ACT Research Report Series 2016 (1)

Does Taking Developmental Courses Improve the Success of Students Who First Enroll at Two-Year Colleges?

Julie Noble

ACT®

Julie Noble, former Principal Research Scientist in the Statistical Research Department, conducts research on course placement and postsecondary success at two- and four-year institutions.

Acknowledgments

The author thanks Richard Sawyer, Justine Radunzel, and Jeff Allen for their comments and suggestions on this research.

Contents

Abstract iv

Introduction 1

Developmental Courses and Two-Year College Students 1

Data 2

ACT Compass Test Scores 2

Student Enrollment Status and Age 3

College Course Pair Identification and Selection 3

Course Grades 4

Longitudinal College Outcomes 5

Limitations of the Data 6

Method 6

Student Age and Enrollment Status 6

Descriptive Statistics 7

Evaluating the Success of Developmental Students 7

Propensity Scores 8

Success in the Higher-Level Course and Later Outcomes 9

Results 9

Descriptive Results 9

Models for Predicting Success in College 10

Estimated Probabilities of Success 11

Discussion 28

Success in College Depends on Prior Academic Preparation 29

Simply Taking Developmental Courses Results in Few Long-Term Benefits 30

The Benefit of Taking Developmental Courses Also Depends on the Grades Earned in Them 32

The Benefit of Developmental Courses Depends on Age and First-Year Enrollment Status 32

Does Developmental Coursework Benefit Students? 33

References 36

Appendix A 40

Appendix B 46

Appendix C 51

Appendix D 80

Appendix E 86

Appendix F 95

Abstract

Postsecondary policymakers question whether subsidizing developmental education is a wise use of public money. Some college systems have restricted developmental coursework to two-year colleges and/or are exploring alternative delivery approaches to developmental education. Two-year colleges are perceived as being better equipped and/or more cost-effective for providing developmental instruction.

A recent study (Noble & Sawyer, 2013) showed that completing a developmental course does not usually improve students' chances of short- and long-term success in college. However, particular subgroups of students appeared to benefit from taking a developmental course. In this study, I examined whether taking developmental courses benefits two-year students, and differentiated students by both enrollment status and age. A higher percentage of two-year students than four-year students enroll in developmental coursework, but less than one in four complete entry-level "gateway" courses within two years.

Data for the study consisted of ACT Compass® test and college outcomes data for 64,344 students who first enrolled in one of thirty-seven two-year postsecondary institutions. The success of students who initially enrolled in five lower-level (developmental) courses in English, mathematics, or reading was compared with those of students who initially enrolled in associated higher-level courses. I first estimated probabilities of success with respect to twenty outcome variables ranging from performance in the associated higher-level college course to degree completion within particular periods of time. The probabilities of success were conditioned on developmental course enrollment, ACT Compass test score, age and enrollment status (full- or part-time), the grade received in the developmental course (if taken), and other student characteristics. I then compared the probabilities of success of students who did and did not first take the developmental course, but who otherwise were similar.

The results were similar to those found in the study previously cited: Positive benefits were found only for higher-level course and grade point average (GPA) outcomes, and for specific course pairs. Any positive benefits resulting from first taking the lower-level course disappeared over time, however. Moreover, a very large percentage of students (35% to 55%) who took lower-level courses did not progress to any higher-level courses in the same subject area. Those who did not progress were much less likely to be successful in college in the long term. For *all* students who first enrolled in lower-level courses, as opposed to those who progressed to the higher-level course, the probabilities of short- and long-term college success would likely be much lower than those reported here.

Particular subgroups of students who took a lower-level course (as characterized by their ACT Compass test scores, the grade they received in the course, and their age/enrollment status) did benefit from taking the developmental course. In particular, students who received an A (or sometimes a B) grade in the developmental course appeared to benefit from taking it. Furthermore, part-time students aged 21 or younger appeared to derive more benefit from taking developmental courses than older students did, but they had lower probabilities of success.

The report concludes with a discussion about possible contributing factors to academic success, including academic supports and the noncognitive characteristics of two-year developmental students. Suggestions for further research are also made.

Introduction

Postsecondary policymakers question whether subsidizing developmental education is a wise use of public money. Estimated annual costs for developmental instruction range from $1.9 billion to nearly $3 billion at two-year colleges to $500 million at four-year colleges (Bailey, Jeong, & Cho, 2010; Strong American Schools, 2008). Facing demands for increasing graduation and retention rates, some college systems have restricted developmental coursework to two-year colleges and/or are exploring alternative delivery approaches such as modular, co-requisite, or integrated instructional models (Bettinger & Long, 2005; Burdman, 2012; "Experts: Remedial college classes need fixing," 2012; Fulton, Gianneschi, Blanco, & DeMaria, 2014; Merisotis & Phipps, 2000). Two-year colleges are perceived as being better equipped and/or more cost-effective for providing developmental instruction (e.g., Ignash, 1997; Vandal, 2010; Shults, 2000).

A recent study (Noble & Sawyer, 2013) showed that completing a developmental course does not usually improve students' chances of short- and long-term success in college. However, particular subgroups of students (e.g., part-time students) appeared to benefit from taking a developmental course. As the authors noted, most of the recent research on the effectiveness of developmental instruction has focused on degree-seeking students and/or on full-time students. Research on the success of nontraditional students is limited. In a recent survey of postsecondary institutions (Fong, 2012), about 43% of responding institutions reported that they do not examine retention and degree completion rates for nontraditional students. Over 75% did not know their current degree completion rate for nontraditional students. Only 16% reported having a good understanding of why their nontraditional students dropped out. Ironically, nontraditional students have been found to have relatively low degree completion rates (Choy, 2002; Aud et al., 2012).This study examined whether taking developmental courses benefits students who enroll in two-year colleges. Nearly two-thirds of two-year students enroll in and complete developmental coursework, but only 22% also complete entry-level "gateway" courses within two years. Only 9.5% of those who complete entry-level courses complete a degree within three years (Fulton et al., 2014).

Developmental Courses and Two-Year College Students

For public two-year colleges, a majority (59%) of students enroll part-time, compared to slightly more than one-third (36%) at public four-year colleges. In addition, 61% of nontraditional-aged two-year college students enroll part-time, compared to 44% of similar traditional-aged students (National Center for Education Statistics [NCES], 2010). The Noble and Sawyer (2013) study was limited in that (1) student age wasn't considered and (2) there were limited controls for possible confounding characteristics of students who did/did not take a developmental course. I therefore considered both student age and enrollment status to determine whether developmental coursework benefits nontraditional and part-time students. I also accounted for other possible confounding student characteristics when examining these relationships.

Following the approach used by Noble and Sawyer (2013) and Perkhounkova, Noble, and Sawyer (2006), I compared lower-level course students' conditional probability of success (defined in various ways) with the corresponding conditional probability of success of students with similar test scores and other characteristics who enrolled directly into the corresponding higher-level course. Students took the lower-level course either before or concurrently with the first time they took the higher-level course.

Noble and Sawyer (2013) showed that developmental instruction was effective only for students who earned an A grade and sometimes a B grade in the developmental course. The study also examined lower-level courses with pass/fail grades as well as lower-level courses with A–F grades. This approach was also planned for this study; however, there were insufficient students with pass/fail grades and, of those, very few or no students failed the lower-level courses examined in this study. Therefore, only A–F grades in lower-level courses were used as predictors. Descriptive statistics provided in Appendices A and B include the results for students who took lower-level courses with pass/fail grades.

Estimated conditional probabilities of success could be influenced by other variables, in addition to test scores. Examples include background characteristics, high school coursework and grades, and psychosocial and situational variables. Conditioning on other variables permits studying particular groups of students, thereby yielding a more detailed and accurate description of the benefit of developmental courses. I therefore explicitly conditioned on test score, part-time vs. full-time enrollment status, and student age, as well as propensity scores (composites derived from other student and institutional characteristics, described below).

Data

Data for this study consisted of the ACT Compass test and ACT® test student records and college outcomes data for 64,344 students from thirty-seven two-year colleges from two public state postsecondary systems; specifically, students enrolled as first-time entering freshmen between fall 2005 and fall 2009.[1] These colleges primarily use ACT Compass test scores for course placement, but also accept ACT scores for this purpose. One state also included limited data for private two-year institutions. Both states are located in the south-central region of the United States. All students initially enrolled at a two-year institution and were followed to other two- and four-year institutions within the two state systems, if they transferred (or were dually enrolled). No data were available on students who transferred to institutions outside the two state systems.

ACT Compass Test Scores

I used students' ACT Compass Writing Skills, Pre-Algebra, Algebra, and Reading Skills scores to predict later college outcomes. I did not use the ACT Compass College Algebra score as a predictor because of limited use of this test by both states.

ACT Compass tests are modular; each test may be taken at a different time, and may be taken multiple times. ACT Compass test scores were therefore limited to those with test dates within a range of three years prior to the term date for the first course taken in a subject area to not more

[1] The time span for follow-up data depended on the cohort year. Students and institutions were included only in analyses for which outcome data were available. Students were tracked for at least four years. (Four years for the 2009 cohort, five years for the 2008 cohort, six years for the 2007 cohort, seven years for the 2006 cohort, and eight years for the 2005 cohort).

than six weeks after the beginning of the term.[2] Concordant ACT English, reading, and mathematics scores were used for students with missing ACT Compass scores, or with ACT Compass scores that did not comply with the range of test dates and term dates required for inclusion in the study.

Student Enrollment Status and Age

I classified students by full-time or part-time enrollment status using *credit hours attempted* during their first fall and spring terms; *credit hours earned* was used if credit hours attempted was missing. I classified students with fewer than 24 total credit hours attempted during the first year as part-time and those with 24 attempted hours or more as full-time. Student age was categorized as less than or equal to 21 years (≤ 21), 22–25 years, or greater than 25 years (> 25).

College Course Pair Identification and Selection

Institutions provided complete college transcripts for all their enrolled students. Using the course code list from ACT's Course Placement Service® (ACT, 2015) and the course catalogs for the institutions, I coded all courses as first-year vs. later, by level (developmental, standard college-level, or honors), and by whether the course was specific to a particular program or major (e.g., mathematics for elementary school teachers). I retained for analysis only the developmental or first-year college-level courses in English, mathematics, reading, and the social sciences that were not specific to a particular program or college major.[3] Conversely, I excluded seminars and other developmental offerings (e.g., supplemental instruction) that could not be explicitly defined as a course or associated with a particular subject area.

I identified courses with known sequencing (e.g., Arithmetic to Elementary Algebra or Developmental English Composition to Standard English Composition) and retained the most frequently occurring course sequences across institutions. I also required the selected courses to have data from at least ten institutions. All institutions were required to have data for both the lower-level and corresponding higher-level course (i.e., course pair) in a subject area, with a minimum sample size of five students in the lower-level course. I excluded from the analyses students who skipped courses in the mathematics sequence.[4] Moreover, if students took more than two mathematics courses in the mathematics course sequence, I used only the data for the first two courses, to avoid having intervening coursework influence test score/course outcome relationships. For example, if students took Arithmetic, Elementary Algebra, and Intermediate Algebra, I used only their data for Arithmetic and Elementary Algebra. I also required, for each pair of lower- and higher-level courses, that students took the lower-level course either before or concurrently with the first time they took the higher-level course. For students who took a lower-level course multiple times, I retained data from both the first time they took the course and from the last time they took the course prior to (or concurrently with) taking the higher-level course. For the corresponding higher-level courses, I retained data only from the first time students took the higher-level course.

[2] For students with multiple scores on an ACT Compass test from administrations occurring within this item frame, the score closest in time to the start date of the relevant course was used.

[3] I also excluded honors courses from the analyses.

[4] One might hypothesize that, given the outcomes shown here for developmental students who also took the higher-level course, it is unlikely that the outcomes for students who skipped the higher-level course would be any better, assuming that the next course would be of greater difficulty. Further investigation would help to determine the probabilities of success of these students and the extent to which these students differed from those who took the higher-level course, in terms of prior academic preparation and other psychosocial characteristics.

Five pairs of developmental courses and typical subsequent courses were examined in this study:

1. Developmental English Composition and Standard English Composition (N = 38,925)
2. Arithmetic and Elementary Algebra (N = 19,603)
3. Elementary Algebra and Intermediate Algebra (N = 18,299)
4. Intermediate Algebra and College Algebra (N = 21,070)
5. Developmental Reading and first social science course (N = 53,547).

For each course pair, I assembled data of three distinct groups of students: those who enrolled in the lower- and higher-level courses, those who enrolled only in the higher-level course, and those who enrolled only in the lower-level course.

For two of the three mathematics course pairs, the lower-level course and the higher-level course were both developmental courses. To avoid confusion, the term "lower-level course" in this report refers to the first course in each course pair, and the term "higher-level course" refers to the second course in each pair. The higher-level course could be either a developmental or college-level course.

For course pair 5, six social science courses were considered as potential "first social science courses": American History, Other History, Psychology, Sociology, Political Science, and Economics. The first social science course taken by a student was then identified; if more than one of these social science courses was taken at that time, one of the courses was randomly selected for inclusion in the course pair. Only those students who took one of the six social science courses (alone or subsequent to taking Developmental Reading) were included in the analyses.

Course Grades

I transformed A–F grades in the higher-level courses to two different levels of outcome variables: a B or higher grade (successful) vs. less than a B grade (unsuccessful), and a C or higher grade (successful) vs. less than a C grade (unsuccessful).[5] For either level of outcome variable, I classified withdrawals as unsuccessful. Pass/fail grades in higher-level courses occurred infrequently and were excluded as outcomes.

For all lower-level courses, A–F grades from the last time the course was taken were retained in their original form as predictor variables for the analyses. For predicting success in the lower-level course, A–F and pass/fail grades from the first time the course was taken were recoded to B or higher, C or higher, or pass/fail outcomes according to the same method described for higher-level courses.[6]

As mentioned previously, for the models using lower-level course grade as predictors, the intent was to develop separate models for students receiving A–F grades and for those receiving pass/fail grades in the lower-level course. However, both the student sample sizes and the numbers of institutions with pass/fail grades for these courses were much smaller than those with A–F grades. In addition, there were virtually no failing students in the pass/fail courses; pass rates were .99

[5] I also found grades that could not be converted to an A–F scale (e.g., audit, administrative withdrawal, etc.). We omitted these grades from the analyses.

[6] W grades were included with A–F grades from the lower-level courses when recoded to success outcome variables and levels. Only those W grades from courses that predominantly used A–F grades were included. Those from courses that predominantly used pass/fail grades were excluded from the analyses. The percentages of W grades ranged from 3% in Developmental English Composition to 9% in Reading for the last time the course was taken. W grades were not included as predictors of success in higher-level courses or of other college outcomes.

or 1.00 for all five lower-level courses. Therefore, models could not be developed using pass/fail grades as predictors.

We typically classify students who took the lower-level course in a course pair, but did not take the higher-level course, as having an unsuccessful outcome. However, a large percentage of students taking the lower-level course in a course pair did not progress to any higher-level course, with percentages ranging from 35% for Developmental Reading/first social science course to 55% for Arithmetic/Elementary Algebra (see Appendices A and B; descriptive statistics for these students are provided in Appendix B). Because of these very high percentages of students and their relatively low college success rates, I could not include them in the models as unsuccessful students. Therefore, interpretation of the results for higher-level course and subsequent outcomes were limited to students who completed the lower-level course and who enrolled in the higher-level course.

