Educational Assessment, 20:23–45, 2015

ISSN: 1062-7197 print/1532-6977 online
DOI: 10.1080/10627197.2015.997614

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College Performance and Retention: A Meta-Analysis of the Predictive Validities of ACT® Scores, High School Grades, and SES

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This meta-analysis examines the strength of the relationships of ACT® Composite scores, high school grades, and socioeconomic status (SES) with academic performance and persistence into the 2nd and 3rd years at 4-year colleges and universities. Based upon a sample of 189,612 students at 50 institutions, ACT Composite scores and high school grade point average (GPA) are highly correlated with 1st-year academic performance. First-year academic performance emerges as the best predictor of 2nd- and 3rd-year retention. SES is a weak predictor of both academic performance and retention. Moderator analyses of admission selectivity indicate that although the estimated mean validity coefficients for ACT Composite scores and high school GPA vary slightly, the credibility intervals indicate they are valid predictors across levels of admission selectivity. This longitudinal study demonstrates the importance of precollege academic preparation and how success in the 1st year of college strongly influences persistence toward completing a degree.

For decades colleges have used test scores, notably the ACT and SAT, and high school grade point average (GPA) as predictors of academic performance and persistence (Zwick, 2006, provided a summary of the research on this topic). Although standardized test scores and high

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school GPA are highly correlated, each contributes to the prediction of academic performance and persistence as seen in recent research (ACT, 2007; Allen, Robbins, Casillas, & Oh, 2008; Bridgeman, Pollack, & Burton, 2008; Kobrin, Patterson, Shaw, Mattern, & Barbuti, 2008; Mattern & Patterson, 2010, 2011a, 2011b, 2011c, 2011d, 2011e; Robbins, Allen, Casillas, Peterson, & Le, 2006; Robbins et al., 2004; Willingham, Pollack, & Lewis, 2002).

In this study, we present meta-analyses that integrate precollege achievement measures, academic performance, and academic persistence. We first investigate the validity coefficients of ACT Composite score, high school GPA, and socioeconomic status (SES) on 1st-year GPA, 2nd-year retention, and the relationship between 1st-year GPA and 2nd-year retention. Although Sackett, Kuncel, Arneson, Cooper, and Waters (2009) found that the contribution of SES as a predictor of academic performance was negligible, we include it as a variable because of its hypothesized relationship with retention and to replicate the Sackett et al. findings. We then extend the analyses out to 3rd-year retention and include 2nd-year cumulative GPA. We also perform moderator analyses. For 1st-year GPA and 2nd-year retention, we examine mean correlations disaggregated by admission selectivity to determine if the relationships between our predictor variables and outcome variables differ across selectivity levels. We then examine the effects of admission selectivity in the analyses for 2nd-year academic performance and 3rd-year retention.

ACADEMIC PERFORMANCE AND PERSISTENCE

Traditionally, most validity studies have defined college academic performance as 1st-year GPA (Wilson, 1983; Zwick, 2006), a cumulative measure of grades earned in multiple semesters or quarters. Research on differential grading across academic majors has demonstrated that GPA has its limitations as a criterion measure of academic performance because the criterion is not exactly the same when considering students taking courses in different academic fields (e.g., Goldman & Widawski, 1976; V. E. Johnson, 1997; Strenta & Elliot, 1987), but grades earned in the first 2 years of college are somewhat more comparable given that students are taking more general education courses than major-specific courses. Although there can be alternative definitions and operationalizations of the construct, such as term GPA (e.g., Humphreys, 1968) or subject-area GPA (e.g., Bridgeman et al., 2008), we use cumulative GPA to represent academic performance in the current study. This approach allows results to be comparable to earlier research findings (Kobrin et al., 2008; Mattern & Patterson, 2011d; Sackett et al., 2009). Our other outcome variable of interest, academic persistence, is defined as students' continued enrollment at the college they had originally entered (cf. Robbins et al., 2004).

Although high school GPA has been one of the best predictors of undergraduate academic performance, it does have shortcomings. First, high school grading standards vary across the country, from school to school and from teacher to teacher (Woodruff & Ziomek, 2004a, 2004b). High school class rank is also not a perfect measure because a student's academic rank within a school is relative to the other students in the school. Another issue is that curriculums vary across high schools. Some high school curriculums challenge their students to perform at their maximum levels, but students at other high schools could receive perfect grades without ever being pushed to perform at a level approaching what is required in college. In contrast, standardized admission test scores provide a common measure that institutions can use to compare applicants regardless of which high school they attended.

A second factor to consider is that grades are measures of both academic and nonacademic characteristics. Willingham et al. (2002) provided a summary of the research on variations in grading standards, and they identified nonacademic components such as attendance, citizenship, participation, disruptive behavior, effort, coping skills, and interpersonal competence as factors that teachers consider when assigning grades, characteristics of typical classroom behavior. Likewise, Noble and Sawyer (2004) and Sawyer (2007) posited that high school GPA measures cognitive, noncognitive, and behavioral characteristics, whereas ACT scores predominantly measure cognitive characteristics. Consequently, in addition to variation in grading standards, admission officers do not know how much of a student's GPA is due to favorable behavior in an academic setting and how much is due to academic achievement. Standardized tests, on the other hand, provide a common measure regardless of high school attended and are designed to measure cognitive factors.

High school GPA and admission test scores are individually valid predictors of undergraduate academic performance, but together they provide a more accurate prediction of future academic performance (ACT, 2007; Bridgeman et al., 2008; Kobrin et al., 2008; Linn, 1982; Sawyer, 2010; Willingham, Lewis, Morgan, & Ramist, 1990). ACT (2007) reported that the median multiple correlation for the four ACT subject area tests was .42, but when using ACT scores and high school course grades together the "median multiple correlation for the regression of college GPA jointly on the four ACT scores and the four high school subject area averages (in English, mathematics, social studies, and natural sciences) was .53" (p. 94). For the SAT, Kobrin et al. (2008) reported that the uncorrected correlation between high school GPA and 1st-year GPA was .36 and the multiple correlation of high school GPA and the three SAT subtests with 1st-year GPA was .46. After making corrections for range restriction, the adjusted correlations were .54 and .62, respectively.

Although the relationships of standardized test scores and high school GPA with 1st-year academic performance are well established, their relationships with academic performance beyond the 1st year have received less attention (Wilson, 1983; Zwick, 2006). Recent research by Mattern and Patterson (2011c, 2011d, 2011e) has examined the validity of SAT scores and high school GPA as predictors of undergraduate GPA, both annual and cumulative, through the 2nd, 3rd, and 4th years of study. After making corrections for range restriction, the strength of the relationships with independently calculated annual GPA decreased somewhat after the 1st year of study, but their relationships with cumulative GPA remained strong through the 4th year. Additional analyses based on institutional admission selectivity (their criteria being the percentage of applicants admitted) found that the corrected validity coefficients for the combined SAT scores tend to be slightly higher at more-selective institutions than they are at less-selective institutions, but the validity coefficients for high school GPA decreased slightly across institutional admission selectivity levels after the 1st year (Kobrin et al., 2008; Mattern & Patterson, 2011c, 2011d, 2011e). This was the pattern whether looking at independently calculated annual GPA or cumulative GPA.

The lower validity coefficients at institutions with less selective admission standards may stem, at least in part, from the effects of remedial coursework. We know that students who do not meet the ACT College Readiness Benchmarks (Allen, 2013; Allen & Sconing, 2005)[1] are more likely than higher scoring students to take remedial courses (ACT, 2007). As seen in Table 1, these students are

[1]ACT College Readiness Benchmarks are the minimum ACT subject area scale scores for students to have 50% chance of earning a B or better and approximately a 75% chance of earning a C or better in 1st-year credit bearing college courses (for English Composition, an ACT English score of 18; for College Algebra, an ACT Mathematics score of 22; for College Social Sciences, an ACT Reading score of 22; and for College Biology, an ACT Science score of 23).

