.62	0.64
Intermediate Algebra	Algebra	0.43	0.63	0.63	0.66
College Algebra	Algebra	0.40	0.65	0.66	0.69
College Algebra	College Algebra	0.56	0.61	0.62	0.61

Second, all but one of the median accuracy rates for the predictors used individually or jointly are lower than those in Tables 7 and 8. That is, Compass scores and HSGPA have lower predictive strength for nontraditional students than they do for traditional students. This suggests that other, unmeasured factors affect the performance of nontraditional more than they affect the performance of traditional students. Family and work commitments, among other factors, may explain this difference.

Third, though the median accuracy rates for Compass scores for the non-traditional students are generally lower than those for the traditional students (Table 8), the differences between median accuracy rates for HSGPA for traditional and non-traditional students tend to be even larger. This suggests that the validity of HSGPA decays over time. This is related to the fourth point, which is that the median accuracy rates for Compass scores alone are equal to or higher than those for HSGPA alone for six of the twelve analyses. This occurs only once among the traditional students and three times in the overall analyses. This suggests that HSGPA

provides less information about the future performance of nontraditional students than it does for traditional students.

Median Intervention Hit Rates

Table 10 presents the median intervention hit rates for the base rate and three predictor sets:

1. No variables used to identify students for intervention (this is the base rate),

2. Compass score only,

3. HSGPA only, and

4. Compass and HSGPA used jointly.

The intervention hit rate is defined as the proportion of students expected to be unsuccessful in the course (i.e., earn a C or lower grade or withdraw from the course), among those scoring in the bottom 10% on the predictor variable(s) at each institution. In the context of the intervention hit rate, therefore, the base rate is the overall proportion of students expected not to succeed. Thus, the base rates for the intervention hit rates differ from the base rates for the accuracy rates given in Table 7.

Table 10

Median Intervention Hit Rates, All Students

			Predictor set		
Course type	**Compass test**	**Base rate**	**Compass**	**HSGPA**	**Compass & HSGPA**
English Composition 1	Writing Skills	0.54	0.69	0.77	0.78
Speech/ Rhetoric	Writing Skills	0.47	0.62	0.75	0.78
American History	Reading	0.68	0.82	0.89	0.90
Other History	Reading	0.65	0.86	0.88	0.92
Psychology	Reading	0.60	0.80	0.84	0.88
Sociology	Reading	0.62	0.84	0.82	0.87
Biology	Reading	0.70	0.89	0.92	0.94
Arithmetic Skills	Pre-Algebra	0.54	0.70	0.67	0.74
Elementary Algebra	Pre-Algebra	0.65	0.76	0.87	0.88
Intermediate Algebra	Algebra	0.62	0.70	0.87	0.88
College Algebra	Algebra	0.65	0.76	0.91	0.92
College Algebra	College Algebra	0.47	0.67	0.82	0.84

The general pattern is that the intervention hit rates for HSGPA are slightly higher than those for Compass scores, but using Compass scores and HSGPA together produces the highest median intervention hit rates. Again using English Composition 1 as an example, the median intervention hit rate for Compass Writing Skills scores is 0.69, which is 0.15 higher than the base rate. The median hit rate for HSGPA is 0.77, and when using Compass Writing Skills scores and HSGPA jointly, the median hit rate increases to 0.78, an increase of 0.24 over the base rate.

Table 11 presents the median intervention hit rates for the base rate and three predictor sets for traditional students. As with the median accuracy rates, the median intervention rates for the traditional students in Table 11 tend to parallel the results from the overall analyses (Table 10), with the median intervention hits rates generally higher for HSGPA than they are for Compass scores, and with the highest rates associated with the joint use of Compass scores and HSGPA.