Longitudinal College Outcomes

Each institution provided up to six years of long-term outcome data. The data included term-by-term credit hours attempted, credit hours earned, re-enrollment indicators, cumulative GPAs, and certificate (one state only), associate's degree, or bachelor's degree completion indicators. From these variables, I coded several binary outcome variables. These outcome variables differed somewhat from those used in the first study, to include those unique to two-year colleges and to delineate results for retention and progress-to-degree outcomes. The outcomes studied included the following:

- Earned a C or higher grade in the lower-level course
- Earned a B or higher grade in the lower-level course
- Earned a passing grade in the lower-level course (where data permitted)
- Earned a C or higher grade in the higher-level course
- Earned a B or higher grade in the higher-level course
- Earned 2.0 or higher Year 1 GPA (or last GPA, if Year 1 was not completed)
- Earned 3.0 or higher Year 1 GPA (or last GPA, if Year 1 was not completed)
- Earned 2.0 or higher Year 2 GPA
- Earned 3.0 or higher Year 2 GPA
- Earned 2.0 or higher Year 3 GPA
- Earned 3.0 or higher Year 3 GPA
- Persisted to Year 2 at any institution within the two state systems
- Persisted to Year 3 at any institution within the two state systems
- Progressed toward a degree at the end of Year 2 (i.e., completed 48 hours or more)
- Earned certificate within four, five, or six years (data for one state only)
- Earned associate's degree within four, five, or six years[7]
- Earned associate's or bachelor's degree within four, five, or six years[8]

[7] Associate's degree completion within four, five, and six years was used to maximize success rates. Completion rates within three years were generally low.

[8] Students who transferred to other two- or four-year institutions within the two states were followed to obtain their coursework and outcome data. Outcome data were not available for students who transferred to private, proprietary, or other out-of-state institutions.

The last three sets of outcomes pertain to degree completion within specified time periods. For the years spanning the data for this study, the Integrated Postsecondary Education Data System (IPEDS) standard time frame for evaluating graduation rates was 150% of normal time. This corresponds to associate's degree completion in three years and bachelor's degree completion in six years. IPEDS now collects graduation rates from institutions at 100%, 150%, and 200% of normal time.

Limitations of the Data

The data for this study consisted of ACT Compass-tested college students who were enrolled in two-year institutions from two south-central states. These two states also use ACT English, mathematics, and reading scores for course placement. Although a large proportion of high school graduates in both states take the ACT, it is not required for two-year college admission.

I focused on explicitly defined pairs of lower-level and higher-level courses in this research. Developmental education is complex and is not limited to performance in lower- and higher-level courses. I had no information about students' participation in other educational support programs or student services (e.g., learning communities, tutoring, etc.). Moreover, in using particular course pairs, I did not study the content or level of other coursework taken, either within or across subjects. Either of these conditions could have influenced students' success in the higher-level course or later in college.

The sample for this study represented ACT Compass- or ACT-tested enrolled students who started their college experience at a two-year institution. Those students who did not take ACT Compass or the ACT (two-year institutions in these states had the option of using other local tests for placement), or ACT Compass-tested high school students (due to possible intervening high school coursework), were not included in the sample. In addition, this study compares college outcomes for students who did and did not first take a lower-level course. The extent to which these two groups differ on characteristics not accounted for in the models could affect the results. For example, several studies noted that students enrolled in developmental coursework are more likely to be students with economic hardship (e.g., Bettinger & Long, 2007; Boylan, 1995; Ignash, 1997). These students might benefit differently from developmental coursework than do students without economic hardship. Differences on other student characteristics such as motivation or behavior might also affect the results. Because data on such potential covariates were incomplete, I was unable to include them in the models for this study.

Method

Student Age and Enrollment Status

Student age and enrollment status were initially treated as separate predictor variables. However, age and enrollment status were confounded in the data: Over 80% of students aged 22–25 or over 25 in the study were part-time students. To retain the enrollment status variable as much as possible, the enrollment status categories for students aged 22–25 and over 25 were combined, resulting in four categories: full-time and ≤ 21 years, part-time and ≤ 21 years, 22–25 years, and > 25 years. These categories were transformed into three dummy variables, with students in the latter three age/enrollment categories compared to students who were full-time and ≤ 21 years (the reference group).

Descriptive Statistics

I calculated sample sizes and means (or proportions), pooled across institutions, for each course pair. These statistics were calculated separately for students who took the lower-level course prior to taking the higher-level course, and for students who took only the higher-level course. Results for students who took the lower-level course were further disaggregated by grade earned the last time they took the course. Similar statistics were calculated for students who took the lower-level course but did not progress to any higher-level course in the same subject area.

Evaluating the Success of Developmental Students

I first estimated hierarchical logistic regression models for predicting students' chances of a B or higher, or C or higher, grade in each lower-level course the first time taken (see Noble & Sawyer, 2013 for a discussion about hierarchical logistic regression).[9] The models included all students who took the lower-level course (i.e., students who did not take any additional coursework in the same subject area, as well as those who progressed to the subsequent higher-level course). The predictor variables were ACT Compass test score, the age/enrollment status dummy variables, and propensity score (described in the next section). Institution-specific mean values for each predictor variable were also used to predict the outcomes. All student and institutional predictor variables were grand-mean centered.

I then estimated hierarchical logistic regression models for predicting students' probability of higher-level course and subsequent success, described previously. For a given course pair, models were based on students either enrolled in the lower-level course or in the higher-level course, or both. I included a binary lower-level course predictor variable that identified students who did (1) and did not (0) enroll in the lower-level course prior to taking the higher-level course. These models also included ACT Compass test score, the age/enrollment status dummy variables, the propensity score, and the interactions (products) of these variables and the developmental course variable. The interactions identify potentially different effects of taking the lower-level course for different combinations of student characteristics (e.g., part-time, older students who took the lower-level course before taking the higher-level course). Additionally, I estimated models for students who first took the lower-level course that also included the grade they received in the lower-level course (A–F grade), the interactions of lower-level course grade with the age/enrollment status dummy variables and propensity score, and the interaction of lower-level course grade with ACT Compass test score. As noted above, institution-specific mean values for each predictor variable were used to predict outcomes at the institution level. All student-level and institution-level predictor variables were grand-mean centered. Student-level ACT Compass test score, lower-level course taken indicator variable, propensity score, age/enrollment status, and lower-level course grade were retained in all relevant models, regardless of their statistical significance, as they were the primary predictor variables in the study.

Parsimonious models were developed by course pair; that is, one set of predictors was used for all outcomes for a course pair.[10] Institution- and student-level predictors were removed from the

[9] Hierarchical regression models in this study describe the relationship between predictor variables and course/college outcomes and account for variation in these relationships across institutions.

[10] This approach was used for practical reasons, due to the large number of models to be estimated, and to minimize overinterpretation of isolated but statistically significant results.

model if the predictor was statistically significant ($p < .01$ for main effects; .05 for interactions and institution-level predictors) for fewer than five outcomes for a course pair.[11]

Hierarchical models estimate both fixed effects (the average regression coefficients across institutions) and random effects (the variability of the regression coefficients across institutions). In this study, I first estimated random slope and random intercept models, but only the estimated variability in the intercepts across institutions was significantly different from zero ($p > .01$) for most models.[12] Random intercept models were therefore estimated for all course pairs; non-statistically significant random intercepts were noted.

Propensity Scores

Propensity score methodology is a technique to estimate the effect of a treatment or intervention by accounting for covariates that predict receiving that treatment. Thus, these methods allow researchers to control for potential bias due to important covariates not being included in the models (i.e., omitted variable bias). For predicting college success outcomes, psychosocial and situational variables would be important variables to consider; however, complete data were available for only a few student and institutional characteristics. Using propensity regression methodology (Rosenbaum & Rubin, 1983; Austin, 2011), propensity for taking a lower-level course was estimated for each course pair using students' ethnicity, gender, institution state, in-state vs. out-of-state enrollment, and self-reported high school average. Multiple imputation was used to resolve missing data, primarily for high school average.[13,14] The propensity scores were then included as predictor variables in the models.

Goodness-of-fit tests (average absolute standardized difference in predicted outcomes; Austin, 2008) were used to evaluate the fit of the propensity score models. Covariates for which the difference exceeded 0.1 would reflect imbalance in the covariate between students who took the lower- and higher-level course and those who took only the higher-level course.

To test the adequacy of the propensity scores, sensitivity analysis was used to determine the sensitivity of the models to omitted variable bias in the models (Marcus, 1997). For each model, the absolute value of the regression weight associated with the lower-level course indicator was compared to the corresponding absolute value of the weight associated with propensity score. Models for which the propensity score weight exceeded the lower-level course indicator weight would reflect sensitivity to omitted variable bias.

Propensity scores in models for predicting higher-level course success and subsequent outcomes were based on students who took the higher-level course, regardless of whether they took the lower-level course. Students who took the lower-level course and did not progress to a subsequent course in the same subject area were not included.

In contrast, for predicting success in the lower-level course, propensity scores were developed for students who took the lower-level course, regardless of whether or not they took the higher-level course, relative to all students who enrolled directly in the higher-level course. Though students

[11] The estimated regression coefficient for the overall interaction term was statistically significantly different from zero, given the other predictors in the model.

[12] Consistent with other ACT Compass research (Westrick & Allen, 2014).

[13] High school average was obtained from three sources: Students' ACT Compass records, the ACT Course Grade Information Section (if available), and the ACT Student Profile Section high school GPA range (if available). High school average was missing for 35% of student records.

[14] Results are based on the first imputed data set only.

who took the higher-level course were not included in the models for predicting lower-level course success, I used these propensity scores as predictors to control for student characteristics in the lower-level course models, thus paralleling the controls used in the models for predicting higher-level and subsequent college success.

Success in the Higher-Level Course and Later Outcomes

As noted earlier, a large percentage of students (35% to 55%) who took a lower-level course did not progress beyond that course to a subsequent course in the same subject area; these students were therefore unsuccessful with respect to success in the higher-level course. These students were also less successful with respect to the longer-term success outcomes. The results reported here for predicting success in the higher-level course (or success with respect to longer-term outcomes) pertain only to the subset of lower-level course students who subsequently enrolled in the higher-level course. Therefore, the results for these outcomes should be interpreted in light of this restriction.

Results

Descriptive Results

Tables A-1 through A-5 in Appendix A provide pooled descriptive statistics for the five course pairs. Each table contains the number of institutions, the number of students, and the means (or proportions) for all predictor and outcome variables. These statistics are presented separately for students who took the lower-level course before taking the associated higher-level course, and for those who enrolled directly in the higher-level course, and excluding those who took the lower-level course but did not progress to a different higher-level course. The statistics are also presented separately according to the grading scale in the lower-level course (A–F or pass/fail). Descriptive statistics are also reported in Appendix B, Tables B-1 through B-5, for students who took the lower-level course but did not progress to a subsequent course in the same subject area.

According to the "No. of students" columns in Tables A-1 through A-5, the percentages of students who took the lower-level course before taking the associated higher-level course ranged from 17% for Developmental Reading/first social science course to 44% for Elementary Algebra/Intermediate Algebra. Among the students who took the lower-level course before the higher-level course, the percentage earning an A–F grade (vs. a pass/fail or other grade) also varied widely, ranging from 69% (Developmental Reading/first social science course) to 91% (Elementary Algebra/Intermediate Algebra).

Compared to two-year ACT Compass-tested freshmen nationally, the students in our sample who enrolled in lower-level courses had lower average ACT Compass test scores. National average ACT Compass Writing Skills, Reading, Pre-Algebra, and Algebra scores of two-year students in 2008-09 (ACT, 2009)[15] were 60.36, 77.09, 44.79, and 31.83, respectively. However, students who received A–F grades in the lower-level courses typically had somewhat higher average ACT Compass test scores than all students who took the lower-level courses.[16] In contrast, the average scores of students in the sample who enrolled directly in the higher-level courses were higher than those of

[15] ACT Compass national averages were not available for years prior to 2008-09.

[16] The exception was students who took Arithmetic, where average ACT Compass Pre-Algebra scores were similar.

two-year ACT Compass-tested freshmen nationally, except for the average Pre-Algebra score of students who enrolled directly into Elementary Algebra.

With the exception of Arithmetic/Elementary Algebra, students who first enrolled in a lower-level course were much less likely to enroll full-time than students who enrolled directly in a higher-level course (0.16 to 0.47 vs. 0.30 to 0.54, respectively). For Arithmetic/Elementary Algebra, the opposite was true (0.21 and 0.13, respectively). In general, students who enrolled in Developmental English Composition, Elementary Algebra (before Intermediate Algebra), and Intermediate Algebra (before College Algebra) were older than students who enrolled directly into the associated higher-level courses.

Students who take developmental courses in college typically have lower associate's and five- and six-year bachelor's degree completion rates than students who take only higher-level courses, possibly because developmental courses typically do not count towards a degree. As shown in Tables A-1 through A-5, this was the case for three of the five course pairs. The exceptions were Intermediate Algebra/College Algebra and Arithmetic/Elementary Algebra. However, certificate completion rates for all five course pairs were comparable for students who first took the lower-level course and those who enrolled directly in the higher-level course.

Of the total sample of students who took a lower-level course, 19,899 students (31%) failed to progress beyond at least one lower-level course; 7,062 students (11%) did not progress in any subject area. Of the non-progressing students, 30% to 40% did not have an A–F or pass/fail grade the last time they took the lower-level course. They were typically part-time (about 8% full-time), about age 21, had high school GPAs of about 2.50, and had lower than a C grade in the lower-level course the last time they took it. Compared to lower-level students who did progress, those who did not progress had lower average ACT Compass test scores, and they were also much less likely to be full-time students (40% to 16% vs. 16% to 47%, respectively), but they differed only slightly in age.

Students who did not progress to any higher-level course in a subject area would be expected to have lower college success rates that those who did progress. This was the case, as shown in Tables B-1 through B-5. Students who did not progress to higher-level courses had substantially lower college success rates than students who did progress (as shown in Tables A-1 through A-5). For example, Year 2 and Year 3 re-enrollment rates of students who did not progress to higher-level courses were one-third to one-half the magnitude of those of students who did progress. All certificate and degree completion rates were less than .10 for students who did not progress.[17]

Models for Predicting Success in College

Table C-1 in Appendix C summarizes the five hierarchical logistic regression models for predicting success in lower-level courses. This table contains both the fixed effects (the estimated average regression coefficients across all institutions) and the variance components (estimates of the variance of the regression intercepts across institutions). Tables C-2, C-6, C-10, C-14, and C-18 summarize, by course pair, the fixed effects of the models for predicting success in college (e.g., success in the associated higher-level course, GPAs over time, retention, progress to degree, and degree completion) for students who first enrolled in the lower-level course before enrolling in the higher-level courses, and students who enrolled directly in the higher-level course. Tables C-3, C-7,

[17] Some certificate programs at these institutions did not require students to complete higher-level courses, but only to take, for example, one mathematics course.

C-11, C-15, and C-19 summarize the variance component associated with the fixed effect coefficient (intercept) in these models. These tables are structured similarly to Tables C-2, C-6, C-10, C-14, and C-18. Tables C-4, C-8, C-12, C-16, and C-20 summarize the fixed effects of the models for predicting success in college (e.g., success in the associated higher-level course, GPAs over time, retention, and degree completion) only for students who took a lower-level course before taking the associated higher-level course. Course grade (A–F grades) was included as a predictor in the models. Tables C-5, C-9, C-13, C-17, and C-21 summarize the variance component associated with the fixed effect coefficient (intercept) in these models.

Each table shows, for every outcome type and level, the institution-level and student-level coefficients; for most course pairs, institution-level and student-level coefficients are shown on adjacent pages. The coefficients that were not statistically significant are shaded. Student-level interaction terms were removed from the models when the overall Type III coefficients for the interaction terms were not statistically significant ($p > .05$). I also removed institution- and student-level interaction terms from the models when they were not statistically significant for five or more outcomes. As mentioned previously, student-level ACT Compass test score, lower-level course taken indicator variable, propensity score, age/enrollment status, and lower-level course grade were retained in all relevant models, regardless of statistical significance, as they were the primary predictor variables in the study.