TABLE 1
Typical Range of ACT Composite Scores and Class Ranks by Institution Admission Selectivity

Institution Selectivity Level	*ACT Composite Scores Middle 50%*	*Definition*
1. Highly Selective	25–30	Majority admitted from top 10% of high school class
2. Selective	21–26	Majority admitted from top 25% of high school class
3. Traditional	18–24	Majority admitted from top 50% of high school class
4. Liberal	17–22	Majority admitted from bottom 50% of high school class
5. Open	16–21	Generally open to all with high school diploma or equivalent

Note. ACT Composite scale scores range from 1 to 36. © ACT. Adapted by permission of ACT. Permission to reuse must be obtained from the rightsholder.

also more likely to enroll at institutions with lower admission standards (with institutional admission selectivity defined as the interquartile range of ACT Composite scores and the percentage of admitted students from the upper ranks of their high school classes [ACT, 2010]). Noble and Sawyer (2013) found that the grades earned in developmental courses were often better predictors of long-term academic success than their ACT scores. Compared to similar students who had enrolled directly into the standard courses, students earning an A grade in the developmental course had higher probabilities of early and longer term college success, though these benefits decreased over time. Including students who are completing developmental coursework in validation studies may help explain why validity coefficients for precollege academic predictors are lower at less-selective institutions than they are at more-selective institutions.

In addition to academic performance, retention is another area that needs further examination. Retention can be viewed as a multiple hurdle system. Conceivably, it is determined by three factors: academic eligibility, financial resources, and motivation. All three hurdles must be cleared if the student is to be retained. Of the three, academic eligibility—having a GPA high enough to avoid expulsion—appears to be the most important. Pascarella and Terenzini's (2005) review of single-institution and national studies found that "virtually without exception, students' grades make statistically significant, frequently substantial, and indeed often the largest contribution to student persistence and attainment" (p. 397). Recent studies using ACT scores, high school GPA, SES, psychosocial factors, interest-major congruence, and academic performance as predictors of retention and timely degree attainment (Allen et al., 2008; Allen & Robbins, 2010; Robbins et al., 2006) found that 1st-year academic performance was the strongest predictor of retention through the 1st and 3rd years, and of degree attainment within 4 years.

Along with ACT Composite score and high school GPA, a third predictor variable of interest is SES. Testing critics have claimed that standardized tests such as the ACT and SAT are nothing more than measures of SES (Colvin, 1997; Kohn, 2001). In the testing critics' implicit model, as presented by Sackett et al. (2009), SES accounts for the observed relationship between test scores and college grades. In other words, the argument is that there is no true relationship between test scores and grades, and any relationship observed between them is an artifact of the influence of SES on both test scores and grades. In response, Sackett et al. conducted three meta-analyses using College Board data and data from independent studies on the use of standardized test scores and measures of SES to predict college GPA. Their results demonstrated that after controlling for SES the predictive validity of SAT scores as a predictor of 1st-year GPA remained moderate, but when controlling for SAT scores the predictive

validity of SES as a predictor of 1st-year GPA approached zero. Whereas the Sackett et al. study effectively refuted the testing critics' assertion that test scores are just measures of SES, it is possible that SES by itself is related to other college outcomes, notably retention. By including SES in our own study, we will also be able to verify the Sackett et al. findings on its relationship with 1st-year GPA and go beyond it by examining its relationships with 2nd-year grades and 2nd- and 3rd-year retention.

Last, admission selectivity should be considered a potential moderator of both academic performance and retention. As noted earlier, past research has found that validity coefficients for test scores tend to be slightly higher at more-selective institutions than they are at less-selective institutions (e.g., Kobrin et al., 2008; Mattern & Patterson, 2011d) Furthermore, and as noted earlier, students at less selective institutions generally have lower mean ACT scores and high school GPAs. Conducting correlational analyses for a sample that contains subgroups with different means and standard deviations on one or both of the variables may lead to spurious effect sizes (Kirk, 2008). In addition to the effects of admission selectivity on predictive future academic performance, past research also suggests that institutional admission selectivity has effects on academic persistence (Pascarella & Terenzini, 2005), with higher persistence rates at more-selective institutions.

Although there has been much research on the validity of the SAT for predicting undergraduate grades (Kobrin et al., 2008; Mattern & Patterson, 2011c, 2011d, 2011e; Sackett et al., 2009) and on the relationship between SAT scores and retention (Mattern & Patterson, 2010, 2011a, 2011b), some relationships remain unexamined. The relationships between SES and academic performance beyond the 1st year and its relationship with retention are of interest, as are the relationships between cumulative GPA and retention. After considering the results of past research and the gaps in that research, we decided to conduct meta-analyses of academic performance and retention through the beginning of the 3rd year of undergraduate study. We first examine the strength of the relationships between our two precollege academic achievement variables (ACT Composite scores and high school GPA) and SES with 1st-year GPA, and we then examine the strength of these precollege predictors and 1st-year GPA with 2nd-year retention. For the moderator analyses, we hypothesize that all independent variables are valid predictors for all groups, but admission selectivity will moderate the strengths of the relationships between our two precollege academic achievement variables—ACT Composite scores and high school GPA—and SES with our outcomes of interest, 1st-year GPA, and 2nd-year retention.

We then extend the study by adding 2nd-year cumulative GPA and 3rd-year retention. We examine the strength of the relationships of our three original predictor variables ACT Composite scores, high school GPA, and SES with 2nd-year cumulative GPA. Next we include 2nd-year cumulative GPA with ACT Composite scores, high school GPA, SES, and 1st-year GPA as predictors of 3rd-year retention. Regarding the moderator analyses, we hypothesize that all independent variables are valid predictors of academic performance and retention for all groups, but academic selectivity will moderate the strengths of the relationships of ACT Composite scores, high school GPA, and SES with our outcome variables of interest, 2nd-year GPA, and 3rd-year retention.

METHODS

Sample

Data for the current study included 189,612 ACT-tested students who enrolled in a 4-year institution as first-time students entering in the fall term from 2000 to 2006, with each institution

having between one and seven freshman cohorts. Fifty institutions that had participated in various ACT research services or partnerships were represented. Institutions had reported student enrollment status for at least three consecutive terms, from the first semester of the 1st year through the first semester of the 2nd year for the student cohorts included. The institutions also reported cumulative GPA at the end of the 1st year for most students (but they did not consistently provide term-by-term GPAs). We included data only from 4-year colleges as it is conceivable that the types of students and the nature of academic retention in 2-year colleges can be qualitatively different from those in 4-year colleges (Allen & Robbins, 2010). All institutions were located in the United States. Table 2 provides descriptive information of the institutions.

Available information also included the students' ACT scores, high school GPA, and self-reported parental annual income. Note that although every student in the data set had a valid ACT Composite score, not all students had a reported high school GPA and/or parental income level (our SES measure). Moreover, for the relationships between these predictor variables and 1st-year GPA, only students who had enrolled in courses for both the first and second semester and had a cumulative GPA were included. For the 2nd-year retention analyses, the number of observations in each relationship depended on the number of students who had data available for each predictor variable.

For the 2nd-year academic performance and 3rd-year retention analyses, we needed data that extended out to the first semester of the 3rd year of enrollment. That is, the institutions had to report enrollment data for at least five consecutive semesters, from the fall term of the 1st year to the fall term of the 3rd year, and had to have reported 1st- and 2nd-year cumulative GPA. These follow-up data were available from 48 institutions.[2] The cohorts spanned from 2000 to 2005. To be included in the 2nd-year academic performance analyses, students had to have enrolled for courses in the first and second semesters of the 1st year and the first and second semesters of the 2nd year, and they had to have a cumulative GPA at the end of the 1st year and at the end of the 2nd year. For the 2nd-year academic performance and 3rd-year retention analyses, the sample size for examining each relationship depended on the number of students who had data available for each predictor variable.