Table 11

Median Intervention Hit Rates, Traditional Students

Course type	Compass placement test	Base rate	Predictor set		
			Compass	HSGPA	Compass & HSGPA
English Composition 1	Writing Skills	0.53	0.66	0.74	0.75
Speech/ Rhetoric	Writing Skills	0.49	0.62	0.77	0.75
American History	Reading	0.66	0.78	0.90	0.90
Other History	Reading	0.64	0.81	0.87	0.88
Psychology	Reading	0.61	0.78	0.85	0.86
Sociology	Reading	0.63	0.83	0.83	0.86
Biology	Reading	0.67	0.85	0.91	0.92
Arithmetic Skills	Pre-Algebra	0.63	0.79	0.77	0.82
Elementary Algebra	Pre-Algebra	0.66	0.78	0.87	0.88
Intermediate Algebra	Algebra	0.59	0.73	0.83	0.84
College Algebra	Algebra	0.59	0.73	0.87	0.87
College Algebra	College Algebra	0.49	0.71	0.82	0.85

Table 12 shows median intervention hit rates, by predictor set, for nontraditional students. The highest median intervention hit rates are generally those for the joint use of Compass scores and HSGPA, though there were two exceptions (Arithmetic Skills and College Algebra using Compass College Algebra). As with the median accuracy rates for nontraditional students, however, there are also interesting trends seen in the median intervention hit rate results for the nontraditional students. One is that the base rates are generally lower than those in the overall and traditional student analyses. Another is that although the median intervention hit rates are lower for both Compass scores and HSGPA when compared to the results for the traditional students, the magnitude of the differences tends to be larger for HSGPA, with seven of the rates for HSGPA being more than 0.10 lower for the non-traditional students than for the traditional students. Finally, the median intervention hit rates associated with the joint use of Compass scores and HSGPA were always lower than those seen in the overall analyses (Table 10) and almost always lower than those for the traditional students (Table 11).

Table 12

Median Intervention Hit Rates, Nontraditional Students

			Predictor set		
Course type	**Compass test**	**Base rate**	**Compass**	**HSGPA**	**Compass & HSGPA**
English Composition 1	Writing Skills	0.51	0.63	0.67	0.67
Speech/ Rhetoric	Writing Skills	0.45	0.58	0.63	0.66
American History	Reading	0.61	0.74	0.76	0.80
Other History	Reading	0.58	0.77	0.71	0.83
Psychology	Reading	0.56	0.75	0.72	0.78
Sociology	Reading	0.55	0.78	0.72	0.83
Biology	Reading	0.69	0.88	0.89	0.93
Arithmetic Skills	Pre-Algebra	0.48	0.65	0.52	0.58
Elementary Algebra	Pre-Algebra	0.59	0.72	0.74	0.78
Intermediate Algebra	Algebra	0.57	0.70	0.75	0.78
College Algebra	Algebra	0.60	0.76	0.86	0.89
College Algebra	College Algebra	0.44	0.56	0.79	0.71

Summary of Results

Overall predictive strength

- When both Compass scores and HSGPA were available, the predictive strength of their joint use exceeded that of either measure used individually.
- For the overall group and traditional students (age 19 and under), HSGPA was typically a stronger predictor than Compass scores of earning a grade of B or higher.
- For the nontraditional students, Compass scores were stronger than HSGPA in predicting success in 7 of the 11 courses studied.
- The standardized logistic regression coefficients for HSGPA used alone or with Compass scores were higher for traditional students than they were for nontraditional students.
- The standardized logistic regression coefficients for Compass scores were similar for traditional and nontraditional students.

Accuracy rates

- When both Compass scores and HSGPA were available, the accuracy rate of their joint use exceeded that of either measure used individually in all but one course (Arithmetic Skills[10]).
- For the overall group, the accuracy rates when using HSGPA alone tended to be higher than the accuracy rates when using Compass score alone.
- All of the differences between the median accuracy rates for Compass scores and the median accuracy rates for HSGPA were 0.06 or less, and for ten of the twelve courses the difference was 0.03 or less.
- Compared to the overall results, the differences between the median accuracy rates for Compass scores and the median accuracy rates for HSGPA were slightly larger for the traditional students and slightly smaller for the nontraditional students.