Estimated Probabilities of Success

Variation across institutions. The intercept variances (right-most columns in Tables C-1, C-3, C-5, C-7, C-9, C-11, C-13, C-15, C-17, C-19, and C-21) indicate that probabilities of success differed across institutions. The magnitude of the variances suggests that the probability of success for a typical student would vary by less than .10 among two-thirds of the institutions. Differences in probabilities across institutions were somewhat larger for models excluding lower-level course grade for predicting higher-level course outcomes and certificate completion. Arithmetic and Elementary Algebra course pairs had the largest differences in probabilities of all the course pairs, with and without including lower-level course grades as predictors, with a maximum difference in probabilities across institutions of .28. English and Reading models that included lower-level course grade also had larger differences across institutions; these differences did not exceed .16. Slopes of the predictor variables did not differ significantly across institutions.

Fixed effects results. The fixed effects in Tables C-2, C-4, C-6, C-8, C-10, C-12, C-14, C-16, C-18, and C-20 can be used to calculate estimated probabilities of success at typical institutions. Distributions over students of probabilities of success for different course pairs and outcomes are summarized in Appendix D. In this section, I illustrate and discuss the estimated probabilities for different outcome variables and under different scenarios.

Age/enrollment status was an important predictor in most of the models. To simplify the discussion, I focus on the college outcomes of typical (average) two-year college students in the next sections, regardless of age/enrollment status. Following this discussion, I then report on the results among the four age/enrollment status groups.

Developmental Course Outcomes by ACT Compass Test Score.[18] For all students who took the lower-level course, ACT Compass test score was a statistically significant predictor of B or higher, and C or higher, grade in the lower-level course (see Table C-1 in Appendix C).[19] The probability of a B or higher, or C or higher, grade increased as ACT Compass test score increased (Figures 1 to 3). ACT Compass Pre-Algebra score was also positively associated with a passing grade in Elementary Algebra (Figure 2); ACT Compass Algebra score was not a significant predictor of passing Intermediate Algebra, possibly due to the very high pass rate for this course. Additionally, based on the regression coefficients for age/enrollment status, part-time traditional (age ≤ 21) and older students were less likely to be successful in lower-level courses than full-time, traditional-aged students.

As illustrated in Figures 1 through 3, students had at least a .40 probability of achieving a C or higher grade the first time they took the lower-level course, and at least a 0.25 to 0.30 probability of achieving a B or higher grade.[20] The course with the highest probabilities of success was Developmental English Composition, with minimum probabilities of achieving a C or higher, or B or higher, grade of .60 and .40, respectively. For three of the five courses (including Developmental English Composition), students had at least a 0.50 probability of achieving a C or higher grade, regardless of ACT Compass test score. In contrast, students with the highest ACT Compass test scores had about a 0.55 to 0.60 probability of achieving a B or higher grade.

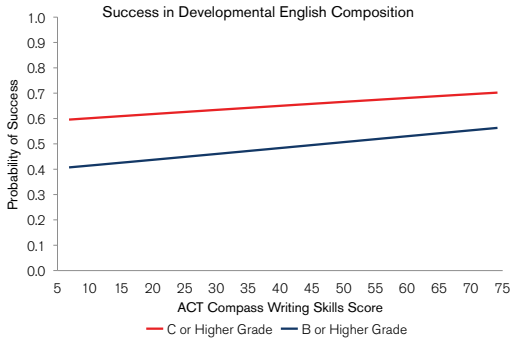

Figure 1. Probability of success in Developmental English Composition, first time taken, by ACT Compass Writing Skills score

[18] Predictions of pass/fail grade in the lower-level course were not reported for Developmental English, Arithmetic, and Developmental Reading due to insufficient data.

[19] Virtually all of the institution-level coefficients were not statistically significant ($p > .05$). Mean ACT Compass test score was retained in all models to ensure accurate estimation of error terms and significance tests.

[20] For all graphs shown in this report, the probability curves are plotted for ACT Compass scores between the 5th and 95th percentiles for a given course pair and course group.

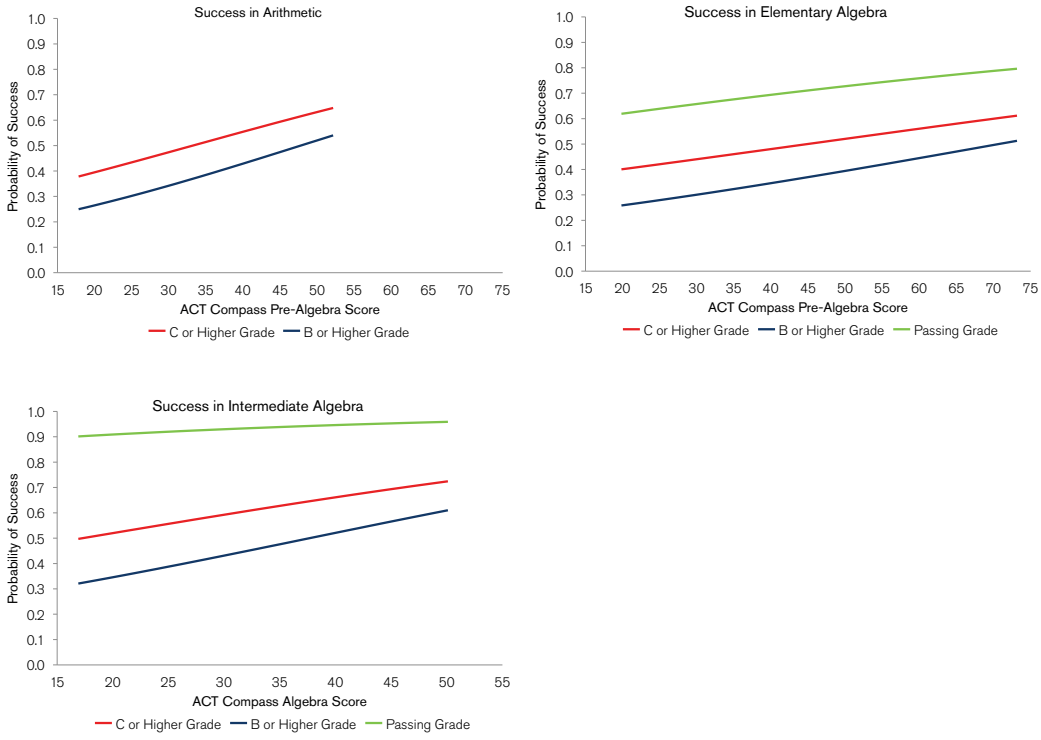

Figure 2. Probability of success in Arithmetic, Elementary Algebra, and Intermediate Algebra, first time taken, by ACT Compass Pre-Algebra or Algebra score

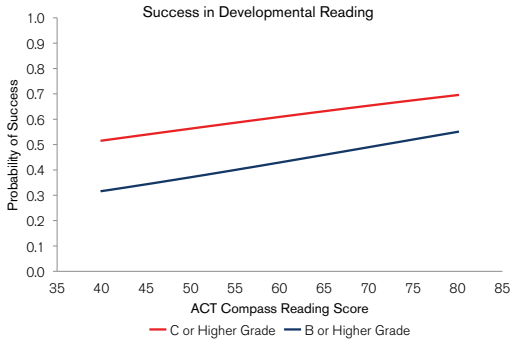

Figure 3. Probability of success in Developmental Reading, first time taken, by ACT Compass Reading score

Higher-Level Course Outcomes by ACT Compass Test Score. As shown in Appendix B, ACT Compass test score was a positive and statistically significant predictor of success for all of the higher-level courses. This result pertains both to students who took the lower-level course prior to enrolling in the higher-level course and to those who enrolled directly in the higher-level course, as well as both B-or-higher and C-or-higher success outcomes. Moreover, score distributions for students who first enrolled in lower-level mathematics courses substantially overlapped those for students who enrolled directly in the associated higher-level courses, particularly at the lower end of the distributions. The scores corresponding to the 5th percentiles for these course pairs differed by only one to three score points.

For the Developmental English Composition/Standard English Composition, Elementary Algebra/Intermediate Algebra, and Developmental Reading/first social science course pairs, students who first took the lower-level course before taking the higher-level course, on average, had significantly ($p < .01$) higher probabilities of success in the higher-level course than those expected of similar students who enrolled directly into the course. This result was true of both the B-or-higher and the C-or-higher success criteria. For the other two course pairs, students who first took the lower-level course had similar or slightly lower probabilities.

Figures 4, 5, 6, and 7 and Appendix D illustrate this finding. In these and subsequent figures, red and navy solid and dashed lines reflect the middle 90% of observed scores. The navy solid lines show estimated probabilities of success for students who enrolled directly in the higher-level course. The red solid lines show estimated probabilities of success for students who first took the lower-level course. Dashed navy lines represent extrapolation to scores of students who enrolled in the lower-level course, illustrating their probability of success, had they enrolled directly in the higher-level course

As shown in Figure 4, students with an ACT Compass Writing Skills score between 10 and 74 had over a .60 probability of a C or higher grade in Standard English Composition, regardless of ACT Compass Writing Skills score and whether they had taken Developmental English Composition prior to taking it. However, for students who first enrolled in Developmental English Composition, their probability of a C or higher grade was typically 0.10 higher than that expected for similar students who enrolled directly into the higher-level course. This difference in probability also depended on ACT Compass Writing Skills score, with larger differences occurring for students with lower scores.[21] Similar results were found for the B or higher outcome, with similar to slightly larger group differences in probability of success.

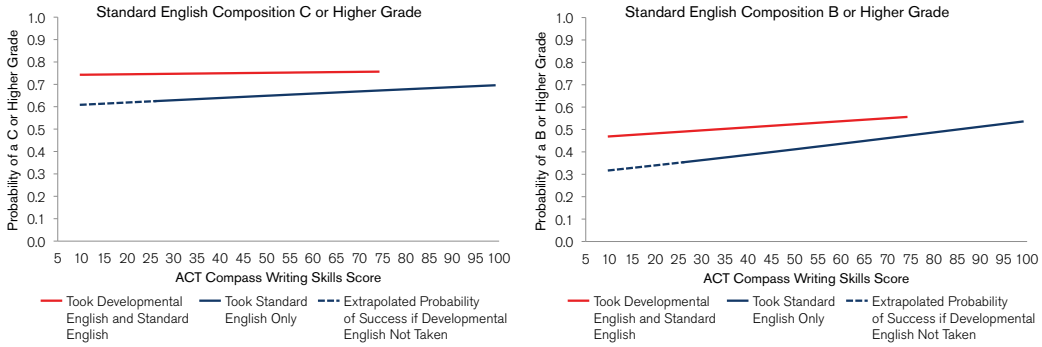

Figure 4. Probability of success in Standard English Composition with and without taking Developmental English Composition

I found similar results for Elementary Algebra/Intermediate Algebra (Figure 5). For students who first enrolled in Elementary Algebra prior to taking Intermediate Algebra, their probability of a C or higher grade was 0.02 to 0.03 points higher than those expected for similar students who enrolled directly into Intermediate Algebra, and 0.04 to 0.05 points for a B or higher grade. Though statistically significant ($p < .01$), these differences in probabilities were smaller than those found for

[21] Although differences in probabilities for those taking and not taking the lower-level course before the higher-level course were, on average, statistically significant ($p<.01$), conditional differences in probabilities between the two groups for particular test scores might not be. Confidence bands around the conditional probabilities would be the appropriate test, but were of lesser interest here, and would overcomplicate the interpretability of the figures.

Developmental English Composition/Standard English Composition, and were similar in magnitude across ACT Compass Pre-Algebra scores.

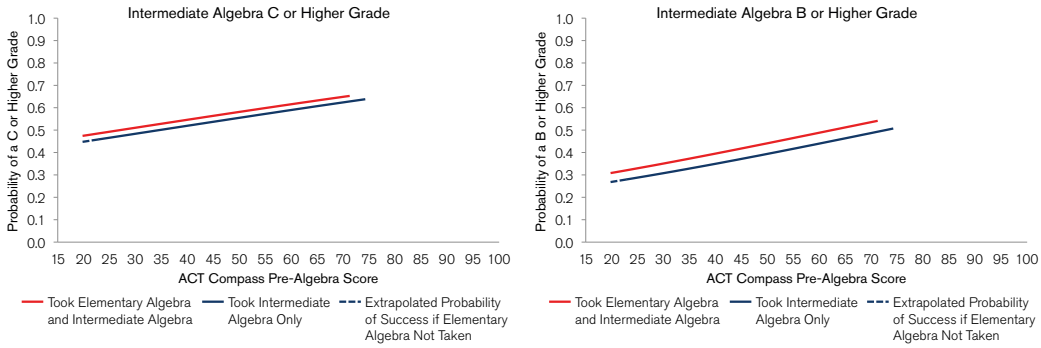

Figure 5. Probability of success in Intermediate Algebra with and without taking Elementary Algebra

Figure 6 shows the results for Arithmetic/Elementary Algebra. In contrast to the course pairs discussed earlier, students who first took Arithmetic had a similar probability of obtaining either a B or higher grade or C or higher grade in Elementary Algebra, regardless of their ACT Compass Pre-Algebra score, compared to similar students who enrolled directly in the higher-level course. The results for Intermediate Algebra/College Algebra were very similar to those for Arithmetic/Elementary Algebra. Differences in probabilities between students who did and did not first enroll in the lower-level course were near zero, or slightly favored students who enrolled directly into the higher-level course. Furthermore, differences in probabilities did not depend on ACT Compass Algebra score.

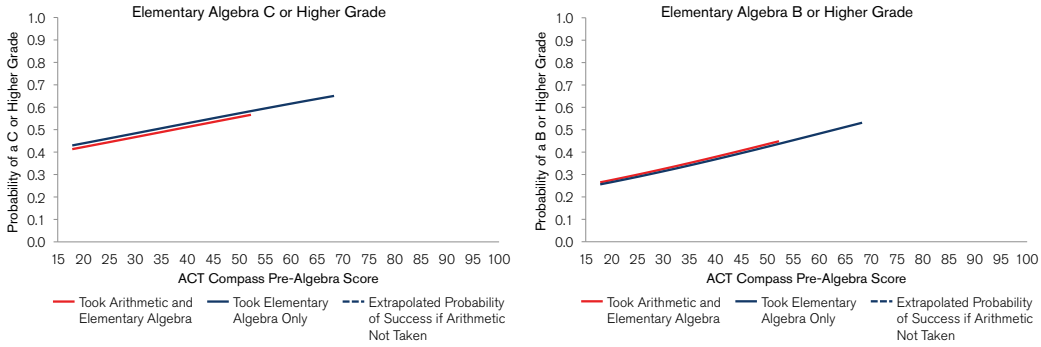

Figure 6. Probability of success in Elementary Algebra with and without taking Arithmetic

The results for Developmental Reading/first social science course were similar to those for Developmental English Composition/Standard English Composition (Figure 7). However, the slopes of the probabilities for first social science course success were much steeper than those for Standard English Composition, indicating a stronger relationship between ACT Compass Reading score and first social science course success. In addition, the differences in probabilities between students who enrolled in Developmental Reading prior to taking the higher-level course and similar students who enrolled directly into the higher-level course were greater for this course pair. Group differences across ACT Compass Reading scores of 43–80 ranged from 0.10 to 0.16 for a C or higher grade, and 0.11 to 0.18 for a B or higher grade, with larger differences occurring at lower score values.

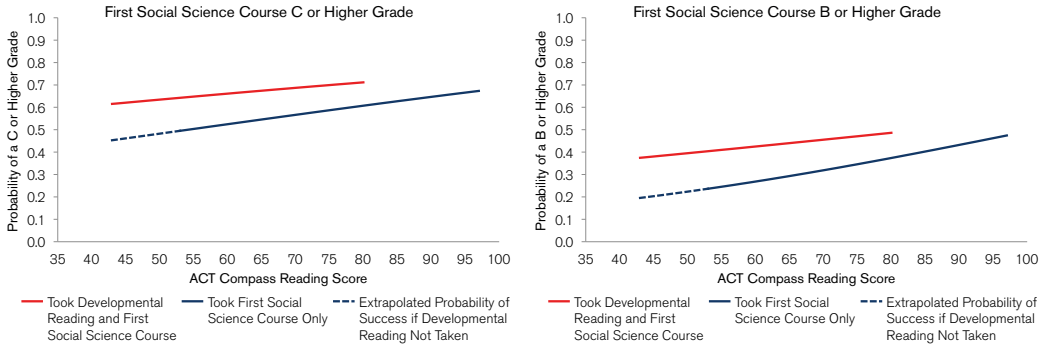

Figure 7. Probability of success in first social science course with and without taking Developmental Reading

Lower-Level Course Grades as Predictors of Success in Higher-Level Courses. Across all course pairs, the probability of success in the higher-level course for students who took the lower-level course also depended on the A–F grade they received in the lower-level course.