To make corrections for range restriction (discussed in more detail later), we used data from all students who took the ACT test from 1999 to 2006 and from 1999 to 2005 as referent populations to which our findings can be generalized. Descriptive information for the referent populations is provided in Table 3, as are the correlations among the three predictors—ACT Composite scores, high school GPA, and SES for the national college-bound referent population of examinees.

Measures

Outcome variables. As discussed earlier, in this study we operationalized 1st- and 2nd-year academic performance as cumulative 1st- and 2nd-year GPA, respectively, with both grading scales ranging from 0.0 to 4.0. We used cumulative GPAs provided by the institutions

[2]Two institutions were dropped. One did not report complete follow-up data through the first semester of the 3rd year. The other school, though self-identified as a 4-year institution, primarily offers 2-year associate degrees and only a few bachelor degrees. It is possible that many students who had not been retained into the 3rd year at this school had either graduated or transferred to other institutions. Because of these losses, the number of schools in the Low selectivity category decreased from eight to six in the 2nd-year cumulative GPA and 3rd-year retention analyses.

TABLE 2
Characteristics of the Schools in the Multi-Institutional Database, 1st-Year Students, and 2nd-Year Returnees

Academic Year	Institutions			ACT			HSGPA			SES		
	Selectivity	k	Public	N	M	SD	N	M	SD	N	M	SD
1	1	0	0	—	—	—	—	—	—	—	—	—
	2	8	5	74,005	23.7	3.9	65,656	3.5	0.4	59,056	0.3	0.9
	3	29	22	92,008	21.0	3.8	80,857	3.3	0.5	77,198	0.0	0.9
	4	3	1	2,550	19.8	4.3	2,196	3.1	0.6	2,098	−0.3	1.0
	5	5	3	11,990	19.6	3.9	10,168	3.2	0.6	9,779	−0.2	0.9
	N/A	5	3	9,059	21.5	3.7	8,088	3.2	0.5	7,604	0.0	0.9
	Total	50	34	189,612	21.9	3.9	166,965	3.4	0.5	155,735	0.1	0.9
2	1	0	0	—	—	—	—	—	—	—	—	—
	2	8	5	55,962	23.8	3.9	50,160	3.6	0.4	44,728	0.4	0.9
	3	29	22	57,374	21.4	3.9	51,191	3.4	0.5	48,288	0.0	0.9
	4	2	1	1,409	20.2	4.4	1,223	3.2	0.6	1,152	−0.3	1.0
	5	4	2	3,983	20.0	3.9	3,570	3.2	0.5	3,326	−0.2	0.9
	N/A	5	3	6,098	21.9	3.8	5,499	3.3	0.5	5,097	0.1	0.9
	Total	48	33	124,826	22.4	3.9	111,643	3.4	0.5	102,591	0.2	0.9

Note. ACT = ACT Composite score; HSGPA = high school grade point average; SES = socioeconomic status, standardized so that $M = 0$ and $SD = 1$; k = number of institutions; Selectivity: 1 = highly selective, 2 = selective, 3 = traditional, 4 = liberal, 5 = open, N/A = not reported by institution. More detailed descriptive statistics for the multi-institutional database are available upon request.

instead of independently calculated annual GPAs due to institutions not consistently reporting semester GPAs and hours earned.

We defined retention as continuous enrollment at the same 4-year institution throughout the academic year(s) and into the following academic year. To be considered retained into the 2nd year, students had to be continuously enrolled at the same 4-year institution for the first and second semesters of the 1st year and enrolled for courses in the first semester of the 2nd year at the same institution. To be considered retained into the 3rd year, students had to have been

TABLE 3
Descriptive Statistics, ACT National Data, 1999–2006 and 1999–2005

Years	Variable	N	M	SD	Correlations (N)	
					ACT	HSGPA
1999–2006	ACT	7,990,217	20.9	4.8		
	HSGPA	6,625,660	3.21	0.61	.58 (6,625,660)	
	SES	6,257,643	4.97	2.90	.34 (6,257,643)	.20 (5,606,273)
1999–2005	ACT	6,783,762	20.9	4.8		
	HSGPA	5,718,341	3.21	0.61	.58 (5,718,341)	
	SES	5,387,797	4.96	2.88	.34 (5,387,797)	.20 (4,869,192)

Note. HSGPA = high school grade point average; SES = socioeconomic status. Mean and standard deviation for socioeconomic status are based on the raw parental income scale (0–9). This was then standardized to a mean of 0.0 and standard deviation of 1.0.

continuously enrolled at the same 4-year institution for the first and second semesters of both the 1st and 2nd years and for the first semester of the 3rd year. Alternative approaches to retention may allow for transfers to other institutions or allow students to drop out and later return. However, from both the perspective of the student and the institution, continuous enrollment is the ideal because (a) transferring between institutions decreases the likelihood of completing a degree, and (b) continuous enrollment increases the likelihood that students will complete a degree (U.S. General Accounting Office, 2003). Furthermore, continuous enrollment at the same institution—and eventual graduation from it—suggests that both the student and the school made good choices during the admissions process.

Precollege academic performance variables. In the present analyses, ACT Composite score and high school GPA were treated as precollege measures of academic performance. The present measure of high school GPA was based on students' self-reported high school grades from the ACT Course Grade Information Section. High school GPA is a measure of performance in high school courses and is a reflection of students' sustained motivation, work ethic, and academic mastery, as well as difficulty of courses and grading standards. Although self-reported grades cannot be expected to be perfectly accurate measures, past research (Schiel & Noble, 1991; Shaw & Mattern, 2009) has found relatively high correlations (of .74 or higher) between self-reported grades and high school transcripts. Our second measure of academic performance, ACT Composite score, is designed to measure the academic skills important for success in postsecondary education and that are acquired in secondary education (ACT, 2007). The ACT assessment consists of four multiple-choice tests—English, Mathematics, Reading, and Science—and the Composite score is the average of the four tests, each with a score scale of 1 to 36.

Operationalization of SES. SES can be operationalized in a number of ways, to include parental income, parental education levels, parental occupation, free or reduced lunch status, high school poverty rates, and combinations of these variables. An ideal operationalization of SES would be a combination of these variables, but for this study we used the only variable available—parental annual income—data provided by students on a scale from 0 to 9 when they completed the Student Profile Section of the ACT. The 10 possible responses for income were as follows: less than $18,000, about $18,000 to $24,000, about $24,000 to $30,000, about $30,000 to $36,000, about $36,000 to $42,000, about $42,000 to $50,000, about $50,000 to $60,000, about $60,000 to $80,000, about $80,000 to $100,000, and more than $100,000. Using ACT national data from 1999 to 2006, we standardized reported income to have a mean of zero and a standard deviation of 1. All self-reported parental income levels from our sample were then converted to the standardized scale, and these standardized SES levels were used in all analyses.

Methodological Issues

Choice of data analysis methods. An important issue was how to pool the data from multiple institutions. Institutions vary in their applicant pools, selectivity, and grading practices that may influence the relationships between the predictors (standardized test scores, high school GPA, SES) and the criteria of interest (college GPA, retention). With such data, hierarchical linear modeling (HLM) is often the analysis method of choice (Raudenbush & Bryk, 2002). The current study, however, requires correction for range restriction involving a categorical dependent variable

(retention), which cannot be done under the HLM approach.[3] This correction for range restriction is needed because our sample included only students who had enrolled in college courses, but the population of interest was the national college-bound ACT-tested population on which the predictors were used. Compared to those in the population of interest, the variances of the predictors in our sample of enrolled students were likely to be restricted because the students had somehow been selected into the colleges. This range restriction problem is well known in the personnel selection and education literatures (Cronbach, 1960; Gulliksen, 1987). Procedures to correct for bias due to range restriction (and thereby allowing estimation of relationships in the unrestricted population of interest) have also been well established (Hunter, Schmidt, & Le, 2006; Sackett & Yang, 2000). Therefore, we opted to use psychometric meta-analytic techniques, which allow for corrections of range restriction and other artifacts (Hunter & Schmidt, 2004). For this study, we pooled the data from multiple institutions and used meta-analytic techniques so that we could make generalizations about performance and retention relationships for the ACT-tested student population. Note that the Hunter and Schmidt (2004) meta-analysis methodology is a random effects model that allows parameters to vary across studies (in this study, across institutions); thus, important features of HLM are retained by our methodology.