Intervention hit rates

- When both Compass scores and HSGPA were available, intervention hit rates for Compass scores and HSGPA used together were higher than those for HSGPA alone or Compass scores alone in all but one course (Intermediate Algebra).
- For the overall group and traditional students, the hit rates when HSGPA was used alone were generally higher than the hit rates when using Compass scores alone.
- For nontraditional students, the differences between the median intervention hit rates for Compass scores and the median accuracy rates for HSGPA used alone were generally smaller than the differences seen with the traditional students.

[10] The decline in the accuracy rate from the Compass-only model to the joint model can be attributed to using a different sample of students to estimate the joint model. (The sample used for the joint model is a subset of the sample used for the Compass-only model).

Discussion

We examined the strength of Compass placement tests and high school GPA for predicting success in first-year college courses. Predictive strength, course placement accuracy, and accuracy of identifying at-risk students are statistics that inform validity arguments for Compass and high school GPA. Consistent with other research, the combination of high school GPA and Compass scores performed better than either measure used alone. When HSGPA is available, its joint use with Compass scores helps institutions predict student success in courses, make placement decisions, and identify at-risk students. However, HSGPA is not always available, especially for nontraditional students enrolling at two-year institutions.

The analyses for traditional and nontraditional students have provided new insights on the value of Compass scores for institutions serving nontraditional students (age 20 and older). The results indicate that the overall predictive strength of HSGPA tended to be lower for nontraditional students than it was for traditional students, and Compass scores were often the stronger predictor of academic performance for nontraditional students. The diminished predictive strength of HSGPA for nontraditional students was also seen in the analyses for accuracy rates and intervention hit rates. This may be due to the passage of time between high school completion and entry (or re-entry) into postsecondary education. The decline in the predictive strength of HSGPA makes Compass scores especially important for placement and intervention for nontraditional students. Because the study sample included fewer nontraditional students (relative to the overall Compass examinee population), the overall predictive strength of HSGPA is likely to be overestimated. On the other hand, the use of self-reported HSGPA versus official transcript HSGPA may have the effect of underestimating the predictive strength of HSGPA.

It is also important to note that many students in the Compass-tested population are still in high school.[11] Further research needs to address the question of whether high school student status moderates the relationship between HSGPA and college course success. We have observed that traditional/nontraditional status moderates the relationship of HSGPA and college course success, but further research could examine additional potential moderators of both Compass scores and HSGPA, including gender, full-time/part-time status, ethnicity, and first generation status.

The study findings can also be helpful to Compass users who wish to use HSGPA in a multiple measures model and want to know how much weight to assign to each measure. The unstandardized regression coefficients in the appendix (Table A3) provide starting points for weighting Compass scores and HSGPA. For example, Figure 1 plots the probability of success in Intermediate Algebra, by Compass Algebra Score and HSGPA.

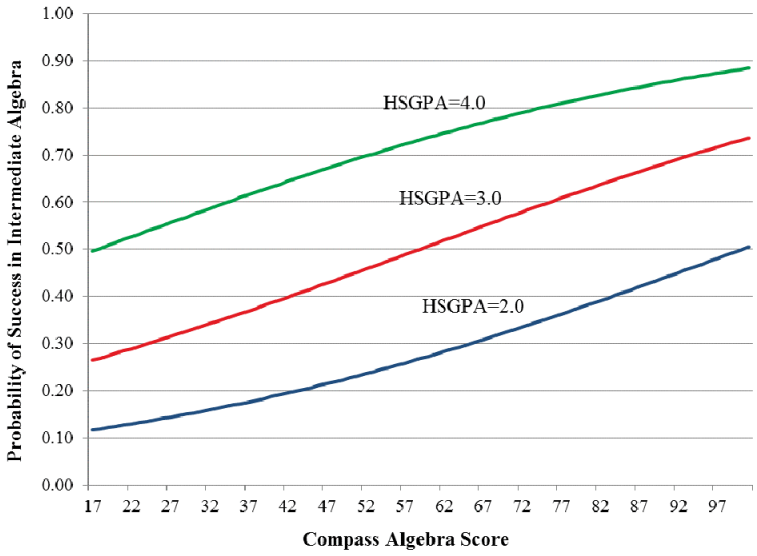

Figure 1. Probability of Success in Intermediate Algebra, by Compass Algebra Score and HSGPA.