For most course pairs, the probability of earning a B or higher or C or higher grade in the higher-level course also depended on ACT Compass test score when lower-level course grade was included in the models. There were two exceptions: ACT Compass Writing skills score was not a statistically significant predictor of success in Standard English Composition after Developmental English Composition grade was added to the models. For Elementary Algebra/Intermediate Algebra, ACT Compass test score was a significant predictor of a B or higher grade ($p < .01$) when lower-level course grade was included in the model, but not for a C or higher grade. For all course pairs, the test score by lower-level course grade interaction was not statistically significant ($p > .05$), i.e., differences in probabilities among lower-level course grades did not vary by ACT Compass test score.

In general, even for those outcomes where ACT Compass test score was statistically significant, the slopes of the probability curves were flatter than those when lower-level course grade was not included. This finding was not surprising, given that taking the lower-level course, and the corresponding grade received, occurred closer in time to the subsequent college outcomes, relative to the test date for the corresponding ACT Compass score.

For all course pairs, students who received an A grade in the lower-level course had a higher probability of success in the higher-level course than did similar students who enrolled directly in the higher-level course. Students who received a B grade in Arithmetic also had a consistently higher probability of success in Elementary Algebra. For all other course pairs and outcome levels, only students with a B grade in the lower-level course and lower ACT Compass scores (typically below the median score for the lower-level course) had higher probabilities of success. Students with a C grade consistently had lower probabilities than those who enrolled directly in Elementary Algebra. Figure 8 illustrates these findings for Arithmetic/Elementary Algebra (both outcome levels; see also Table D-2 in Appendix D).

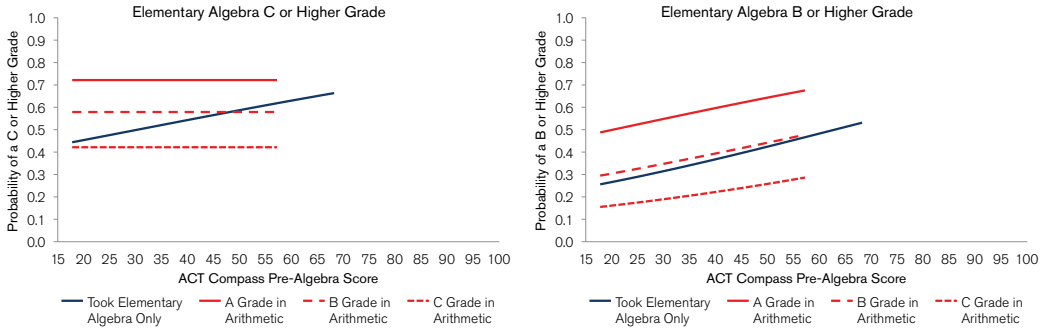

Figure 8. Probability of success in Elementary Algebra by Arithmetic grade and ACT Compass Pre-Algebra score

In Figure 8, probabilities of a B or higher grade for students who enrolled directly in Elementary Algebra ranged from 0.26 to 0.55 across ACT Compass Pre-Algebra scores of 19 to 71. The corresponding probabilities of success for students who first took Arithmetic and received an A grade ranged from 0.49 to 0.67, and ranged from 0.30 to 0.48 for those who received a B grade. Therefore, grades of A and B were the only grades where the probabilities of a B or higher grade for students who first took Arithmetic always exceeded those for students who enrolled directly in Elementary Algebra. Probabilities associated with a B or higher grade were only slightly higher than those for students enrolling in the higher-level course. The results for C or higher grade followed a similar trend, but with considerably higher probabilities for both groups of students. ACT Compass test score was not a statistically significant predictor of a C or higher grade in Elementary Algebra, when grade earned in Arithmetic was included in the model.

Figure 9 for Developmental Reading/first social science course illustrates the more typical results for the other course pairs. Students with an A grade in Developmental Reading had a higher probability of success (both B or higher, and C or higher, grade) in their first social science course than similar students who enrolled directly in it. Students with a B grade in Developmental Reading also had higher probabilities, but only for those with ACT Compass Reading scores of less than 69 (see also Appendix D, Table D-5).

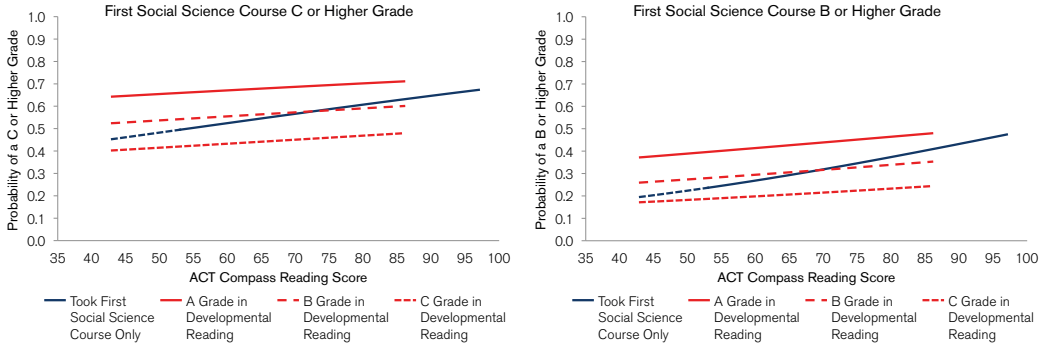

Figure 9. Probability of success in first social science course by Developmental Reading grade and ACT Compass Reading score

Cumulative GPA Year 1, Year 2, and Year 3. I next discuss cumulative GPA outcomes at Year 1, Year 2, and Year 3 for typical two-year students, according to their lower-level coursework. ACT Compass test score was a statistically significant and positive predictor of nearly all 3.0 or higher cumulative GPA outcomes, but not for most 2.0 or higher GPA outcomes.

For two course pairs (Developmental English Composition/Standard English Composition and Developmental Reading/first social science course), taking the lower-level course was associated with substantially higher probabilities of success for all GPA outcomes, compared to those expected of similar students who enrolled directly in the associated higher-level course. Moreover, the benefit from taking the lower-level course decreased as ACT Compass test score increased for most GPA outcomes (i.e., the lower-level course indicator by ACT Compass test score interaction was statistically significant [$p < .05$]). For the other course pairs, taking the lower-level course was associated with similar or lower probabilities than those for similar students who enrolled directly in the higher-level course. Figure 10 illustrates the results for Developmental English Composition/ Standard English Composition for Year 2 GPA.

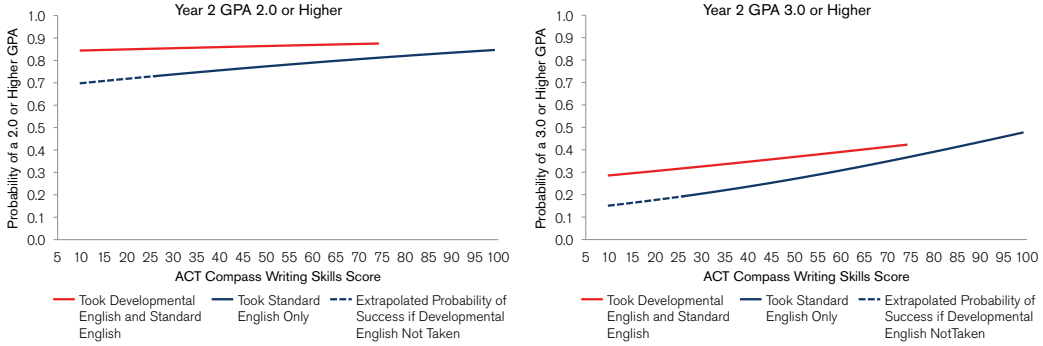

Figure 10. Probability of 2.0 or higher, or 3.0 or higher, Year 2 GPA for students who did and did not take Developmental English Composition before Standard English Composition

For students who first took Developmental English Composition, their probability of a 3.0 or higher Year 2 GPA ranged from 0.29 to 0.42 for ACT Compass Writing Skills scores of 10 to 74 (see Figure 10). In comparison, the corresponding probabilities for students who enrolled directly in the higher-level course ranged from 0.14 to 0.36 for the same score values. Group differences in probabilities also decreased as ACT Compass Writing Skills score increased.

Figure 11 shows the results for Intermediate Algebra/College Algebra for Year 3 GPA. For these outcomes, differences in probabilities for students who did and did not first take Intermediate Algebra before taking College Algebra were not statistically significant. No benefit was shown for taking Intermediate Algebra prior to taking College Algebra in terms of any of the GPA outcomes.

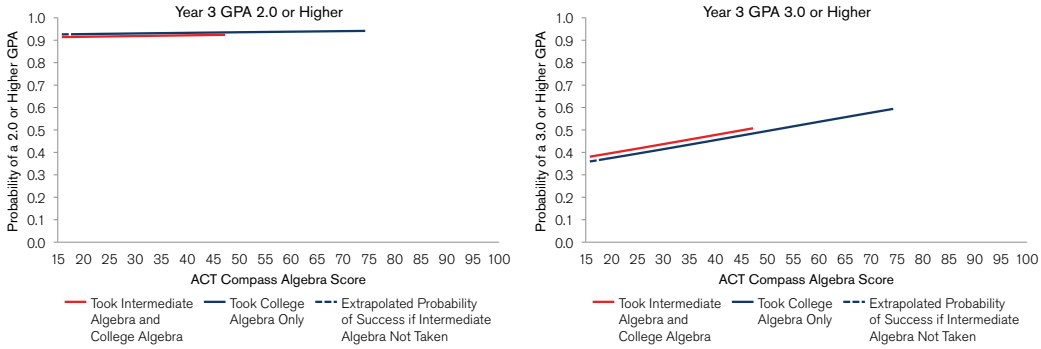

Figure 11. Probability of 2.0 or higher, or 3.0 or higher, Year 3 GPA for students who did and did not take Intermediate Algebra before College Algebra

Lower-Level Course Grades as Predictors of Cumulative GPA Outcomes. Across all course pairs, the probability of successful cumulative GPA outcomes for students who took the lower-level course also depended on the A–F grade they received in the lower-level course.

ACT Compass test score was not a positive and significant predictor of most cumulative GPA outcomes, when lower-level course grade was included in the model. The exception was Developmental English Composition/Standard English Composition for Year 1 and Year 2 GPA outcomes (both 2.0 or higher and 3.0 or higher), and Elementary Algebra/Intermediate Algebra for Year 3 GPA, for both outcome levels.

For all course pairs, students who received an A grade in the lower-level course had a consistently higher probability of a 2.0 or higher or 3.0 or higher GPA in Year 1, Year 2, and Year 3 than did similar students who enrolled directly in the higher-level course (see Tables D-1 through D-5 in Appendix D). Students who received a B grade in Arithmetic also had a consistently higher probability for these outcomes. For other course pairs (except Intermediate Algebra/College Algebra), only students with lower ACT Compass scores who received a lower-level course grade of B had higher probabilities of success for the Year 1, Year 2, and Year 3 GPA outcomes.

Figures 12 and 13 summarize the results for Developmental English Composition/Standard English Composition for Year 2 GPA of 3.0 or higher and Intermediate Algebra/College Algebra for Year 1 GPA of 2.0 or higher.

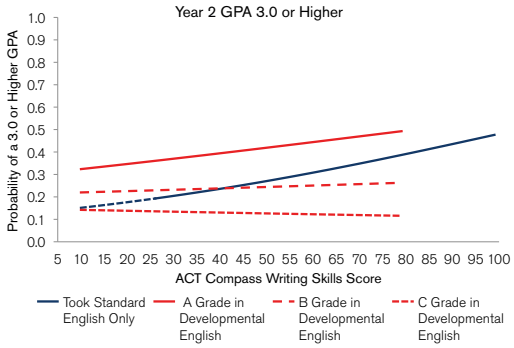

Figure 12. Probability of a Year 2 GPA of 3.0 or higher by Developmental English Composition grade and ACT Compass Writing Skills score

As shown in Figure 12, probabilities of a 3.0 or higher Year 2 GPA associated with a Developmental English Composition grade of A were consistently higher than those for similar students who enrolled directly in Standard English Composition, with differences decreasing slightly as ACT Compass Writing Skills score increased from 10 to 79. Probabilities associated with a lower-level course grade of B were higher only for students with ACT Compass Writing Skills scores of less than 37.

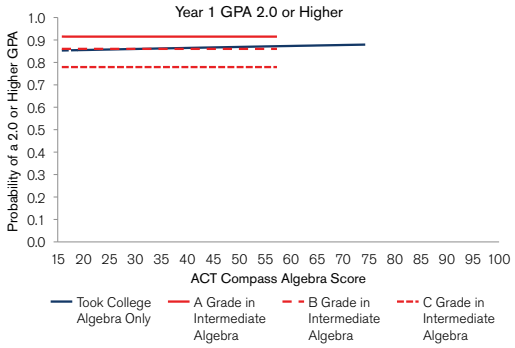

Figure 13. Probability of a Year 1 GPA of 2.0 or higher by Intermediate Algebra grade and ACT Compass Algebra score

For Intermediate Algebra/College Algebra, probabilities of a Year 1 GPA of 2.0 or higher were very high, regardless of Intermediate Algebra grade. Probabilities were 0.78, 0.86, and 0.91 for students with Intermediate Algebra grades of C, B, and A, respectively, for ACT Compass Algebra scores ranging from 16 to 57. Probabilities for students who enrolled directly into College Algebra ranged from 0.85 to 0.87 for the same score values, with lower-level course grade of A having probabilities that exceeded those for students who took only the higher-level course.

The findings related to lower-level course grade for the other course pairs were similar to those for these course pairs: The A and B grade findings for 3.0 or higher GPA results paralleled those for Developmental English Composition/Standard English Composition, and the A grade results for 2.0 or higher GPA paralleled those for Intermediate Algebra/College Algebra.

Early College Outcomes. I next discuss re-enrolling Year 2 or Year 3, and progressing to degree by the end of Year 2, relative to lower-level coursework of typical two-year students.

The probabilities of success for re-enrolling Year 2 and Year 3, and progress to degree, differed substantially from those for cumulative GPA outcomes. Across course pairs, ACT Compass test score was either not related or slightly negatively related to re-enrolling Year 2; however, ACT Compass test score was positively related to re-enrolling Year 3 for three of the course pairs, and to progressing to degree at the end of Year 2 for four of the course pairs. The negative and non-significant results are likely due to lower re-enrollment rates for higher-achieving students (possibly transferring to proprietary schools and/or out of state), and the criteria used to determine progress to degree.

For Developmental English Composition/Standard English Composition, taking the lower-level course was associated with higher probabilities of success than those of similar students who enrolled directly in the higher-level course. This finding was seen for all three early college outcomes. The benefit from taking the lower-level course decreased as ACT Compass test score increased (i.e., the lower-level course indicator by ACT Compass test score interaction was statistically significant

($p < .05$). For the other course pairs, taking the lower-level course was associated with similar or lower probabilities than those for similar students who enrolled in the higher-level course.

Figures 14 and 15 illustrate the results for Elementary Algebra/Intermediate Algebra and re-enrolling Year 2, and Developmental English Composition/Standard English Composition for re-enrolling Year 3.