Range restriction. The fundamental question we wanted to answer in this study was, How strongly are our precollege predictor variables—ACT Composite score, high school GPA, and SES—related to future academic performance and retention in our population of interest, ACT-tested students? As Sackett et al. (2009) observed, unless institutions decided to randomly select their future students, the best approach to answering this type of question is to make corrections for range restriction. In our study we expected that range restriction would occur to different degrees at all the institutions. Nationally, not all high school students take the ACT, and not all of the students who do take it enroll in college. Consequently, at the institutional level we expected to find fewer students with very low scores on the ACT, even at institutions with open admissions. At the more selective schools we expected range restriction to be more severe. Data from the national ACT test-taking population (described earlier and shown in Table 3) allowed us to compare the distributions of scores of all examinees and those who actually entered college.

In addition, self-selection creates range restriction at all schools. One would expect students with lower ACT scores to be less likely to apply to and attend highly selective schools, and students with higher ACT scores to be less likely to apply to and attend open-admission schools (Table 1). We anticipated that each school would have a different range of ACT scores for its student population. We also expected to see this type of range restriction in high school GPA as well as in SES, though we believed that the availability of financial aid would make range restriction in SES less of an issue.

Measurement error variance. Measurement error variance exists in most variables in social sciences. Our measures are only proxies of the underlying constructs that we seek to measure, so if we are interested in the underlying constructs, corrections for measurement error variance should be

[3]HLM can be applied to the corrected covariance matrices of the institutions. However, although multilevel logistic regression (aka Hierarchical Generalized Linear Modeling; Agresti, Booth, Hobart, & Caffo, 2000), which is based upon the HLM approach, can be applied to categorical dependent variables, there has been no known solution allowing the combination of HGLM with institution-level estimates corrected for range restriction.

made. However, the questions we seek to answer should dictate which corrections we make. The focus of the current study is on the predictor measures, and institutions often use the observed scores for these measures to predict college outcomes. That is, institutions often do not make corrections for measurement error variance. Furthermore, we want the results of this study to be comparable to those from the Sackett et al. (2009) study, in which there were no corrections for measurement error variance. Accordingly, no correction for measurement error variance is made for the predictors in this study. Regarding the criteria, as discussed earlier, we defined academic performance and persistence as college cumulative GPA and retention, respectively. As such, cumulative GPA and retention are the ultimate criteria of interest in the current study. For this reason, and to make results comparable to past research findings (Robbins et al., 2004; Sackett et al., 2009), we also do not make corrections for measurement error variance in these criteria.

Data Analysis

First-year GPA and 2nd-year retention analysis. For each institution, we calculated the Pearson product–moment correlations between the following variables: ACT Composite scores, high school GPA, SES, and 1st-year GPA. Next, we calculated point biserial correlations between the preceding four variables and 2nd-year retention.[4] The correlations were then corrected for range restrictions in the three predictors (ACT, high school GPA, and SES) using the multivariate range restriction correction procedure introduced by Lawley (1943). Range restriction ratios on these predictors were computed for each institution based upon the standard deviations obtained from the institution and from our referent population. We used the software (RANGEJ), developed by J. T. Johnson and Ree (1994), to perform the corrections for multivariate range restriction on the predictors. The corrected correlations thus were estimates of correlations between the variables if they had been obtained in the referent population. We then meta-analytically combined the correlations across institutions using the Hunter–Schmidt meta-analysis method (Hunter & Schmidt, 2004). To account for the increase in sampling error resulting from range restriction corrections, we applied the Ree, Earles, and Teachout (1994)

[4]It is well known that point biserial correlations are affected by base rates in the binary variable (Hunter & Schmidt, 2004). The further away the base rates are from the middle value of .50, the lower the correlations will become. Accordingly, it has been suggested that correlations should be corrected for the difference in base rates across studies. That is, a common base rate should be used for all the correlations so as to eliminate the artifactual variation observed in these correlations due to differences in base rates. However, in the current study, we believe that differences in base rates of student retention across institutions reflect differences in institution-level characteristics (e.g., student body, institutional policy). As such, the variation in base rates of retention across institutions may not be due to some statistical artifacts but may result from substantive factors. We are interested in investigating these factors via moderator analysis. Accordingly, we did not correct for variation in base rates across institutions in the current study. An alternative to reporting to point biserial correlations would have been to report d values. These values can be calculated using equation 7.11 from Hunter and Schmidt (2004):

$$d = \{[(N-2)/N]^{1/2}2r\}/[(1-r^2)^{1/2}.$$

In cases where the two groups have different sizes, the number "2" is replaced by

$$2 = 1/(pq)^{1/2},$$

where p and q are the proportions of persons in the two groups.

procedure and calculated effective sample sizes for each correlation. This allowed us to more accurately estimate the variation across institutions due to sampling error.

For each meta-analytically estimated relationship, we used the standard deviation of the corrected institutional validity coefficients to calculate the 90% credibility interval, which indicates the variation of the correlation across institutions. We have no reason to expect the effects of our predictor variables to be fixed, and we expect to find a distribution of validity coefficients across institutions. Furthermore, credibility intervals serve as estimates of the variation of population parameters, allowing the results to be generalized to institutions not included in this study (Hunter & Schmidt, 2004; Schmidt & Hunter, 1999). We also calculated 95% confidence intervals for each estimated mean correlation after making corrections for artifacts (sampling error and range restriction). The confidence intervals were calculated using the standard error of the mean corrected validity coefficients, with the standard errors being dependent upon the number of institutional studies and the number of students within the institutional studies. The confidence intervals serve as a test for the comparisons between subgroups in the moderator analyses (Hunter & Schmidt, 2004). However, we emphasize the credibility intervals because the estimation of population parameters is more important than the estimation of sampling error attributable to the sample of institutions and students included in this study.

Second-year cumulative GPA and 3rd-year retention analysis. Students who dropped out after the 1st year made these analyses more complicated than those described in the previous section. As discussed earlier, student dropouts are largely influenced by how well they perform academically by the end of the 1st year. As such, there were two "hurdles" (i.e., college admission and 1st-year academic performance), which may have created range restrictions in the sample of 2nd-year students available for this analysis. In other words, those 2nd-year students remaining in the sample after the 1st year (2nd-year returnees) and thus available for the current analysis were somehow "selected" based on their academic performance in the 1st year (i.e., 1st-year GPA). Accordingly, corrections for range restriction were performed twice, in the reverse order to which range restrictions occurred (Hunter & Schmidt, 2004; Hunter et al., 2006). First, corrections were made for range restriction on academic performance using the standard deviation of 1st-year GPA estimated in the sample of 1st-year students as the unrestricted standard deviation. The corrected correlations obtained in this step provided the estimates of the relationships among the variables of interest in the 1st-year student population. Next, corrections were made on these correlations following the multivariate range restriction correction procedure as described in the previous section. Results of the second step were our estimates of the correlations among the variables of interest in the national ACT-tested applicant population.