[11] Among Compass examinees who reported their type of high school certificate, 20% reported still being in high school (ACT, 2012).

Figure 1 is created by applying the logistic regression model to obtain the predicted probability of success (p), using the estimated regression coefficients in Table A1:

$$p = \frac{\exp(L)}{1 + \exp(L)}$$

$$L = -4.4027 + 0.0244 \times \text{Compass Algebra Score} + 1.005 \times \text{HSGPA}$$

Note that the regression coefficients (-4.4027, 0.0244, and 1.005) are obtained from the appendix and are specific to Intermediate Algebra, without differentiating between traditional and nontraditional students. We recommend that individual institutions develop their own placement models from analyses of their own data.[12] The findings of this study, including the estimated regression coefficients, can be used as one consideration for determining optimal placement strategies.

An alternative to formally assigning weights in multiple measures is to use "decision zones": For students whose scores are within a band of the Compass cutoff score, HSGPA and other information can be used to make the placement decision. When other information (e.g., HSGPA or other test scores) is not readily available but can be obtained through additional data collection (e.g., requesting high school transcripts) or more testing, the decision zone approach offers some efficiency because the expense of obtaining additional information can be avoided for students who score outside of the decision zone.

Despite the validity decay associated with HSGPA, models that use HSGPA and Compass jointly perform better than single-predictor models, even for nontraditional students. This is especially true for English Composition courses, where HSGPA was a stronger predictor of success for both traditional and nontraditional students. We therefore recommend using

[12] ACT's Course Placement Service (http://www.act.org/research/services/crsplace/) provides a convenient mechanism for doing this.

multiple measures for making course placement decisions and identifying students for intervention whenever possible.

Finally, recall that the HSGPA data used in this study were self-reported by students. Because of the stakes involved with course placement decisions, it is possible that self-reported HSGPA would experience a decline in predictive strength if routinely used as a placement measure. HSGPA data obtained from official student transcripts is therefore more trustworthy for use in making course placement decisions. Recent initiatives to streamline the collection and distribution of high school transcript information have potential to help colleges use HSGPA (and high school course work) for placement and intervention systematically and efficiently.[13]

[13] Examples of state high school transcript initiatives include the Iowa Department of Education's Electronic Transcript & Student Record Project and the Data Quality Campaign's inclusion of "Student-level transcript information, including information on courses completed and grades earned" among the 10 essential elements of a comprehensive longitudinal data system (Laird, 2008).

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Appendix

Tables A1, A2, and A3

Table A1

Estimated Variances across Institutions of Standardized Logistic Regression Coefficients in the Single-Predictor Models (Standard Errors in Parentheses)