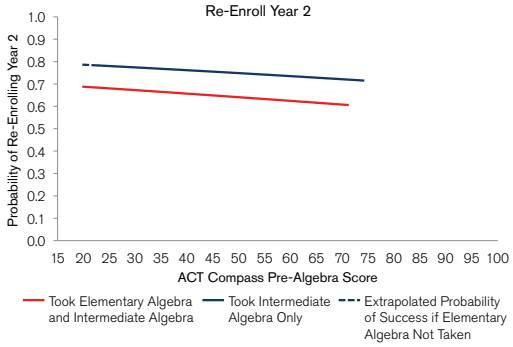

Figure 14. Probability of re-enrolling Year 2 for students who did and did not take Elementary Algebra before Intermediate Algebra

For Elementary Algebra/Intermediate Algebra, the probability of re-enrolling Year 2 was consistently lower for students who first enrolled in the lower-level course, with probabilities ranging from 0.68 to 0.60 for ACT Compass Pre-Algebra scores of 22–74. Probabilities ranged from 0.78 to 0.72 for similar students who enrolled in the higher-level course. Differences in probabilities between the two groups did not depend on ACT Compass test score.

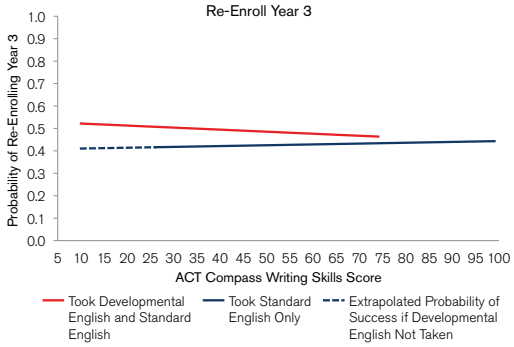

Figure 15. Probability of re-enrolling Year 3 for students who did and did not take Developmental English Composition before Standard English Composition

In contrast, for Developmental English Composition/Standard English Composition, the probability of re-enrolling Year 3 was consistently slightly higher for students who first enrolled in the lower-level course, with probabilities ranging from 0.52 to 0.46 for ACT Compass Writing Skills scores of 10–74. Probabilities were lower for similar students who enrolled directly in the higher-level course, with probabilities ranging from 0.41 to 0.43. As Figure 15 illustrates, differences between the two groups also depended on ACT Compass Writing Skills score.

Lower-Level Course Grades as Predictors of Early College Success. Across virtually all course pairs, the probability of early college success for students who took the lower-level course also depended on the A–F grade they received in the lower-level course. The one exception was re-

enrolling Year 2 for Intermediate Algebra/College Algebra, for which lower-level course grade was not statistically significant ($p > .01$). ACT Compass test score was a significant negative predictor of re-enrolling Year 2 for three course pairs, and for two course pairs for re-enrolling Year 3, when lower-level course grade was include in the models. Results for progress to degree differed across course pairs.

For re-enrolling Year 2 or Year 3, students with a lower-level course grade of A had a higher probability of success than similar students who enrolled directly into the higher-level course for all course pairs except Intermediate Algebra/College Algebra (for which course grade was not a significant predictor of re-enrolling Year 2). This finding held for all ACT Compass test score values.

Students with lower ACT Compass scores and a B grade in the lower-level course had higher probabilities of re-enrolling Year 2 and Year 3 for three of the five course pairs.[22] Figure 16 illustrates these results for Elementary Algebra/Intermediate Algebra.

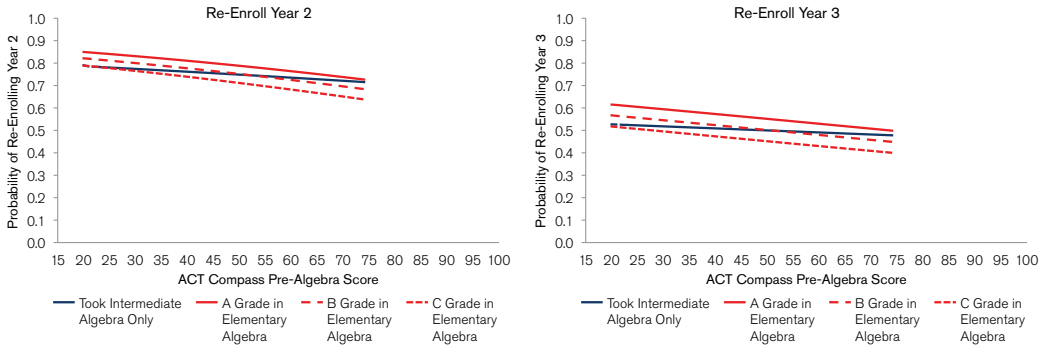

Figure 16. Probability of re-enrolling Year 2 or Year 3 by Elementary Algebra grade and ACT Compass Pre-Algebra score

In contrast, students with a B grade in Arithmetic had consistently higher probabilities. Figure 17 illustrates these results for re-enrolling Year 3.

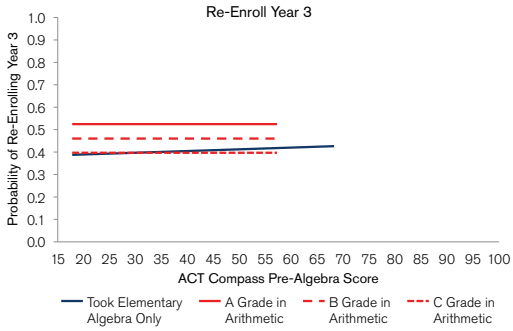

Figure 17. Probability of re-enrolling Year 3 by Arithmetic grade and ACT Compass Pre-Algebra score

For three of the five course pairs, students who first enrolled in the lower-level course had lower probabilities of showing progress to degree than similar students who enrolled directly in the higher-level course, regardless of lower-level course grade. Figure 18 illustrates this finding for

[22] These course pairs included Developmental English Composition/Standard English Composition, Elementary Algebra/Intermediate Algebra, and Developmental Reading/first social science course (re-enrolling Year 2 only).

Developmental Reading/first social science course (see also Table D-5 in Appendix D). For the other two course pairs (Arithmetic/Elementary Algebra and Elementary Algebra/Intermediate Algebra), only a lower-level course grade of A resulted in higher probabilities of success than those of similar students who enrolled directly in the higher-level course.

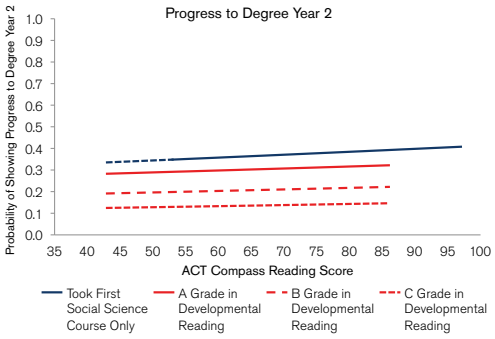

Figure 18. Probability of progressing to degree by Developmental Reading grade and ACT Compass Reading score

Certificate, Associate's Degree, and Associate's or Bachelor's Degree Completion. In this section I compare probabilities of degree completion for students who first enrolled in a lower-level course and those who enrolled directly in the corresponding higher-level course. As noted earlier, degree completion rates are generally low for two-year students; these results were also found here.

For all certificate outcomes and course pairs, the relationship between ACT Compass test score and probability of success was zero, or near zero. Additionally, probabilities of success did not differ between students who first enrolled in the lower-level course and those who enrolled directly in the higher-level course.

In contrast, for four of the five course pairs, ACT Compass test score was positively and significantly related to associate's degree completion and to associate's or bachelor's degree completion within four, five, or six years.[23] For Intermediate Algebra/College Algebra, ACT Compass Algebra score was not a statistically significant predictor ($p > .05$) of these outcomes. Observed degree completion rates were very similar for both groups, possibly reflecting different degree requirements for mathematics. Students may not be required to complete College Algebra to complete an associate's degree, for example.

For most course pairs, enrolling in the lower-level course was associated with a similar or lower probability of completing an associate's degree or either an associate's or bachelor's degree within four, five, or six years, compared to enrolling directly in the higher-level course. The exceptions were Developmental English Composition/Standard English Composition (for all degree outcomes except associate's degree within six years) and Developmental Reading/first social science course (for either an associate's or bachelor's degree within four or five years). The differences in probabilities for these exceptions were generally small, with most not exceeding 0.05 points across ACT Compass scores. Figure 19 illustrates these exceptions using the results for Developmental English Composition/Standard English Composition and completing an associate's or bachelor's degree within six years. Figure 20 illustrates the more typical result of similar or lower probabilities for

[23] ACT Compass Pre-Algebra score was not statistically significant for predicting associate's degree completion at Year 6 for Elementary Algebra/Intermediate Algebra.

students who first took the lower-level course using the results for Elementary Algebra/Intermediate Algebra and completing an associate's degree within five years.

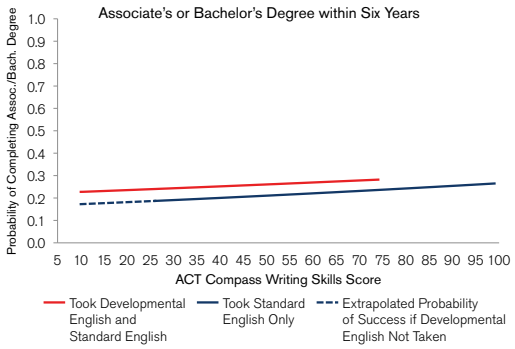

Figure 19. Probability of completing either an associate's or bachelor's degree within six years for students who did and did not take Developmental English Composition before Standard English Composition

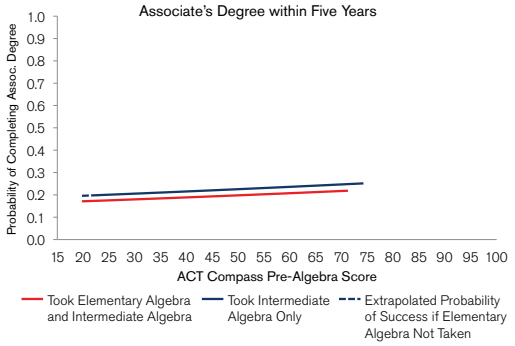

Figure 20. Probability of completing an associate's degree within five years for students who did and did not take Elementary Algebra before Intermediate Algebra

In the earlier study (Noble & Sawyer, 2013), we found that by considering the additional time required to complete a bachelor's degree by students who took the lower-level and higher-level courses, these students could complete bachelor's degrees in six years at a rate similar to or higher than that of non-developmental students in five years. This result also occurred for two-year students in this study for four of the five course pairs[24] for associate's degree completion within four vs. five years (for English and Reading), and associate's or bachelor's degree completion within four vs. five years (for all course pairs except Arithmetic/Elementary Algebra). For example, for Intermediate Algebra/College Algebra and associate's or bachelor's degree completion within four years, the probability of success for students who enrolled directly in College Algebra was 0.35, compared to 0.30 for those who first took Intermediate Algebra. However, the corresponding probability for completing an associate's or bachelor's degree within five years for those who first took Intermediate Algebra was 0.38, slightly exceeding the four-year degree completion probability for students who took only the higher-level course.

[24] Differences in probabilities for Arithmetic/Elementary Algebra and Intermediate Algebra/College Algebra were slight.

Lower-Level Course Grades as Predictors of Certificate and Degree Completion. Across all course pairs, the probability of completing an associate's degree or either an associate's or bachelor's degree within four, five, or six years for students who first took the lower-level course also depended on the A–F grade they received in the lower-level course (see Tables C-1 through C-5 in Appendix C). These results also held for completing a certificate within four, five, or six years, but only for Developmental English Composition and Developmental Reading. Across the mathematics course pairs, lower-level course grade was a consistently significant predictor only for completing a certificate within four years, and not within five and six years.

ACT Compass test score was a statistically significant and positive predictor only for completing an associate's degree or associate's or bachelor's degree within four years for the Arithmetic/Elementary Algebra course pair, when Arithmetic grade was included in the models. For all other course pairs, the relationship of these outcomes with ACT Compass test score was zero or near zero, when lower-level course grade was included.

Only those students with an A grade in the lower-level course had higher probabilities of completing an associate's degree or associate's or bachelor's degree within four, five, or six years than did those enrolling directly into the higher-level course. This result was seen across all ACT Compass scores for all course pairs except the English Composition course pair, where probabilities associated with a lower-course grade of A were higher only for students with lower ACT Compass scores. In general, for certificate completion, differences in probabilities between students who received A grades in the lower-level course and those who enrolled directly in the higher-level course were near zero. Probabilities associated with a B or higher grade were similar to or lower than those for similar students who enrolled directly in the higher-level course.

Figures 21 and 22 illustrate the results for degree completion by lower-course grade. Figure 21 shows the results for completing an associate's or bachelor's degree within four years for Arithmetic/Elementary Algebra. The results for completing an associate's degree within four years were very similar. Figure 22 shows the results for completing an associate's degree within five years for Elementary Algebra/Intermediate Algebra.

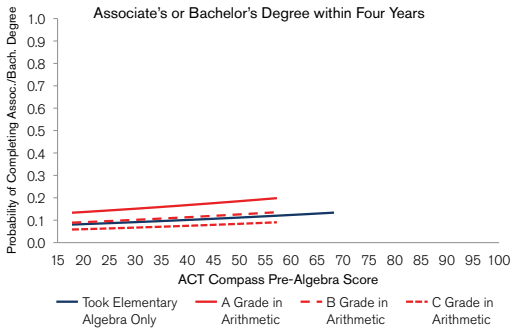

Figure 21. Probability of completing an associate's/bachelor's degree within four years by Arithmetic grade and ACT Compass Pre-Algebra score

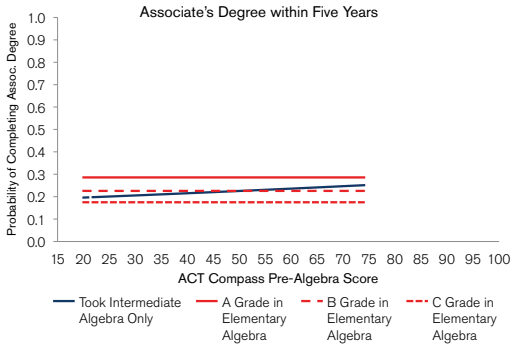

Figure 22. Probability of completing an associate's degree within five years by Elementary Algebra grade and ACT Compass Pre-Algebra score

For Arithmetic/Elementary Algebra, probabilities of completing an associate's or bachelor's degree within four years ranged from 0.13 to 0.19 for students with an Arithmetic grade of A, and 0.09 to 0.13 for those with a grade of B, for ACT Compass Pre-Algebra scores of 18–57. For students who enrolled directly in Elementary Algebra, probabilities ranged from 0.09 to 0.12 for the same scores. Thus, only the probabilities of success for a lower-level course grade of A exceeded those for students who enrolled directly in the higher-level course.

As shown in Figure 22, only the probability of completing an associate's degree for students with an A grade in Elementary Algebra consistently exceeded those for students who enrolled directly in Intermediate Algebra. In contrast, only those students with lower ACT Compass Pre-Algebra scores and who received a B grade in the lower-level course had slightly higher probabilities of completing an associate's degree.

Age/Enrollment Status and College Success. For the vast majority of course pairs and outcome variables, the age/first-year enrollment status dummy variables were statistically significant predictors of college success (see Appendix C, Tables C-1 through C-5). Moreover, the benefit of taking the lower-level course depended on the age/enrollment status group. The exceptions to this finding were all certificate completion outcomes for the Developmental English Composition/Standard English Composition, Arithmetic/Elementary Algebra, and Elementary Algebra/Intermediate Algebra course pairs, and completing a certificate in Year 6 for Developmental Reading/first social science course. The results are shown in Appendix E, Tables E-1 to E-5.

In general, traditional students (full-time, aged ≤ 21) and students aged > 25 had the highest probabilities of success; for some outcomes and course pairs[25], students aged > 25 had the higher probabilities. Part-time students aged ≤ 21 universally had the lowest probabilities of success for all five course pairs.