Moderator analysis. As noted earlier, we were interested in examining admission selectivity as an institutional moderator on outcomes through 2nd-year retention. As seen in Table 1, the admissions policies of the institutions in this study are classified into five levels according to the interquartile range of ACT Composite scores and the high school class ranks of their accepted freshmen: highly selective, selective, traditional, liberal, and open. Institutions self-report the admission selectivity category to which they belong. To verify the accuracy of the

institutions self-reported admission selectivity, we calculated the means and standard deviations for ACT Composite scores and high school GPAs, as well as SES, for each level. As seen in Table 2, the mean ACT Composite scores increased with admission selectivity and the means fell within the corresponding ranges found in Table 1. Although high school class ranks were unavailable, the means for high school GPA tended to increase and the standard deviations decreased with higher levels of admission selectivity.

For further confirmation, we calculated at the institution level the correlations between the admission selectivity levels and the means and standard deviations for the predictor variables. Of the 50 institutions in the data set, 45 could be classified by their admission selectivity. In Table 4, given that the admission selectivity scale starts with the highly selective institutions (Level 1) and these institutions seek to admit the highest performing high school students, the correlations between the admission selectivity scale and precollege academic achievement measures (ACT scores and high school GPA) were negative. Note that SES was also negatively correlated with admission selectivity. The correlations between the standard deviations for the three predictor variables were generally positive. These results suggest that there was greater range restriction on the predictor variables at the more selective institutions than there was at the less-selective institutions and that any corrections made for range restriction to the validity coefficients for these precollege achievement variables would be greater at the more-selective institutions. This was especially true for high school GPA. The correlations were smallest for SES, and the correlation for 1st-year students was approximately zero.

For the admission selectivity moderator analyses, we used three selectivity groups: low (open/liberal), mid (traditional), and high (selective/highly selective). Note that although the number of institutions in the high and low selectivity categories were the same ($K = 8$), the number of the students in the high selectivity category far exceeded the number found in the low selectivity category.

We conducted moderator analysis by admission selectivity as hypothesized a priori (Hunter & Schmidt, 2004). At each institution we calculated correlations for all pairs of the variables. These correlations were then corrected for the effect of range restrictions on the three precollege predictors following the multivariate range restriction procedure (Lawley, 1943) discussed earlier. We used the unrestricted standard deviations from our referent population for each subcategory to make the corrections. Meta-analytic techniques were then

TABLE 4
Correlations With Admission Selectivity Levels, Institutional Means, and Standard Deviations

Academic Year	*Predictor*	*k*	*N*	*Ms*	*SDs*
1	ACT	45	180,553	−0.54	0.15
	HSGPA	45	158,877	−0.47	0.55
	SES	45	148,131	−0.42	−0.02
2	ACT	43	118,728	−0.47	0.15
	HSGPA	43	106,144	−0.39	0.43
	SES	43	97,494	−0.42	0.10

Note. ACT = ACT Composite score; HSGPA = high school grade point average; SES = socioeconomic status, standardized so that $M = 0$ and $SD = 1$; k = number of institutions.

used to combine the results across all institutions and again for each level of admission selectivity.[5]

RESULTS

First-Year GPA and 2nd-Year Retention

Table 5 presents the estimated mean correlations ($\hat{\bar{\rho}}$) between the original predictor variables and 1st-year GPA and 2nd-year retention. The first three rows of Table 5 contain the meta-analytic results between the predictor variables and 1st-year academic performance. After corrections for range restriction, the estimated mean correlation between ACT scores and 1st-year GPA was .51, and the estimated mean correlation between high school GPA and 1st-year GPA was .58. In addition, the validity coefficients for ACT Composite score and high school GPA were found to be somewhat variable across institutions, with 90% of the coefficients estimated to fall between .43 and .60, and between .49 and .68, respectively (as indicated by the 90% credibility intervals). In contrast, after correcting for artifacts, the estimated mean correlation between SES and 1st-year GPA was only .24 and did not vary across institutions. For all three predictor variables, the lower bounds of the credibility intervals exceeded zero, indicating that there were generally positive relationships between the predictors and the criterion. It should be noted that the correlation between SES and 1st-year GPA (.24) did not fall within either the ACT–1st-year GPA 90% credibility interval (.43–.60) or the high school GPA–1st-year GPA 90% credibility interval (.49–.68), suggesting that across institutions ACT scores and high school GPA generally have much stronger relationships with 1st-year GPA than does SES. These results are similar to those reported in past research (e.g., Sackett et al., 2009).

The last four rows in Table 5 give the estimated mean correlations between the predictor variables—ACT Composite scores, high school GPA, SES, and 1st-year GPA—and 2nd-year retention. As expected, 1st-year GPA, the most proximal predictor of 2nd-year retention, had the strongest relationship ($\hat{\bar{\rho}} = .41$). ACT Composite scores ($\hat{\bar{\rho}} = .19$) and high school GPA ($\hat{\bar{\rho}} = .21$) were similar in the strength of their relationships with 2nd-year retention, and SES had the weakest relationship with 2nd-year retention ($\hat{\bar{\rho}} = .10$). Compared to their own validity coefficients for the prediction of 1st-year GPA, the estimated mean correlations between the three original predictor variables and 2nd-year retention were much lower. Nevertheless, all the estimated mean correlations were positive, and the 90% credibility intervals did not include zero, indicating that the variables were also related to 2nd-year retention.

Moderator Analyses for 1st-Year GPA and 2nd-Year Retention

We had formally hypothesized that admission selectivity would moderate the strengths of the relationships between ACT Composite scores, high school GPA, and SES with 1st-year GPA and 2nd-year retention. In Table 6, when looking at the estimated mean correlations it appears

[5]Because of their social importance, we examined type of institution (public/private), gender, and SES on an exploratory basis. Because moderator analyses can be misleading if the moderators are correlated with one another, we checked the correlations between admission selectivity, gender, SES, and public/private, and we found that these correlations were close to zero. Consequently, we examined each potential moderator separately. The results closely paralleled the overall results, and for brevity the results are not presented here but can be made available upon request.

TABLE 5
Meta-Analysis of Multi-Institution ACT Data—Overall Sample (1st-Year Cumulative GPA and 2nd-Year Retention)

	Correlations	*k*	*N*	$\bar{r}$	*SDr*	$\hat{\bar{\rho}}$	$S\hat{D}\rho$	*95% CI*	*90% CV*
1.	ACT – CGPA1	50	169,818	.38	.07	**.51**	.05	.50, .53	.43, .60
2.	HSGPA – CGPA1	50	150,305	.47	.05	**.58**	.06	.57, .60	.49, .68
3.	SES – CGPA1	50	139,354	.12	.04	**.24**	.00	.24, .25	.24, .24
4.	ACT – Retention2	50	189,612	.12	.04	**.19**	.04	.18, .20	.12, .25
5.	HSGPA – Retention2	50	166,965	.17	.04	**.21**	.07	.19, .23	.09, .33
6.	SES – Retention2	50	155,735	.07	.02	**.10**	.04	.09, .11	.04, .17
7.	CGPA1 – Retention2	50	169,818	.38	.05	**.41**	.05	.39, .42	.32, .49

Note. ACT = ACT Composite scores; HSGPA = high school grade point average; SES = socioeconomic status (using parents' annual income as a proxy for SES); CGPA1 = cumulative 1st-year grade point average; Retention2 = 2nd-year retention; $\hat{\bar{\rho}}$ = estimated mean correlation between two variables in the *national population of examinees* (these correlations were obtained from multivariate range restriction correction procedure correcting for selection due to ACT, HSGPA, and SES); $S\hat{D}\rho$ = standard deviation of the estimated mean correlation; CI = confidence interval; CV = credibility interval. Bold indicates that credibility interval does not include zero.

that the strength of the relationships between the predictor variables and the outcome variables tended to increase as the level of admission selectivity increased, but these differences were relatively small. For all comparisons, the 95% confidence intervals overlapped, suggesting that the differences in mean estimates may be due to sampling error, though the amount of overlap was minimal for the high school GPA and 1st-year GPA relationships and for the 1st-year GPA and 2nd-year retention relationships. More important, the 90% credibility intervals for the different groups overlapped and none of the 90% credibility intervals included zero. These results clearly indicate that both ACT scores and high school GPA are valid and important predictors of college outcomes for the three institutional selectivity subgroups.