Course Type (Compass test)	Subgroup	Compass		HSGPA	
		Intercept	Slope	Intercept	Slope
English Composition 1 (Writing Skills)	Overall	0.259 (0.030)	0.039 (0.007)	0.271 (0.036)	0.027 (0.008)
	Traditional	0.366 (0.048)	0.034 (0.008)	0.301 (0.044)	0.026 (0.010)
	Nontraditional	0.282 (0.040)	0.031 (0.011)	0.341 (0.055)	0.013 (0.009)
Speech/ Rhetoric (Writing Skills)	Overall	0.139 (0.049)	0.047 (0.023)	0.267 (0.094)	0.040 (0.023)
	Traditional	0.152 (0.061)	0.016 (0.017)	0.272 (0.103)	0.025 (0.024)
	Nontraditional	0.079 (0.055)	0.056 (0.050)	0.165 (0.095)	
American History (Reading)	Overall	0.266 (0.077)	0.004 (0.010)	0.417 (0.135)	0.080 (0.049)
	Traditional	0.330 (0.109)		0.370 (0.136)	0.124 (0.089)
	Nontraditional	0.378 (0.142)	0.006 (0.015)	0.530 (0.208)	
Other History (Reading)	Overall	0.227 (0.088)	0.073 (0.043)	0.352 (0.142)	0.000 (0.000)
	Traditional	0.182 (0.077)	0.042 (0.044)	0.206 (0.103)	0.126 (0.111)
	Nontraditional	0.487 (0.204)		0.904 (0.398)	
Psychology (Reading)	Overall	0.316 (0.053)	0.057 (0.016)	0.502 (0.091)	0.060 (0.017)
	Traditional	0.341 (0.064)	0.062 (0.020)	0.475 (0.094)	0.051 (0.020)
	Nontraditional	0.382 (0.077)	0.048 (0.022)	0.477 (0.112)	0.009 (0.011)
Sociology (Reading)	Overall	0.278 (0.080)	0.029 (0.018)	0.348 (0.108)	0.039 (0.024)
	Traditional	0.353 (0.112)	0.033 (0.023)	0.320 (0.104)	0.057 (0.041)
	Nontraditional	0.344 (0.128)	0.060 (0.046)	0.575 (0.226)	0.001 (0.014)
Biology (Reading)	Overall	0.145 (0.044)	0.075 (0.036)	0.215 (0.072)	0.037 (0.030)
	Traditional	0.226 (0.072)	0.069 (0.050)	0.173 (0.073)	0.067 (0.042)
	Nontraditional	0.166 (0.085)	0.083 (0.074)	0.406 (0.182)	0.051 (0.089)
Arithmetic Skills (Pre-Algebra)	Overall	0.344 (0.152)	0.005 (0.014)	0.391 (0.216)	0.080 (0.088)
	Traditional	0.560 (0.282)	0.010 (0.030)	0.386 (0.242)	0.097 (0.120)
	Nontraditional	0.222 (0.116)	0.077 (0.086)	0.378 (0.292)	
Elementary Algebra (Pre-Algebra)	Overall	0.259 (0.074)	0.055 (0.021)	0.314 (0.100)	0.026 (0.019)
	Traditional	0.130 (0.049)	0.036 (0.026)	0.196 (0.073)	
	Nontraditional	0.492 (0.174)	0.036 (0.025)	0.492 (0.197)	0.005 (0.024)
Intermediate Algebra (Algebra)	Overall	0.257 (0.070)	0.040 (0.016)	0.459 (0.143)	0.045 (0.030)
	Traditional	0.216 (0.072)	0.026 (0.022)	0.392 (0.135)	0.022 (0.028)
	Nontraditional	0.578 (0.189)	0.021 (0.026)	0.732 (0.287)	0.067 (0.064)
College Algebra (Algebra)	Overall	0.443 (0.080)	0.058 (0.016)	0.490 (0.103)	0.073 (0.033)
	Traditional	0.438 (0.089)	0.045 (0.018)	0.482 (0.113)	0.079 (0.039)
	Nontraditional	0.636 (0.151)	0.030 (0.021)	0.771 (0.214)	0.069 (0.069)
College Algebra (College Algebra)	Overall	0.281 (0.073)	0.088 (0.032)	0.417 (0.126)	0.048 (0.042)
	Traditional	0.307 (0.092)	0.062 (0.037)	0.471 (0.149)	0.046 (0.041)
	Nontraditional	0.294 (0.142)	0.045 (0.088)	0.320 (0.198)	0.115 (0.144)

Note. Blank spaces indicate that the model did not detect statistically significant variation across institutions.

Table A2

Estimated Variances across Institutions of Standardized Logistic Regression Coefficients in the Two-Predictor Models (Standard Errors in Parentheses)