For traditional students, taking both the lower-level and higher-level courses was associated with lower probabilities of success, when compared to those who took only the higher-level course, for all course pairs. For part-time students aged ≤ 21, the opposite was true for Developmental English Composition/Standard English Composition and Developmental Reading/first social science course for almost all outcomes and outcome levels: Taking both courses was associated with higher probabilities of success than those for students who took only the higher-level course, with differences in probabilities ranging from 0.05 to 0.20. Similar results were found for this age/

[25] These included Year 1 and Year 2 GPA outcomes for all course pairs except Elementary Algebra/Intermediate Algebra.

enrollment group for all course pairs except Arithmetic/Elementary Algebra, but only for Year 2 and Year 3 GPA outcomes and selected levels of associate's or bachelor's degree completion.

The results for students aged 22–25 or > 25 generally paralleled those of traditional students: They tended to favor students who enrolled directly in the higher-level courses. For students aged 22–25, there were few exceptions to this finding, including higher-level course success in Standard English Composition and first social science course for students who first enrolled in the lower-level course. Differences in probabilities were .14 and .10 and .10 and .07, respectively, for C or higher and B or higher outcomes. Exceptions for students aged > 25 were few and inconsistent across course pairs.

Age/Enrollment Status, Lower-Level Course Grade, and College Success. Taking lower-level course grades into consideration changed some of the results by age/enrollment status (see Appendix F). Across course pairs, for traditional students and students aged 22–25, those with an A grade in the lower-level course had similar or higher probabilities of success than similar students who enrolled directly in the higher-level course for higher-level course success, some GPA outcomes, and degree completion. For some outcomes, a lower-level course grade of B was also associated with higher probabilities of success for students aged 22–25. In contrast, part-time students aged ≤ 21 with A or B grades in the lower-level course had higher probabilities of success for all course pairs. Moreover, those with C grades had higher probabilities of success for most degree completion outcomes. For students aged > 25, those with an A grade in the lower-level course also had higher probabilities of success, but only for Developmental English Composition/ Standard English Composition, Arithmetic/Elementary Algebra, and Elementary Algebra/ Intermediate Algebra, and for differing outcomes. A, B, or C grades were associated with similar or lower probabilities of success compared to those for similar students who enrolled directly in the higher-level course for the other two course pairs.

Across age/enrollment status groups, for the English course pair, probabilities of success for students aged 22–25 and > 25 with lower-level course grades of A, B, or C were not significantly different from those for traditional students for higher-level course (B or higher grade) and GPA outcomes. For some outcomes, the probabilities associated with lower-level course grades of A for students aged > 25, and occasionally for students aged 22–25, exceeded those of all traditional students who enrolled directly in the higher-level course. For example, the probability of a 3.0 or higher Year 1 GPA for traditional students who took only the higher-level course was .52 (see Table E-1). However, for students aged 22–25 and > 25 with lower-level course grades of A, their probabilities of achieving the same outcome were .57 and .59, respectively (see Table F-1). Similar findings occurred for a 3.0 or higher Year 2 GPA.

These findings were also shown for the Year 2 and Year 3 GPA outcomes for Arithmetic/Elementary Algebra (2.0 or higher only) and Elementary Algebra/Intermediate Algebra (both outcome levels), but not for Developmental Reading/first social science course. The probabilities of success for students aged 22–25 and > 25 with lower-level course grades of A exceeded those for all traditional students who enrolled directly in the higher-level course. Furthermore, probabilities of success for nontraditional-aged students with Elementary Algebra grades of B also exceeded those of traditional students who enrolled directly in Intermediate Algebra, but only for GPAs of 3.0 or higher (0.62 and 0.67 vs. 0.49, and 0.61 and 0.67 vs. 0.45, respectively).

For part-time students aged ≤ 21, though lower-level course grades of A or B were associated with higher probabilities of success than those for similar students who enrolled directly in the higher-

level course, their probabilities remained universally lower than those for similar students in the other age/enrollment groups.

Goodness-of-Fit and Sensitivity Analyses of Regression Models. Students who first enrolled in the lower-level course and those who enrolled directly in the higher-level course were compared on the conditional means (log odds for dichotomous variables) of the variables used to create the propensity scores (students' ethnicity, gender, institution state, in-state vs. out-of-state enrollment, and self-reported high school average). The means were conditioned on the lower-level course indicator, propensity score, their interaction, as well as the other covariates included in the regression models (ACT Compass test score, age/enrollment status). The average absolute standardized differences in the means showed adequate fit (differences < .1) for 28 out of 35 predictor/course pair combinations. The predictors for which fit was less adequate were fairly consistent across course pairs: high school average (Developmental English Composition/Standard English Composition and Developmental Reading/first social science course), racial/ethnic minority students vs. white students (Developmental English Composition/Standard English Composition and Developmental Reading/first social science course), and state location of institution (Developmental English Composition/Standard English Composition, Intermediate/College Algebra, and Developmental Reading/first social science course).

The sensitivity analyses showed that the regression models could be sensitive to omitted variables (i.e., variables not included in the models). The regression coefficients for the propensity scores (and propensity score coefficient/2) were almost always larger than the coefficients for the lower-level course indicator. Given the limited number and types of predictor variables used to estimate the propensity scores, the sensitivity analysis results could be expected. No information was available about students' motivation and reasons for enrolling in a two-year college, or their psychosocial characteristics. Further research with additional covariates will help differentiate actual benefits from the effects of omitted variable bias.[26]

Discussion

The results of Noble and Sawyer (2013) confirmed previous research findings: Developmental students are less successful overall than students who do not take developmental courses (Attewell et al., 2006; NCES, 2004). However, as Noble and Sawyer (2013) found, I also found that particular subgroups of students do benefit from taking developmental coursework, especially when I took into account the greater time they needed to complete their bachelor's degrees.

In this study, I examined the effectiveness of developmental courses from a similar perspective, but focused on two-year college students. I compared the college success of students who enrolled in both a lower- and higher-level course to those who enrolled only in the higher-level course: These students had the same ACT Compass scores, age/enrollment status, student and institutional characteristics, and were enrolled in similar institutions (i.e., group differences in these variables were adjusted through prediction models and propensity scores). I measured college success using many different outcome variables: completing the subsequent course with a satisfactory grade; cumulative GPA the first, second, and third year; re-enrollment the second and third years; and certificate or degree completion (certificate, associate's degree, or associate's or bachelor's degree in four, five, or

[26] It is unlikely that inclusion of additional covariates will change the overall results. Even with restricting the sample to those lower-level students who progressed to the higher-level course, the results, though somewhat more positive than prior research, illustrated the same general conclusions.

six years). I compared the conditional probabilities of success, given ACT Compass test score, age/enrollment status, and propensity score, of five groups of students who took particular lower-level courses and the associated higher-level course with the corresponding conditional probabilities of students who enrolled directly in the higher-level course.

This study found somewhat similar results to those found in the earlier study. Positive benefits were found only for course grade and GPA outcomes and for specific course pairs: Taking the lower-level course was associated with higher probabilities of a B or higher or C or higher grade in the higher-level course for three of the five course pairs. Results for most Year 1 through Year 3 GPA outcomes followed the same pattern for two of these three course pairs. Any positive benefits resulting from first taking the lower-level course disappeared over time, however. In general, little or no benefits were found for most retention and degree completion outcomes (if not taking into account the extra time required for developmental course work).

Due to the large percentages of students (35% to 55%) who took lower-level courses but who did not progress to higher-level courses, I was unable to include them as unsuccessful outcomes in the regression models. However, by comparing the observed success rates for those students enrolled in the lower-level course who progressed and those who did not, it is immediately apparent that those who did not progress were also much less likely to be successful in college in the long term. These findings are consistent with those of other studies (Bailey et al., 2010; Jenkins et al., 2009; Jaggars & Stacey, 2014). A large proportion of developmental students do not progress beyond developmental courses to entry-level gateway college courses.

These findings have direct implications for interpreting the overall results of this study in terms of *all* students who first enrolled in lower-level courses, and not only those students who progressed to the higher-level course. With the lower ACT Compass test scores, lower-level course grades, and success rates for students who did not progress, when combined with the modeled results shown here, the probabilities of short- and long-term college success for all students who took the lower-level course would likely be much lower than those reported here. These results would more closely parallel our earlier findings (Noble & Sawyer, 2013), as well as other research (Adelman, 1999; Attewell et al., 2006; Calcagno & Long, 2008; NCES, 2004) on the benefits of taking developmental coursework.

Some students who did not progress to the higher-level course did progress to completing a certificate. Students in certificate programs might not be required to take entry-level gateway coursework, particularly coursework that might be required for an associate's or bachelor's degree. Additional study of non-progressing students by program of study, as well as additional information about requirements for certificate completion, would help clarify this issue.

Success in College Depends on Prior Academic Preparation

As shown in Noble and Sawyer (2013), with few exceptions, students who were better prepared for college coursework were more likely to be successful, both short- and long-term, than students who were underprepared. This was true of students who first enrolled in the lower-level course and those who enrolled directly in the higher-level course.

ACT Compass test score was a significant predictor for both lower- and higher-level course outcomes, as well as several longer-term college outcomes, including degree completion. Furthermore, test score remained a significant predictor of several outcomes even with the inclusion of lower-level course grade in the models. Recent studies (Scott-Clayton, 2012; Fulton et

al., 2014) claim that misplacement of students (over- and under-placement) is one contributor to the ineffectiveness of developmental programs. These researchers advocate eliminating the use of placement tests in favor of using high school average, or using both in combination in making placement decisions.

The results here argue for using placement test scores for course placement, along with other relevant variables such as lower-level course grade (if appropriate) and high school GPA (used here in the propensity score). ACT recommends the use of multiple measures in making course placement decisions. However, for many two-year students, particularly for returning adult students, high school GPA is either unavailable or out-of-date; it no longer reflects what a student knows and is able to do.

Among students who enrolled in the lower-level course, grade in that course was also a significant predictor of short- and long-term success. In some cases, both ACT Compass test score and lower-level course grade were significant predictors of success; in others, ACT Compass test score was not significant when grade was included in the model. This finding is consistent with the results from the earlier study: If developmental coursework is effective in providing the knowledge and skills needed for success in the next course, then test scores obtained before taking developmental coursework no longer reflect what students know and are able to do after they take the course. Moreover, ACT Compass test scores were used to place the majority of students in lower-level courses. The resulting distributions of ACT Compass test scores were restricted, especially for mathematics courses.

It is worth reiterating that, when validating test scores or other measures for course placement, institutions and researchers need to ensure that no intervening instruction has occurred (or else is statistically controlled for). This also means that test scores should be current, rather than relying on older scores, as older scores may not accurately present a student's current level of knowledge and skill. The ACT Compass Course Placement Service (ACT, 2015) recommends that institutions include in their validity studies data only from first-time students without prior developmental instruction. The ACT Compass Course Placement Service also recommends that institutions identify students who are taking developmental coursework at the same time as standard college-level courses.

Simply Taking Developmental Courses Results in Few Long-Term Benefits

For three of the five developmental courses, simply taking the courses (without considering the grades earned in them) and enrolling in subsequent higher-level courses resulted in increased chances of succeeding in those courses. Maximum differences in probabilities were relatively large for Developmental English Composition/Standard English Composition and Developmental Reading/first social science course (maximum increases in probability of .13 and .15, and .16 and .18, respectively).

Typical two-year students who took Developmental English Composition or Developmental Reading, as a group, also improved their chances of successful GPA outcomes. Similar results were found in the earlier study for selected developmental courses. These results could be due to how institutions treat course credits and grades from developmental courses in GPA calculations (Parsad & Lewis, 2003). Follow-up with the two states providing the college outcome data revealed that for one state, developmental grades were included in cumulative GPA calculations. For the other state,

the inclusion/exclusion decision was institution-specific and not determined at the state level. The relatively high percentages of students receiving C or higher grades in these courses are therefore not surprising.

The re-enrollment and progress-to-degree results were an interesting contrast to those for higher-level course grade and GPA outcomes. Students who took Developmental English Composition or Developmental Reading prior to higher-level courses were more likely to re-enroll and show progress to degree than similar students who enrolled only in the higher-level courses. The benefits decreased as ACT Compass score increased, however: Higher-achieving students who first took either the lower-level or the higher-level course were less likely to re-enroll Year 2 or Year 3 than similar lower-achieving students. These findings may in part be due to students' intent to transfer after enrolling in a two-year college. Higher-achieving students are more likely to transfer to a four-year institution and may also take a few classes at a two-year college in advance of or concurrently with courses at another institution. The data for this study were limited to students who could have transferred within the two public state systems of higher education. No data were available from out-of-state institutions or from most in-state private institutions and vocational/technical colleges.

Moreover, part-time students, by definition, will appear as not progressing to degree: Part-time status was defined as taking less than 24 credit hours the first year, and showing progress to degree was defined as having completed 48 credit hours by the end of Year 2.

For the progress-to-degree outcome, I expected to find lower probabilities for students who first took the lower-level course, due to delays in accumulating credit hours towards graduation from taking developmental courses. For most course pairs, this finding did not occur; Intermediate Algebra/College Algebra was the exception. There are at least two possible reasons for this result. First, as noted earlier, treatment of developmental course credit hours could be much like treatment of developmental grades; developmental course credit hours may be included/excluded on an institution-by-institution basis and dependent on a student's program of study. Second, the cutoff used for progress to degree (48 hours) might have been too restrictive for the two-year college student population, where the vast majority were part-time students. Across the course pairs, progress-to-degree rates were less than 0.50; the one exception was Intermediate Algebra/College Algebra, which also had considerably higher percentages of full-time students than other course pairs.

After the first two years, benefits associated with developmental coursework tended to decline and, in many cases, disappear. This was particularly the case for completing a certificate program. There was benefit to taking Developmental English Composition for almost all associate's degree or associate's or bachelor's degree outcomes, and for taking Developmental Reading for completing an associate's or bachelor's degree in four or five years. These findings are consistent with those of the earlier study and to some extent with other studies that looked at long-term college outcomes (e.g., Adelman, 1999; Calcagno & Long, 2008), which found that taking developmental coursework did not improve later college success. These studies used different methodological approaches and college outcomes than those used here, however. The findings here and in the earlier study also illustrate the importance of taking time to degree into consideration in conducting such research, with consideration for the delayed accumulation of credit hours resulting from taking developmental coursework.

Unlike the earlier study, across all outcomes studied, Developmental Reading appeared to be beneficial for improving the academic preparedness of entering students. For the institutions in

this study, Developmental Reading could be taken prior to, concurrent with, or following college-level social science courses. Students who took Developmental Reading after taking their first social science course were excluded from the analyses, thereby limiting the numbers of students who actually took Developmental Reading. It may be that the policies at two-year institutions for taking this sequence of courses differ from those of the states as a whole. Having all students take Developmental Reading prior to or concurrent with standard college-level social sciences coursework might change these results.

The potential benefits of taking developmental coursework were also found to depend on the course grade in the lower-level course and first-year enrollment status. The following sections address these factors.

The Benefit of Taking Developmental Courses Also Depends on the Grades Earned in Them

Consistent with findings by Noble and Sawyer (2013), Perkhounkova, Noble, and Sawyer (2006), and others (Bettinger & Long, 2005; Boatman & Long, 2010; Calcagno & Long, 2008), the benefits of taking developmental coursework depend on the grade in the developmental course. A–F grading for the courses studied here was generally tougher than that shown in the earlier study for both two- and four-year institutions. Pass/fail grades for both studies typically had very high percentages of students receiving passing grades, which limits the extent to which students can be differentiated in terms of what they know and are able to do.

A grades in the lower-level course were associated with higher probabilities of success than expected, had students enrolled directly in the higher-level course. This finding was consistent across almost all course pairs, age/enrollment status group, ACT Compass test score, and outcomes (except for certificate completion). Similarly, students with B grades in the lower-level course also had higher probabilities, but only for students with lower ACT Compass test scores, and only for higher-level course and GPA success outcomes.

The benefits associated with receiving an A grade in the lower-level courses tended to decrease over time. For later college success outcomes, only a grade of A in the lower-level course was associated with a higher probability of success than would have been expected, had students enrolled directly in the higher-level course.