Second-Year Cumulative GPA and 3rd-Year Retention

In Table 7 we present the results of the overall analysis for 2nd-year returnees. Note that the estimated mean correlations between the three initial predictors and 2nd-year GPA ($\hat{\bar{\rho}} = .55$ for ACT Composite scores, $\hat{\bar{\rho}} = .62$ for high school GPA, and $\hat{\bar{\rho}} = .25$ for SES) were slightly higher than their correlations with 1st-year GPA (Table 5). For 3rd-year retention, the estimated mean correlations with ACT Composite score ($\hat{\bar{\rho}} = .18$), high school GPA ($\hat{\bar{\rho}} = .22$), and SES ($\hat{\bar{\rho}} = .09$) were comparable to the corresponding estimated mean correlations with 2nd-year retention. Also note that the estimated mean correlation between 1st-year GPA and 3rd-year retention ($\hat{\bar{\rho}} = .38$) was comparable to the estimated mean correlation between 2nd-year GPA and 3rd-year retention ($\hat{\bar{\rho}} = .37$).

Moderator Analyses for 2nd-Year Cumulative GPA and 3rd-Year Retention

Table 8 provides the results of our moderator analyses by institution selectivity, which closely paralleled the overall results seen in Table 7. At all levels of institution admission selectivity,

TABLE 6
Meta-Analysis of Multi-Institution ACT Data on 1st-Year Students—Moderator Analysis—Selectivity

	Correlations	*Selectivity Level*	*k*	*N*	$\bar{r}$	*SDr*	$\hat{\bar{\rho}}$	$SD\hat{\rho}$	*95% CI*	*90% CV*
1.	ACT – CGPA1	High	8	69,944	.36	.05	**.54**	.04	.51, .56	.48, .59
		Mid	29	80,750	.39	.08	**.51**	.05	.49, .53	.43, .54
		Low	8	11,357	.39	.11	**.47**	.11	.40, .55	.30, .65
2.	HSGPA – CGPA1	High	8	62,145	.47	.03	**.63**	.06	.59, .67	.54, .72
		Mid	29	71,378	.48	.05	**.57**	.04	.55, .59	.50, .64
		Low	8	9,807	.45	.10	**.50**	.13	.41, .59	.29, .71
3.	SES – CGPA1	High	8	55,176	.12	.01	**.26**	.00	.24, .27	.26, .26
		Mid	29	67,818	.12	.05	**.24**	.00	.23, .25	.24, .24
		Low	8	9,322	.11	.06	**.23**	.00	.20, .26	.23, .23
4.	ACT – Retention2	High	8	74,005	.11	.03	**.21**	.04	.18, .24	.14, .27
		Mid	29	92,008	.12	.05	**.18**	.04	.17, .20	.13, .24
		Low	8	14,540	.14	.05	**.18**	.04	.15, .22	.12, .25
5.	HSGPA – Retention2	High	8	65,656	.17	.02	**.25**	.06	.21, .29	.16, .35
		Mid	29	80,857	.18	.02	**.23**	.04	.21, .24	.16, .29
		Low	8	12,364	.16	.06	**.20**	.05	.16, .24	.12, .28
6.	SES – Retention2	High	8	59,056	.08	.01	**.14**	.03	.11, .16	.08, .19
		Mid	29	77,198	.07	.02	**.10**	.03	.08, .11	.05, .15
		Low	8	11,877	.08	.02	**.12**	.00	.09, .14	.12, .12
7.	GPA1 – Retention2	High	8	69,944	.39	.04	**.43**	.04	.40, .46	.36, .50
		Mid	29	80,750	.38	.04	**.40**	.04	.38, .41	.33, .47
		Low	8	11,357	.32	.09	**.34**	.09	.28, .41	.20, .49

Note. ACT = ACT Composite scores; HSGPA = high school grade point average; SES = socioeconomic status (using parents' annual income as a proxy for SES); CGPA1 = cumulative 1st-year grade point average; Retention2 = 2nd-year retention; $\hat{\bar{\rho}}$ = estimated mean correlation between two variables in the *national population of examinees* (these correlations were obtained from multivariate range restriction correction procedure correcting for selection due to ACT, HSGPA, and SES); $SD\hat{\rho}$ = standard deviation of the estimated mean correlation; CI = confidence interval; CV = credibility interval. Bold indicates that credibility interval does not include zero.

TABLE 7
Meta-Analysis of Multi-Institution ACT Data—Second-Year Returnees

	Correlations	*K*	*N*	$\bar{r}$	*SDr*	$\hat{\bar{\rho}}$	$SD\hat{\rho}$	*95% CI*	*90% CV*
1.	ACT – CGPA2	48	114,635	.45	.05	**.55**	.03	.54, .55	.51, .59
2.	HSGPA – CGPA2	48	102,782	.50	.05	**.62**	.04	.60, .63	.55, .68
3.	SES – CGPA2	48	94,173	.12	.05	**.25**	.03	.24, .27	.20, .31
4.	ACT – Retention3	48	124,826	.10	.03	**.18**	.03	.17, .19	.13, .23
5.	HSGPA – Retention3	48	111,643	.14	.03	**.22**	.03	.21, .24	.18, .27
6.	SES – Retention3	48	102,591	.05	.02	**.09**	.04	.08, .11	.02, .16
7.	CGPA1 – Retention3	48	122,981	.29	.04	**.38**	.06	.36, .39	.28, .47
8.	CGPA2 – Retention3	48	114,635	.28	.06	**.37**	.07	.35, .39	.26, .48

Note. ACT = ACT Composite scores; HSGPA = high school grade point average; SES = socioeconomic status (using parents' annual Income as a proxy for SES); CGPA1 = cumulative 1st-year grade point average; CGPA2 = cumulative 2nd-year grade point average; Retention3 = third-year retention; $\hat{\bar{\rho}}$ = estimated mean correlation between two variables in the *national population of examinees* (these correlations were obtained from multivariate range restriction correction procedure correcting for selection due to ACT, HSGPA, and SES); $SD\hat{\rho}$ = standard deviation of the estimated mean correlation; CI = confidence interval; CV = credibility interval. Bold indicates that credibility interval does not include zero.

high school GPA and ACT Composite scores were more strongly related to 2nd-year cumulative GPA than was SES. The estimated mean correlations for ACT Composite scores in this study were quite similar across admission selectivity levels (.55, .54, .56), and the 95% confidence intervals overlapped. In contrast, the estimated mean correlations for high school GPA increased with admission selectivity (.57, .60, .64), and the 95% confidence intervals for the Mid and High admission selectivity levels did not overlap. The estimated mean correlations between SES and 2nd-year cumulative GPA were similar across admission selectivity levels (.28, .25, .28) though, as with high school GPA, the 95% confidence intervals for the Mid and High admission selectivity levels did not overlap. However, the subgroup credibility intervals for ACT Composite scores overlapped considerably, as did the subgroup credibility intervals for high school GPA. For all three predictor variables across all three levels of admission selectivity, the 90% credibility intervals did not contain zero.