Course type (Compass test)	Subgroup	Intercept	Compass	HSGPA
English Composition 1 (Writing Skills)	Overall	0.2759 (0.0363)	0.0296 (0.0090)	0.0237 (0.0075)
	Traditional	0.3136 (0.0456)	0.0207 (0.0085)	0.0188 (0.0089)
	Nontraditional	0.3318 (0.0544)	0.0171 (0.0142)	0.0124 (0.0091)
Speech/ Rhetoric (Writing Skills)	Overall	0.2668 (0.0962)	0.0387 (0.0351)	0.0321 (0.0198)
	Traditional	0.2915 (0.1085)		0.0175 (0.0201)
	Nontraditional	0.1577 (0.0954)	0.0781 (0.0825)	
American History (Reading)	Overall	0.4338 (0.1394)		0.0725 (0.0478)
	Traditional	0.3794 (0.1374)		0.1085 (0.0843)
	Nontraditional	0.6031 (0.2438)	0.1070 (0.1384)	
Other History (Reading)	Overall	0.3091 (0.1294)	0.0764 (0.0725)	
	Traditional	0.1987 (0.0986)	0.0118 (0.0312)	0.0748 (0.0878)
	Nontraditional	0.9061 (0.3983)		
Psychology (Reading)	Overall	0.5348 (0.0965)	0.0351 (0.0149)	0.0532 (0.0164)
	Traditional	0.5032 (0.0985)	0.0530 (0.0225)	0.0385 (0.0175)
	Nontraditional	0.5416 (0.1258)	0.0032 (0.0144)	0.0094 (0.0119)
Sociology (Reading)	Overall	0.3434 (0.1062)	0.0151 (0.0194)	0.0343 (0.0220)
	Traditional	0.3183 (0.1024)	0.0160 (0.0169)	0.0451 (0.0371)
	Nontraditional	0.5569 (0.2269)	0.1153 (0.1113)	
Biology (Reading)	Overall	0.1864 (0.0666)	0.0524 (0.0516)	0.0231 (0.0271)
	Traditional	0.1426 (0.0642)		0.0460 (0.0363)
	Nontraditional	0.4684 (0.2065)		0.0398 (0.0855)
Arithmetic Skills (Pre-Algebra)	Overall	0.3861 (0.2132)	0.0179 (0.0366)	0.0837 (0.0903)
	Traditional	0.3863 (0.2421)	0.0581 (0.1221)	0.1123 (0.1293)
	Nontraditional	0.4049 (0.3028)	0.0247 (0.0801)	
Elementary Algebra (Pre-Algebra)	Overall	0.3052 (0.0968)	0.0260 (0.0146)	0.0191 (0.0166)
	Traditional	0.2141 (0.0797)	0.0057 (0.0095)	
	Nontraditional	0.4357 (0.1828)	0.0907 (0.0528)	0.0031 (0.0226)
Intermediate Algebra (Algebra)	Overall	0.4871 (0.1519)	0.0423 (0.0266)	0.0472 (0.0320)
	Traditional	0.4214 (0.1445)	0.0192 (.02320)	0.0235 (0.0297)
	Nontraditional	0.7316 (0.2948)	0.0634 (0.0565)	0.0464 (0.0609)
College Algebra (Algebra)	Overall	0.5164 (0.1098)	0.0407 (0.0173)	0.0746 (0.0334)
	Traditional	0.5381 (0.1271)	0.0495 (0.0221)	0.0835 (0.0412)
	Nontraditional	0.7279 (0.2014)	0.0096 (0.0210)	0.0719 (0.0670)
College Algebra (College Algebra)	Overall	0.3960 (0.1219)	0.0771 (0.0440)	0.0512 (0.0434)
	Traditional	0.4105 (0.1342)	0.0834 (0.0507)	0.0438 (0.0407)
	Nontraditional	0.3083 (0.2000)	0.0723 (0.1678)	0.0688 (0.1359)

Note. Blank spaces indicate that the model did not detect statistically significant variation across institutions.