The Benefit of Developmental Courses Depends on Age and First-Year Enrollment Status

The results of this study showed that, in general, full-time students aged ≤ 21 are more likely than part-time or older students to succeed in college. For some outcomes, students aged > 25 had higher probabilities. Part-time students aged ≤ 21 were the least likely to be successful across most outcomes and course pairs. Age/enrollment status did not appear to be associated with any of the Certificate completion outcomes, however.

Full-time students aged ≤ 21 and students aged 22–25 who took both the lower-level and higher-level courses did not appear to benefit from taking the lower-level course for all course pairs. In contrast, part-time students aged ≤ 21 appeared to derive more benefit from taking Developmental English Composition, Arithmetic, Elementary Algebra, and Developmental Reading than other students did. These results were seen for Year 2 and Year 3 GPA outcomes and some success levels of associate's or bachelor's degree completion. For example, part-time students aged ≤ 21

who first took Developmental English Composition were more likely to have Year 2 GPAs of 2.0 or higher, or 3.0 or higher, and they were more likely to complete an associate's degree or associate's or bachelor's degree, within four, five, or six years, compared to similar students who enrolled directly in the associated higher-level course.

The associations between first-year enrollment status and the effectiveness of lower-level courses helped inform the results from Noble and Sawyer (2013), where we compared only full-time and part-time students. Most of the research on the effectiveness of developmental instruction has focused on two-year or four-year college students (but not on both), or on degree-seeking students only, or on full-time students only. Also, as noted earlier, longer-term outcomes for nontraditional students are not typically studied in detail. Federal reporting (IPEDS) for postsecondary institutions focuses on first-time, full-time, degree-seeking students. Students who take only developmental coursework are not included in IPEDS reporting. Based on the information available on two-year students for this study, many of them would not be included in federal reporting.

Does Developmental Coursework Benefit Students?

Students who take developmental courses are not as successful in college as students who do not need to take developmental courses. My research, as well as that of Noble and Sawyer (2013), confirms this finding: Students who took both the lower- and higher-level course, as a group were as successful in college as non-developmental students with respect to higher-level course and GPA outcomes, but not for re-enrollment over time and degree completion within a fixed time period. However, as we recommended in the earlier study, consideration of the additional time required to complete an associate's or bachelor's degree by developmental students showed that these students can complete degrees at a rate similar to or higher than those of non-developmental students.

Do students derive *any* benefit from taking developmental courses, in the sense that they are more successful than similar students who do not take developmental courses? I defined similarity in terms of students' readiness for college-level work, as measured by their ACT Compass test scores, by their age/enrollment status, and other student and institutional characteristics. I compared the conditional probability of success, given ACT Compass test score, age/enrollment status, and propensity score, of groups of students who took particular lower-level courses with those who took the next higher-level course. For two of the five lower-level courses, students did benefit, but not through degree completion. For all course pairs and outcomes, however, students did benefit if they earned an A in the lower-level course. For some course pairs, students who entered the developmental course with lower ACT Compass test scores and who earned a B in the lower-level course also derived benefit.

Considerations that may help inform these results include the following:

Academic supports. Average grades and lower-level course success rates for students who did not progress to higher-level courses were considerably lower than those for students who did. These students also had lower average ACT Compass scores and were much more likely to be part-time students. These findings highlight the importance of providing developmental instruction that is appropriate for a variety of levels of skills and knowledge.

Moreover, these findings, and those for students who did not progress, highlight the need for student support and advising to encourage students to take the courses that are appropriate to their skill levels, to pass the course, and to persist to the subsequent course. As noted by Boylan

(1995), developmental education is not limited to providing developmental courses, but also includes advising/counseling and other services that address needs related to students' noncognitive characteristics.

Several studies (Karp & Bork, 2012; Venezia et al., 2010; Venezia et al., 2003) have noted the lack of preparedness of two-year college students for the placement process, the lack of knowledge of placement policies and how students are affected by them, and the implications of taking developmental coursework in terms of both time and costs. The studies also recognized the limited support programs provided to students as they progress into entry-level coursework.

Support programs can provide academic assistance for academically underprepared students and social support to encourage social integration at the institution (Padgett & Keup, 2011). They may include freshman orientation, first-year seminars, summer bridge programs, mentoring, advising, and counseling for selected population subgroups, course placement, and learning communities (Muraskin, 1997). Researchers from the National Resource Center for the First-Year Experience and Students in Transition reported that, of 87% of responding US postsecondary institutions (N = 1,019), over half had nearly all first-year students participating in the program (Padgett & Keup, 2011). In contrast, only about one-third of responding institutions had initiatives for sophomores; these initiatives typically emphasized retention, satisfaction, and student engagement (Keup et al., 2010).

Noncognitive characteristics of students. Although academic preparation is important for success in college, noncognitive characteristics are also important. I hypothesize that students' noncognitive characteristics explain, to a large extent, developmental students' disappointing long-term success. Examples of these factors include psychosocial characteristics, motivation, and academic discipline (Allen & Robbins, 2010; Allen et al., 2010), family environment (support and encouragement to succeed in college), and life situations (e.g., care for dependents, the need to work while in college). Such nonacademic characteristics affect grades earned in college, as well as those earned in high school (Goldman & Hewitt, 1975; Goldman et al., 1974; Goldman & Widawski, 1976; Stiggins et al., 1989). Research with ACT Engage® for college students has also shown the relationships between students' noncognitive characteristics and college retention, GPA, and timely degree attainment (e.g., Allen & Robbins, 2010; Allen et al., 2010). Support programs and advising, as described earlier, can help students who are "at risk" due to these factors, in addition to academic factors.

The cost and fatigue factors associated with taking full-term developmental courses. Taking developmental courses is expensive, time consuming, and can be frustrating for many students. As we have seen here, many give up. In response, institutions and researchers are exploring a variety of alternative delivery approaches, such as modular, co-requisite, or integrated instructional models (Bettinger & Long, 2005; Burdman, 2012; "Experts: Remedial classes need fixing," 2012; Fulton et al., 2014; McTiernan et al., 2013; Merisotis & Phipps, 2000; Rutschow & Schneider, 2011), or targeted brush-up instruction delivered on-line (e.g., American Education Corporation, 2009; Blackboard, Inc., 2012; Pearson Education Inc., 2012; see also Tong et al. [2012] for a detailed summary of developmental mathematics software). These alternative approaches have advantages in time, cost, and/or convenience to students, but their effectiveness, like that of traditional developmental courses, needs to be studied, especially for different student subgroups.

Continued research on developmental education is needed; there are still many unanswered questions, several of them mentioned in this section. Such research can help support or refute the value of instructional methods, instructional approaches, and noncognitive characteristics of students in informing and increasing the benefits of developmental education. In particular, the large numbers of developmental students who don't progress, as well as the diversity of student age and enrollment status at two-year colleges, highlight the complexity of developmental course effectiveness and the need for their consideration in such research.

References

ACT. (2009). *The ACT Compass Program Entering Student Descriptive Report: National 2-year institutions September 2008 through August 2009.* Iowa City, IA: ACT.

ACT. (2015). *ACT Compass Course Placement Service.* Iowa City, IA: ACT.

Adelman, C. (1999). *Answers in the tool box: Academic intensity, attendance patterns, and bachelor's degree attainment.* Washington, DC: Office of Education Research and Improvement, US Department of Education.

Allen, J., & Robbins, S. (2010). Effects of interest–major congruence, motivation, and academic performance on timely degree attainment. *Journal of Counseling Psychology. 57* (1), 23–35.

Allen, J., Robbins, S., & Sawyer, R. (2010). Can measuring psychosocial factors promote college success? *Applied Measurement in Education, 23*, 1–22.

American Education Corporation. (2009). *A+dvancer college readiness online.* Retrieved from www.advancerlearning.com/home.htm.

Attewell, P., Lavin, D., Domina, T., & Levey, T. (2006). New evidence on college remediation. *Journal of Higher Education,* 77(5), 886-924.

Aud, S., Hussar, W., Johnson, F., Kena, G., Roth, E., Manning, E., Wang, X., & Zhang, J. (2012). *The condition of education 2012* (NCES 2012-045). Washington, DC: US Department of Education, National Center for Education Statistics.

Austin, P. (2008). Goodness-of-fit diagnostics for the propensity score model when estimating treatment effects using covariate adjustment with the propensity score. *Pharmacoepidemiology & Drug Safety, 17,* 1202–1217.

Austin, P. (2011). An introduction to propensity score methods for reducing the effects of confounding in observational studies. *Multivariate Behavioral Research, 46*(3), 399–424.

Bailey, T., Jeong, D. W., & Cho, S.-W. (2010). Referral, enrollment, and completion in developmental education sequences in community colleges. *Economics of Education Review, 29*(2), 255–270.

Bettinger, E. P., & Long, B. T. (2005). *Addressing the needs of under-prepared students in higher education: Does college remediation work?* (NBER Working Paper No. 11325). Retrieved from www.nber.org/papers/w11325 on August 7, 2011.

Bettinger, E., & Long, B. T. (2007). Remedial and developmental courses. In S. Dickert-Conlin & R. Rubenstein (Eds.), *Economic inequality and higher education: Access, persistence, and success* (pp. 69–100). New York, NY: Russell Sage Foundation.

Blackboard, Inc. (2012). *Blackboard for higher education.* Retrieved from www.blackboard.com/higher-education/index.aspx.

Boatman, A., & Long, B. T. (2010). *Does remediation work for all students? How the effects of postsecondary remedial and developmental courses vary by level of academic preparation* (NCPR Working Paper). New York, NY: National Center for Postsecondary Research.

Boylan, H. (1995). Making the case for developmental education. *Research in Developmental Education, 12(2), 1–4.*

Burdman, P. (2012). *Where to begin? The evolving role of placement exams for students starting college.* Boston, MA: Jobs for the Future. Retrieved from www.jff.org/sites/default/files/publications/ATD_WhereToBegin_050213.pdf.

Calcagno, J. C., & Long, B. T. (2008). *The impact of postsecondary remediation using a regression discontinuity approach: Addressing endogenous sorting and noncompliance.* (NBER Working Paper 14194). Cambridge, MA: National Bureau of Economic Research.

Choy, S. (2002). *Nontraditional undergraduates* (NCES 2002–012). Washington, DC: U.S. Department of Education, National Center for Education Statistics. Retrieved from nces.ed.gov/pubs2002/2002012.pdf.

Experts: Remedial college classes need fixing. (2012, May 30). *Education Week.* Retrieved from news.yahoo.com/experts-remedial-college-classes-fixing-184407870.html.

Fong, J. (2012). *Measuring nontraditional student success: An imperative for colleges and universities.* Washington, DC: University Professional and Continuing Education Association.

Fulton, M., Gianneschi, M., Blanco, C., & DeMaria, P. (2014). *Developmental strategies for college readiness and success.* Denver, CO: Education Commission of the States. www.ecs.org/docs/DevEdStrategies.pdf.

Goldman, R. D., & Hewitt, B. N. (1975). Adaptation-level as an explanation for differential standards in college grading. Journal of Educational Measurement, 12(3), 149–161.

Goldman, R. D., Schmidt, D. E., Hewitt, B. N., & Fisher, R. (1974). Grading practices in different major fields. *American Education Research Journal, 11*(4), 343–357.

Goldman, R. D., & Widawski, M. H. (1976). A within-subjects technique for comparing college grading standards: Implications in the validity of the evaluation of college achievement. *Educational and Psychological Measurement, 36*(2), 381–390.

Ignash, J. M. (1997). Who should provide postsecondary remedial/developmental education? *New Directions for Community Colleges, 100*, 5–20.

Jaggars, S., & Stacey. G. (2014). *What we know about developmental education outcomes.* New York, NY: Columbia University, Teachers College, Community College Research Center.

Jenkins, D., Jaggars, S. S., Roksa, J., Zeidenberg, M., & Cho, S.-W. (2009). *Strategies for promoting gatekeeper course success among students needing remediation: Research report for the Virginia Community College System.* New York, NY: Columbia University, Teachers College, Community College Research Center.

Karp, M., & Bork, R. (2012). *"They Never Told Me What to Expect, so I Didn't Know What to Do": Defining and Clarifying the Role of a Community College Student.* (CCRC Working Paper No. 47). New York, NY: Columbia University, Teachers College, Community College Research Center.

Keup, J. R., Gahagan, J., & Goodwin, R. N. (2010). *2008 National survey of sophomore-year initiatives: Curricular and cocurricular structures supporting the success of second-year college students* (Research Reports on College Transitions No. 1). Columbia, SC: University of South Carolina, National Resource Center for the First-Year Experience and Students in Transition.

Marcus, S. (1997). Using omitted variable bias to assess uncertainty in the estimation of an AIDS education treatment effect. *Journal of Educational and Behavioral Statistics, 22*(2), 193-201.

McTiernan, L., Palmer, I., & Fulton, M. (2013). *NextDev Challenge: Instructional delivery.* Denver, CO: Education Commission of the States.

Merisotis, J., & Phipps, R. (2000). Remedial education in colleges and universities: What's really going on? *Review of Higher Education, 24*(1), 67–85.

Muraskin, L. (1997). *A structured freshman year for at-risk students.* Washington, DC: National TRIO Clearinghouse.

National Center for Education Statistics. (2004). *The condition of education 2004* (NCES 2004-077). Washington, DC: US Department of Education, Office of Educational Research and Improvement.

National Center for Education Statistics. (2010). *Integrated Postsecondary Education Data System* (IPEDS). Retrieved March 16, 2015 from nces.ed.gov/ipeds/.

Noble, J., & Sawyer, R. (2013). *Does taking developmental courses improve student success in college?* A paper presented at the Annual Forum of the Association for Institutional Research in Long Beach, CA.

Padgett, R. D., & Keup, J. R. (2011). *2009 National survey of first-year seminars: Ongoing efforts to support students in transition.* (Research Reports on College Transitions No. 2). Columbia, SC: University of South Carolina, National Resource Center for the First-Year Experience and Students in Transition.

Parsad, B., & Lewis, L. (2003). *Remedial education at degree-granting postsecondary institutions in fall 2000.* Washington, DC: US Department of Education, Office of Educational Research and Improvement.

Pearson Education Inc. (2012). *MyFoundationsLab*™. Retrieved from foundations.mathxl.com/home_foundations.htm.

Perkhounkova, Y., Noble, J., & Sawyer, R. (2006). A method of modeling the effectiveness of developmental instruction. *Research in Developmental Education, 20(*2), 1–5.

Rosenbaum, P. R., & Rubin, D. (1983). The central role of the propensity score in observational studies for causal effects. *Biometrika, 70* (1), 41–55.

Rutschow, E. Z., & Schneider, E. (2011). *Unlocking the gate: What we know about improving developmental education.* Retrieved from www.mdrc.org/sites/default/files/full_595.pdf.

Scott-Clayton, J.E. (2012). *Do high-stakes placement exams predict college success?* Retrieved from academiccommons.columbia.edu/catalog/ac:146482.

Shults, C. (2000). I*nstitutional policies and practices in remedial education: A national study of community colleges.* Washington DC: American Association of Community and Junior Colleges.

Stiggins, R. J., Frisbie, D. A., & Griswold, P. A. (1989). Inside high school grading practices: Building a research agenda. *Educational Measurement: Issues and Practice, 8*(2), 5–14.

Strong American Schools. (2008). *Diploma to nowhere.* Retrieved May 29, 2012 from www.broadeducation.org/asset/1128-diploma%20to%20nowhere.pdf.

Tong, J. A., Saxon, D. P., Boylan, H. R., Bonham, B. S., & Smith, M. C. (2012). A research overview and product list of mathematical software for developmental education. *Research in Developmental Education, 24*(2).

Vandal, B. (2010). *Getting past go: Rebuilding the remedial education bridge to college success.* Denver, CO: Education Commission of the States.

Venezia, A., Bracco, K. R., & Nodine, T. (2010). *One shot deal? Students' perceptions of assessment and course placement in California's community colleges.* San Francisco, CA: WestEd.