TABLE 8
Meta-Analysis of Multi-Institution ACT Data on 2nd-Year Returnees—Moderator Analysis—Selectivity

	Correlations	*Selectivity Level*	*k*	*N*	$\bar{r}$	*SDr*	$\hat{\rho}$	$S\hat{D}\rho$	*95% CI*	*90% CV*
1.	ACT – CGPA2	High	8	53,174	.43	.04	**.56**	.01	.55, .57	.55, .57
		Mid	29	51,387	.46	.06	**.54**	.03	.53, .55	.49, .59
		Low	6	4,581	.49	.07	**.55**	.04	.51, .59	.49, .61
2.	HSGPA – CGPA2	High	8	47,706	.48	.04	**.64**	.02	.63, .66	.61, .67
		Mid	29	45,995	.52	.05	**.60**	.04	.59, .62	.54, .66
		Low	6	4,108	.52	.07	**.57**	.07	.51, .63	.46, .68
3.	SES – CGPA2	High	8	42,488	.13	.01	**.28**	.00	.27, .29	.28, .28
		Mid	29	43,269	.10	.07	**.25**	.00	.24, .26	.25, .25
		Low	6	3,814	.15	.08	**.28**	.00	.26, .30	.28, .28
4.	ACT – Retention3	High	8	55,962	.10	.00	**.18**	.02	.16, .20	.15, .21
		Mid	29	57,374	.11	.04	**.18**	.04	.16, .20	.11, .25
		Low	6	5,392	.16	.04	**.20**	.05	.15, .25	.12, .28
5.	HSGPA – Retention3	High	8	50,160	.13	.01	**.22**	.04	.19, .25	.16, .28
		Mid	29	51,191	.16	.03	**.23**	.02	.21, .24	.19, .26
		Low	6	4,793	.18	.04	**.22**	.05	.17, .27	.14, .31
6.	SES – Retention3	High	8	44,728	.05	.00	**.12**	.00	.10, .13	.12, .12
		Mid	29	48,288	.04	.02	**.09**	.01	.08, .11	.09, .10
		Low	6	4,478	.07	.06	.10	.07	.03, .16	−.01, .21
7.	CGPA1 – Retention3	High	8	55,581	.29	.04	**.38**	.06	.34, .43	.28, .48
		Mid	29	56,248	.29	.05	**.37**	.05	.35, .40	.29, .46
		Low	6	5,146	.26	.08	**.33**	.09	.25, .41	.17, .48
8.	CGPA2 – Retention3	High	8	53,174	.29	.04	**.38**	.06	.33, .42	.27, .48
		Mid	29	51,387	.27	.06	**.36**	.06	.33, .38	.25, .46
		Low	6	4,581	.27	.08	**.33**	.10	.25, .42	.17, .49

Note. ACT = ACT Composite scores; HSGPA = high school grade point average; SES = socioeconomic status (using parents' annual income as a proxy for SES); CGPA1 = cumulative 1st-year grade point average; Retention2 = 2nd-year retention; High = institutions with "highly selective" or "selective" admission standards; Mid = institutions with "traditional" admission standards; Low = institutions with "liberal" or "open" admission standards; $\hat{\rho}$ = estimated mean correlation between two variables in the *national population of examinees* (these correlations were obtained from multivariate range restriction correction procedure correcting for selection due to ACT, HSGPA, and SES); $S\hat{D}\rho$ = standard deviation of the estimated mean correlation; CI = confidence interval; CV = credibility interval. Bold indicates that credibility interval does not include zero.

Regarding 3rd-year retention, the results also paralleled those found in Table 7. Although there were differences between the estimated mean correlations across admission selectivity levels, the 95% confidence intervals overlapped for each relationship. One difference from the overall results is that the 90% credibility interval for the correlation between SES and 3rd-year retention included zero for schools in the Low selectivity category.

DISCUSSION

Predicting Academic Performance

First-year academic performance. The correlations between our two precollege predictor variables (ACT Composite scores and high school GPA) with 1st-year GPA found in this study were similar to those found in other recent studies (Bridgeman et al., 2008; Kobrin et al., 2008; Sackett et al., 2009), further validating the use of these measures in making admission decisions. Both ACT Composite scores and high school GPA are measures of academic achievement and although highly correlated (Table 3) each contributes to the prediction of college success (e.g., ACT, 2007; Bridgeman et al., 2008).

As seen in the 90% credibility intervals, the validities of ACT scores and high school GPA vary across institutions, but this finding should not come as a surprise. It is unreasonable to argue that they should be the same across institutions or to argue that the predictor variables are flawed because the validity coefficients vary across institutions. Every institution is unique. The departments, courses, instructors, and students differ from one institution to the next, as do their grading standards. However, it is important to note that none of the 90% credibility intervals for the correlations associated with ACT Composite scores or high school GPA included zero, suggesting that the validity coefficients of ACT scores and high school GPA generalize across institutions.

Moreover, the moderator analyses suggested that the results related to 1st-year academic performance were relatively consistent across the three levels of admission selectivity examined in this study. There were slight differences between the estimated mean correlations with 1st-year GPA across levels of admission selectivity, a finding consistent with previous research (Bridgeman et al., 2008; Kobrin et al., 2008), but these differences were usually small and the 95% confidence intervals overlapped. The confidence intervals tell us how much error in our estimates of mean values is due to sampling error based upon the sample of studies included in the meta-analysis. Confidence intervals refer only to estimates of mean values. However, we are more interested in the population parameters and place more emphasis on the credibility intervals, which indicate that although the estimated mean effect sizes differ across admission selectivity levels, a considerable amount of overlap exists. The results of these analyses do not support our hypothesis that admission selectivity would moderate the relationship between our precollege academic predictors—ACT Composite scores and high school GPA—and SES with 1st-year academic performance.

Another important finding of this study was that ACT Composite scores and high school GPA had much stronger relationships with 1st-year GPA than SES (as measured by parental income) had. This finding was consistent with those found by Sackett et al. (2009) and provides additional evidence against the testing critics' assertions that test scores are mere measures of SES.

Academic performance through the 2nd year. As expected, we found that both ACT scores and high school GPA were valid predictors of academic performance through the 2nd

year of study. Mean correlations for ACT scores and high school GPA with 2nd-year GPA for 2nd-year returnees were as strong as the corresponding mean correlations with 1st-year GPA for the overall sample. The results indicate that both ACT Composite scores and high school GPA continue to operate as predictors of academic performance beyond the 1st year and are consistent with results found by Mattern and Patterson (2011d) for SAT scores and high school GPA. SES also had a positive relationship with 2nd-year cumulative GPA, but the relationship was much weaker than those for ACT Composite scores and high school GPA.

We had also hypothesized institutional admission selectivity would moderate the relationships between our precollege predictors variables, ACT Composite scores, high school GPA, and SES, with 2nd-year cumulative GPA. Mattern and Patterson (2011d) had found that the corrected correlations between SAT scores and 2nd-year cumulative GPA increased slightly across their three levels of institutional admission selectivity (.53, .55, .59), but in this study the relationships between ACT Composite scores were quite similar across admission selectivity levels (.55, .54, .56) and the 95% confidence intervals overlapped. Another difference from the Mattern and Patterson study is that they had found the relationship between high school GPA and 2nd-year cumulative GPA to be relatively stable across their three levels of admission selectivity. In this study we found that not only was the estimated mean correlation for high school GPA higher for institutions in the High admission selectivity category, but the 95% confidence intervals for the High and Mid admission selectivity categories did not overlap, suggesting that for the institutions included in this study, there was a difference. However, differences in the results of this study and the Mattern and Patterson study may be entirely due to the differences in how the admission selectivity categories were defined. Furthermore, the validity generalization output from this study, the credibility intervals, suggests that despite the differences in estimated mean effect sizes, the parameters for the three subgroup populations overlap considerably.

The inclusion of SES as a predictor of 2nd-year cumulative GPA in the overall and in the moderator analyses was a step beyond what Sackett et al. (2009) and Mattern and Patterson (2011b) had done with College Board data. The most important finding of these analyses is that the strength of the relationship between SES and 2nd-year cumulative GPA is much weaker than those for ACT Composite scores and high school GPA regardless of admission selectivity level.