Table A3

Estimated Unstandardized Logistic Regression Fixed-Effects Coefficients (Standard Errors in Parentheses)

Course type (Compass test)	Subgroup	Intercept	Compass	HSGPA
English Composition 1 (Writing Skills)	Overall	-3.2785 (0.0813)	0.0078 (0.0007)	0.9200 (0.0223)
	Traditional	-3.8958 (0.0963)	0.0084 (0.0007)	1.1276 (0.0261)
	Nontraditional	-2.1722 (0.1296)	0.0065 (0.0011)	0.5456 (0.0353)
Speech/ Rhetoric (Writing Skills)	Overall	-3.3527 (0.2249)	0.0106 (0.0018)	0.9952 (0.0682)
	Traditional	-4.0510 (0.2609)	0.0099 (0.0017)	1.2330 (0.0787)
	Nontraditional	-1.7268 (0.3294)	0.0078 (0.0030)	0.4760 (0.1005)
American History (Reading)	Overall	-5.4835 (0.3438)	0.0256 (0.0031)	0.9282 (0.0676)
	Traditional	-5.9795 (0.4383)	0.0194 (0.0039)	1.2784 (0.0950)
	Nontraditional	-4.8264 (0.5726)	0.0301 (0.0056)	0.5767 (0.1012)
Other History (Reading)	Overall	-5.8559 (0.4353)	0.0268 (0.0044)	1.0497 (0.0832)
	Traditional	-6.3426 (0.4922)	0.0248 (0.0047)	1.3019 (0.1034)
	Nontraditional	-5.6976 (0.9653)	0.0416 (0.0104)	0.5440 (0.1551)
Psychology (Reading)	Overall	-5.2787 (0.1844)	0.0275 (0.0016)	0.9247 (0.0429)
	Traditional	-5.6743 (0.1973)	0.0236 (0.0018)	1.1453 (0.0426)
	Nontraditional	-4.0511 (0.2931)	0.0295 (0.0029)	0.4753 (0.0548)
Sociology (Reading)	Overall	-5.2252 (0.2725)	0.0311 (0.0024)	0.8204 (0.0550)
	Traditional	-5.4600 (0.3225)	0.0243 (0.0030)	1.0728 (0.0704)
	Nontraditional	-4.6442 (0.5032)	0.0357 (0.0052)	0.5287 (0.0908)
Biology (Reading)	Overall	-7.2823 (0.3716)	0.0340 (0.0036)	1.2064 (0.0760)
	Traditional	-7.4851 (0.4137)	0.0326 (0.0039)	1.3266 (0.0896)
	Nontraditional	-7.8534 (0.9414)	0.0530 (0.0095)	0.7973 (0.1547)
Arithmetic Skills (Pre-Algebra)	Overall	-2.2506 (0.3775)	0.0254 (0.0040)	0.3946 (0.1119)
	Traditional	-3.7439 (0.5399)	0.0312 (0.0058)	0.7833 (0.1703)
	Nontraditional	-1.3220 (0.5108)	0.0226 (0.0060)	0.1272 (0.1613)
Elementary Algebra (Pre-Algebra)	Overall	-4.2724 (0.2004)	0.0182 (0.0021)	0.9903 (0.0531)
	Traditional	-5.0575 (0.2370)	0.0213 (0.0020)	1.1953 (0.0667)
	Nontraditional	-3.1182 (0.3471)	0.0142 (0.0041)	0.7174 (0.1020)
Intermediate Algebra (Algebra)	Overall	-4.4027 (0.2419)	0.0244 (0.0030)	1.0053 (0.0640)
	Traditional	-5.0561 (0.2795)	0.0270 (0.0029)	1.1937 (0.0764)
	Nontraditional	-2.3824 (0.3839)	0.0218 (0.0053)	0.3659 (0.1313)
College Algebra (Algebra)	Overall	-5.1914 (0.2155)	0.0198 (0.0020)	1.1985 (0.0584)
	Traditional	-5.2143 (0.2523)	0.0181 (0.0023)	1.2557 (0.0706)
	Nontraditional	-4.6022 (0.4111)	0.0220 (0.0033)	0.0987 (0.1164)
College Algebra (College Algebra)	Overall	-5.3309 (0.3614)	0.0249 (0.0038)	1.3034 (0.0984)
	Traditional	-5.9113 (0.4200)	0.0258 (0.0041)	1.4287 (0.1135)
	Nontraditional	-3.2469 (0.8042)	0.0156 (0.0084)	0.8545 (0.2385)

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