Predicting Retention

As noted earlier, retention is a multiple hurdle system that requires adequate academic performance, financial resources, and motivation. Our precollege academic performance predictors, ACT Composite scores and high school GPA, had stronger relationships with retention than SES had, but college academic performance emerged as our strongest predictor of retention. Given that financial resources are required for retention, it was expected that SES would have a stronger relationship with retention than it did in this study. Perhaps the availability of financial aid diminishes the importance of parental income when it comes to retention. Research on financial aid indicates that having a gap between costs and available funds is negatively related to persistence, and students receiving aid are more likely to remain in school and graduate than those not receiving aid (Pascarella & Terenzini, 2005). Provided that students have shown adequate academic performance and are motivated to continue their studies, students can enroll for their 2nd year regardless of where they obtain their financial resources.

Allen and Robbins (2010) found that the most significant factor on timely degree attainment was 1st-year academic performance. In this study we expected that the more proximal predictor, 2nd-year cumulative GPA, would have the strongest relationship with 3rd-year retention, but the effects of 1st-year GPA and of 2nd-year cumulative GPA were nearly identical when predicting 3rd-year retention in both the overall analysis and in the admission selectivity moderator analysis. This finding underscores the importance of 1st-year academic performance on college success.

National data indicate that withdrawal rates from 4-year schools are highest between the 1st and 2nd academic years and declines over the following years (U.S. Department of Education, 2011). This applies at all levels of admission selectivity, but attrition rates are higher at less selective schools than they are at more selective schools, and this pattern continues over the following years. In this study we observed a large attrition rate between the 1st and 2nd years at schools with liberal and open admission policies. Moreover, students at these schools had lower ACT Composite scores and high school GPAs on average and were less prepared for college than the students at the other schools. Perhaps many of these students struggle through both remedial and standard courses in their 1st year and were unable to persist to the 2nd year. Finally, there may be other factors that we did not measure, such as work and family commitments, which may be more important than academic performance for students making decisions on whether they will continue their studies at these schools.

Limitations and Future Research

A major strength of this study was the large sample size both in terms of numbers of institutions and numbers of students. However, for the moderator analyses by college selectivity, the numbers of institutions in the High and Low admission selectivity categories were substantially smaller than the number of postsecondary institutions with traditional admission policies. Future research should investigate our findings by college selectivity with a larger number of institutions and a larger number of students, especially for schools with liberal and open admission policies. In this study we had only eight such institutions with data through the beginning of the 2nd year, and only six that had sufficient follow-up data into the 3rd year. This was unfortunate because one out of every five 4-year institutions in the nation has open admission policies, and roughly 400,000 students each year enroll at 4-year schools that accept 75% or more of their applicants (Snyder & Dillow, 2010). This is a large segment of the college population that should be studied to gain a better understanding of students' performance and persistence at these institutions.

A second limitation was that we did not distinguish between part-time and full-time students. Although some institutions reported semester hours enrolled and hours completed in each semester, others did not provide this information for each semester. For this study we chose to maximize sample size, but in future research it would be helpful to make this distinction.

Another shortcoming is that we did not have specific course grade data to differentiate remedial coursework from standard, 1st-year, credit-bearing coursework. As Noble and Sawyer (2013) pointed out, grades earned on an A–F scale in developmental courses graded are much more informative than ACT scores when predicting student performance in the following standard courses, and in fact the relationship between ACT scores and grades earned in the following standard courses were often not statistically significant. In this study we found that the estimated mean correlations between ACT Composite scores and 1st-year GPA

increased with institutional admission selectivity, which may have been due to the effects of remedial coursework completed before students completed standard, credit-bearing courses that contributed to their GPAs. However, the 95% confidence intervals overlapped, suggesting that the differences in estimated mean correlations may be due to sampling error.

This study focused on 1st- and 2nd-year cumulative GPA, but we also need research on predicting academic performance at the course level and across majors, and on other outcomes of interest. Cumulative GPA as the criterion has serious limitations because students take different courses; hence, there is not one criterion but actually a multitude of criteria. Berry and Sackett (2009) found that the correlations between precollege academic predictors, SAT scores and high school GPA, were higher when predicting individual course grades instead of overall GPA. Past research has also suggested that grading standards differ according to college major, notably in the science, technology, engineering, and mathematics (STEM) fields, where grading standards are more rigorous than in other academic fields (Bridgeman et al., 2008; Strenta & Elliot, 1987; Strenta, Elliot, Adair, Matier, & Scott, 1994). Knowing exactly which courses students completed, whether the courses were remedial or regular courses, and whether grades earned in remedial courses were applied to students' GPAs would help us better understand the effects of standardized test scores and high school grades on academic performance in college. Finally, college mission statements often include statements on other outcomes that may best be described as intellectual, interpersonal, and intrapersonal behaviors (Oswald, Schmitt, Kim, Ramsay, & Gillespie, 2004). Unfortunately, such data were not available from the participating institutions. Research on how well institutions develop these behaviors in their students could expand our definitions of undergraduate performance beyond grades earned.

Another limitation of the study was the use of cumulative 2nd-year GPA instead of independently calculated 2nd-year GPA as a criterion and as a predictor. As discussed earlier, independently calculated 2nd-year GPA was not available from many of the institutions that contributed to our data set. Conducting a similar study with independently calculated 2nd-year GPA would provide additional insights.

Although this study focused on precollege achievement and SES, we know that psychosocial factors also play an important role in predicting academic performance and persistence (Allen, Robbins, & Sawyer, 2010; Oswald et al., 2004; Peterson, Casillas, & Robbins, 2006; Robbins et al., 2006; Robbins et al., 2004; Robbins, Oh, Le, & Button, 2009; Schmitt et al., 2009). Motivation and other psychosocial factors are best measured by instruments specifically designed to measure psychosocial factors associated with college success and college student retention (ACT, 2008; Le, Casillas, Robbins, & Langley, 2005).[6] Research using such an instrument found that the academic self-discipline scale had a correlation of .32 with high school GPA but only .02 with ACT scores (Allen & Robbins, 2010). These psychosocial factors, especially sustained motivation, may help explain the differences between maximum academic performance as measured by achievement tests and typical academic performance as measured by high school and undergraduate grades. Unfortunately, psychosocial measures were not available for this study. Future research that investigates longer term college success with a large, longitudinal data set should incorporate achievement test scores, high school grades, and psychosocial factors in the same model.

[6]ACT® Engage was formerly known as the Student Readiness Inventory.

Finally, an area that deserves further investigation is the relationship between students' academic strengths and interests, and students' academic performance and persistence. This study used ACT Composite scores, but the assessment's four subject area tests (English, Mathematics, Reading, and Science) could also be used in conjunction with ACT Interest Inventory responses to predict academic performance, and persistence in college and specific majors. For example, among STEM majors with the same ACT Composite score, are students whose highest score was on Mathematics more likely to persist in a STEM field than students whose highest score was on Reading? How important is it for their interest profiles to align with the interest profile for the average student in their chosen academic major? Answering questions such as these will help us better understand why some students perform and persist in college and other students do not.

CONCLUSION

This study makes a number of important contributions to the literature on academic performance and persistence. ACT Composite scores and high school GPA were identified as the best predictors of 1st-year GPA, but the current study also demonstrates that both ACT Composite scores and high school GPA are valid predictors of academic performance through the end of the 2nd year of college and retention out to the beginning of the 3rd year of college, useful information for high school students, parents, educators, and admission officers. Furthermore, the validity coefficients of these two predictors generalize across 4-year institutions with different levels of admission selectivity. Finally, 1st-year GPA was found to be the best predictor of 2nd- and 3rd-year retention.

Despite ongoing debates on the appropriate mix of selection criteria for college admissions, these findings reinforce the centrality of measures of standardized achievement and high school performance for understanding the readiness to complete college entry-level general education courses. The ability to master the 1st year of college drives retention and ultimately degree attainment. The real policy question, then, is how to increase the rigor of K-12 curriculum to increase college readiness and to better understand the motivational and academic behavior components of high school GPA to ensure that all students entering a highly demanding, unstructured postsecondary work environment are able to succeed.

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