Venezia, A., Kirst, M. W., & Antonio, A. L. (2003). *Betraying the college dream: How disconnected K-12 and postsecondary education systems undermine student aspirations* (Final Report of the Bridge Project). Stanford, CA: Stanford Institute for Higher Education Research.

Westrick, P. A., & Allen, J. (2014). *Validity evidence for ACT Compass® Placement Tests.* (ACT Research Report No. 2014-2). Iowa City, IA: ACT, Inc.

Appendix A

Pooled Descriptive Results

Tables A-1 through A-5

Table A-1. Summary of Student Groups for Developmental English Composition and Standard English Composition

		Student Group											
		Took Developmental English Composition before Standard English Composition											
		All Developmental English Composition Students			Developmental English Composition Grade Scale						Took Standard English Composition Only		
					A–F			P/F					
		Mean/ Prop.	No. of Students	No. of Inst.	Mean/ Prop.	No. of Students	No. of Inst.	Mean/ Prop.	No. of Students	No. of Inst.	Mean/ Prop.	No. of Students	No. of Inst.
ACT Compass Writing Score		46.65	6,029	27	47.44	5,093	24	41.28	690	8	81.39	26,990	27
Developmental English Composition Grade (Last Time Taken)					2.92	5,093	24	1.00	690	8			
Full-Time Enrollment Status		0.16	6,029	27	0.13	5,093	24	0.42	690	8	0.38	26,990	27
Age at Entry		20.41	6,029	27	20.52	5,093	24	20.03	690	8	19.45	26,990	27
Outcome													
Type	Level												
Success in Developmental English Composition (First Time Taken)	C or Higher				0.90	5,048	24						
	B or Higher				0.66	5,048	24						
	Pass							0.99	670	8			
Success in Standard English Composition (First Time Taken)	C or Higher	0.62	6,029	27	0.60	5,093	24	0.72	690	8	0.72	26,990	27
	B or Higher	0.40	6,029	27	0.40	5,093	24	0.50	690	8	0.56	26,990	27
GPA Year 1 (or Last GPA)	2.0 or Higher	0.69	5,755	27	0.70	4,891	24	0.72	650	8	0.72	25,564	27
	3.0 or Higher	0.34	5,755	27	0.34	4,891	24	0.35	650	8	0.39	25,564	27
GPA Year 2	2.0 or Higher	0.75	3,647	27	0.75	3,173	24	0.78	361	7	0.86	15,377	27
	3.0 or Higher	0.29	3,647	27	0.29	3,173	24	0.30	361	7	0.46	15,377	27
GPA Year 3	2.0 or Higher	0.79	2,669	26	0.80	2,333	23	0.81	258	7	0.89	11,476	26
	3.0 or Higher	0.29	2,669	26	0.29	2,333	23	0.29	258	7	0.46	11,476	26
Return Fall, Any Inst.	Year 2	0.70	6,029	27	0.71	5,093	24	0.64	691	8	0.64	26,990	27
	Year 3	0.45	6,029	27	0.47	5,093	24	0.40	691	8	0.47	26,990	27
Progress to Degree	Year 2	0.25	5,934	27	0.24	5,011	24	0.39	679	8	0.42	26,462	27
Certificate within . . .	4 Years	0.13	3,611	17	0.13	3,396	16			3	0.12	9,582	17
	5 Years	0.14	2,409	17	0.14	2,276	16			2	0.13	6,686	17
	6 Years	0.16	1,740	17	0.16	1,637	16			2	0.14	4,541	17
Associate's Degree within . . .	4 Years	0.12	6,029	27	0.13	5,093	24	0.14	691	8	0.23	26,990	27
	5 Years	0.15	4,144	27	0.16	3,503	24	0.15	449	7	0.26	20,240	27
	6 Years	0.18	3,026	27	0.18	2,552	24	0.16	334	7	0.28	14,488	27
Associate's/Bachelor's Degree within . . .	4 Years	0.13	6,029	27	0.13	5,093	24	0.14	691	8	0.24	26,990	27
	5 Years	0.16	4,144	27	0.16	3,503	24	0.15	449	7	0.29	20,240	27
	6 Years	0.19	3,026	27	0.19	2,552	24	0.18	334	7	0.33	14,488	27

Table A-2. Summary of Student Groups for Arithmetic and Elementary Algebra

		Student Group											
		Took Arithmetic before Elementary Algebra									Took Elementary Algebra Only		
		All Arithmetic Students			Arithmetic Grade Scale								
					A–F			P/F					
		Mean/ Prop.	No. of Students	No. of Inst.	Mean/ Prop.	No. of Students	No. of Inst.	Mean/ Prop.	No. of Students	No. of Inst.	Mean/ Prop.	No. of Students	No. of Inst.
ACT Compass Pre-Algebra Score		32.19	4,665	29	32.59	4,088	21	29.53	387	7	41.76	9,233	29
Arithmetic Grade (Last Time Taken)					2.92	4,088	21	1.00	387	7			
Full-Time Enrollment Status		0.21	4,665	29	0.21	4,088	21	0.25	387	7	0.13	9,233	29
Age at Entry		20.89	4,665	29	20.90	4,088	21	21.03	387	7	20.69	9,233	29
Outcome													
Type	Level												
Success in Arithmetic (First Time Taken)	C or Higher				0.86	4,082	21						
	B or Higher				0.64	4,082	21						
	Pass							0.99	375	7			
Success in Elementary Algebra (First Time Taken)	C or Higher	0.54	4,665	29	0.57	4,088	21	0.39	387	7	0.56	9,233	29
	B or Higher	0.36	4,665	29	0.37	4,088	21	0.26	387	7	0.42	9,233	29
GPA Year 1 (or Last GPA)	2.0 or Higher	0.73	4,449	28	0.73	3,933	21	0.72	354	7	0.62	8,533	28
	3.0 or Higher	0.37	4,449	28	0.37	3,933	21	0.36	354	7	0.32	8,533	28
GPA Year 2	2.0 or Higher	0.78	2,860	26	0.79	2,561	20			4	0.78	4,299	26
	3.0 or Higher	0.32	2,860	26	0.33	2,561	20			4	0.36	4,299	26
GPA Year 3	2.0 or Higher	0.83	2,080	25	0.84	1,874	20			3	0.83	3,158	25
	3.0 or Higher	0.32	2,080	25	0.32	1,874	20			3	0.35	3,158	25
Return Fall, Any Inst.	Year 2	0.72	4,665	29	0.73	4,088	21	0.65	387	7	0.55	9,233	29
	Year 3	0.46	4,665	29	0.48	4,088	21	0.38	387	7	0.36	9,233	29
Progress to Degree	Year 2	0.28	4,577	29	0.29	4,010	21	0.31	382	7	0.22	9,011	29
Certificate within . . .	4 Years	0.12	2,171	17	0.13	2,055	16			1	0.09	5,207	17
	5 Years	0.13	1,348	17	0.13	1,286	16			1	0.11	3,795	17
	6 Years	0.15	860	17	0.15	816	16			1	0.12	2,753	17
Associate's Degree within . . .	4 Years	0.11	4,665	29	0.12	4,088	21	0.08	387	7	0.11	9,233	29
	5 Years	0.15	3,295	28	0.16	2,884	21	0.12	274	7	0.14	6,818	28
	6 Years	0.17	2,282	28	0.19	1,971	21	0.12	200	7	0.16	5,089	28
Associate's/Bachelor's Degree within . . .	4 Years	0.11	4,665	29	0.12	4,088	21	0.09	387	7	0.11	9,233	29
	5 Years	0.16	3,295	28	0.17	2,884	21	0.15	274	7	0.15	6,818	28
	6 Years	0.19	2,282	28	0.20	1,971	21	0.15	200	7	0.17	5,089	28

Table A-3. Summary of Student Groups for Elementary and Intermediate Algebra

		Student Group											
		Took Elementary Algebra before Intermediate Algebra											
		All Elementary Algebra Students			Elementary Algebra Grade Scale						Took Intermediate Algebra Only		
					A–F			P/F					
		Mean/ Prop.	No. of Students	No. of Inst.	Mean/ Prop.	No. of Students	No. of Inst.	Mean/ Prop.	No. of Students	No. of Inst.	Mean/ Prop.	No. of Students	No. of Inst.
ACT Compass Pre-Algebra Score		41.82	5,190	35	42.03	4,747	31	39.59	287	7	47.01	6,664	33
Elementary Algebra Grade (Last Time Taken)					2.80	4,747	31	1.00	287	7			
Full-Time Enrollment Status		0.16	5,190	35	0.15	4,747	31	0.32	287	7	0.30	6,664	33
Age at Entry		20.51	5,190	35	20.61	4,747	31	19.62	287	7	18.75	6,664	33
Outcome													
Type	Level												
Success in Elementary Algebra (First Time Taken)	C or Higher				0.79	4,717	31						
	B or Higher				0.56	4,717	31						
	Pass							0.99	277	7			
Success in Intermediate Algebra (First Time Taken)	C or Higher	0.51	5,190	35	0.52	4,747	31	0.41	287	7	0.59	6,664	33
	B or Higher	0.34	5,190	35	0.34	4,747	31	0.36	287	7	0.44	6,664	33
GPA Year 1 (or Last GPA)	2.0 or Higher	0.75	4,966	34	0.75	4,539	29	0.72	275	7	0.68	5,801	32
	3.0 or Higher	0.37	4,966	34	0.39	4,539	29	0.23	275	7	0.33	5,801	32
GPA Year 2	2.0 or Higher	0.81	3,371	31	0.82	3,136	24			4	0.82	3,346	29
	3.0 or Higher	0.35	3,371	31	0.37	3,136	24			4	0.37	3,346	29
GPA Year 3	2.0 or Higher	0.84	2,535	30	0.85	2,368	24			3	0.85	2,482	30
	3.0 or Higher	0.34	2,535	30	0.35	2,368	24			3	0.35	2,482	30
Return Fall, Any Inst.	Year 2	0.76	5,190	35	0.77	4,747	31	0.62	287	7	0.64	6,664	33
	Year 3	0.53	5,190	35	0.54	4,747	31	0.34	287	7	0.45	6,664	33
Progress to Degree	Year 2	0.32	5,118	35	0.32	4,679	31	0.31	284	7	0.39	6,562	33
Certificate within . . .	4 Years	0.12	3,466	21	0.12	3,367	21			1	0.11	3,393	19
	5 Years	0.14	2,511	20	0.14	2,435	18			1	0.12	2,496	19
	6 Years	0.15	1,848	20	0.15	1,801	18			1	0.13	1,708	19
Associate's Degree within . . .	4 Years	0.18	5,190	35	0.19	4,747	31	0.10	287	7	0.21	6,664	33
	5 Years	0.22	3,854	34	0.23	3,497	28	0.10	220	7	0.24	4,813	33
	6 Years	0.24	2,889	34	0.25	2,628	28	0.09	148	7	0.26	3,310	33
Associate's/Bachelor's Degree within . . .	4 Years	0.18	5,190	35	0.19	4,747	31	0.10	287	7	0.21	6,664	33
	5 Years	0.23	3,854	34	0.24	3,497	28	0.13	220	7	0.26	4,813	33
	6 Years	0.26	2,889	34	0.27	2,628	28	0.14	148	7	0.30	3,310	33

Table A-4. Summary of Student Groups for Intermediate and College Algebra

		Student Group											
		Took Intermediate Algebra before College Algebra											
		All Intermediate Algebra Students			Intermediate Algebra Grade Scale						Took College Algebra Only		
					A–F			P/F					
		Mean/ Prop.	No. of Students	No. of Inst.	Mean/ Prop.	No. of Students	No. of Inst.	Mean/ Prop.	No. of Students	No. of Inst.	Mean/ Prop.	No. of Students	No. of Inst.
ACT Compass Intermediate Algebra Score		29.97	4,689	33	30.82	3,428	29	27.52	1,021	9	47.48	13,195	33
Intermediate Algebra Grade (Last Time Taken)					2.88	3,428	29	1.00	1,021	9			
Full-Time Enrollment Status		0.47	4,689	33	0.40	3,428	29	0.73	1,021	9	0.54	13,195	33
Age at Entry		18.83	4,689	33	18.80	3,428	29	18.96	1,021	9	18.31	13,195	33
Outcome													
Type	Level												
Success in Intermediate Algebra (First Time Taken)	C or Higher				0.83	3,382	29						
	B or Higher				0.60	3,382	29						
	Pass							0.99	971	9			
Success in College Algebra (First Time Taken)	C or Higher	0.60	4,689	33	0.59	3,428	29	0.69	1,021	9	0.65	13,195	33
	B or Higher	0.36	4,689	33	0.34	3,428	29	0.44	1,021	9	0.46	13,195	33
GPA Year 1 (or Last GPA)	2.0 or Higher	0.82	4,257	32	0.81	3,030	28	0.86	1,001	9	0.76	12,305	32
	3.0 or Higher	0.42	4,257	32	0.42	3,030	28	0.45	1,001	9	0.44	12,305	32
GPA Year 2	2.0 or Higher	0.85	3,180	32	0.86	2,270	27	0.84	728	8	0.88	8,300	32
	3.0 or Higher	0.39	3,180	32	0.40	2,270	27	0.41	728	8	0.52	8,300	32
GPA Year 3	2.0 or Higher	0.89	2,411	32	0.89	1,753	27	0.90	521	8	0.90	6,079	32
	3.0 or Higher	0.38	2,411	32	0.38	1,753	27	0.39	521	8	0.51	6,079	32
Return Fall, Any Inst.	Year 2	0.82	4,689	33	0.82	3,428	29	0.82	1,021	9	0.72	13,195	33
	Year 3	0.62	4,689	33	0.62	3,428	29	0.61	1,021	9	0.56	13,195	33
Progress to Degree	Year 2	0.59	4,635	33	0.57	3,382	28	0.69	1,011	9	0.55	12,979	33
Certificate within . . .	4 Years	0.12	2,187	19	0.12	2,071	19			2	0.10	4,896	19
	5 Years	0.14	1,654	19	0.14	1,557	19			1	0.11	3,647	19
	6 Years	0.13	1,194	19	0.14	1,103	18			1	0.12	2,610	19
Associate's Degree within . . .	4 Years	0.33	4,689	33	0.32	3,428	29	0.40	1,021	9	0.33	13,195	33
	5 Years	0.37	3,506	33	0.36	2,528	29	0.44	783	8	0.37	9,960	33
	6 Years	0.40	2,538	33	0.39	1,779	27	0.45	611	8	0.39	7,072	33
Associate's/Bachelor's Degree within . . .	4 Years	0.34	4,689	33	0.32	3,428	29	0.40	1,021	9	0.35	13,195	33
	5 Years	0.40	3,506	33	0.39	2,528	29	0.48	783	8	0.41	9,960	33
	6 Years	0.45	2,538	33	0.43	1,779	27	0.51	611	8	0.45	7,072	33

Table A-5. Summary of Student Groups for Developmental Reading and First Social Science Course

		Student Group											
		Took Developmental Reading before First Social Science Course											
		All Developmental Reading Students			Developmental Reading Grade Scale						Took First Social Science Course Only		
					A–F			P/F					
		Mean/ Prop.	No. of Students	No. of Inst.	Mean/ Prop.	No. of Students	No. of Inst.	Mean/ Prop.	No. of Students	No. of Inst.	Mean/ Prop.	No. of Students	No. of Inst.
ACT Compass Reading Score		65.75	8,429	34	66.47	5,794	31	64.41	1,902	14	84.61	40,480	34
Developmental Reading Grade (Last Time Taken)					2.82	5,794	31	1.00	1,902	14			
Full-Time Enrollment Status		0.22	8,429	34	0.14	5,794	31	0.49	1,902	14	0.40	40,480	34
Age at Entry		19.69	8,429	34	19.77	5,794	31	19.41	1,902	14	19.78	40,480	34
Outcome													
Type	Level												
Success in Developmental Reading (First Time Taken)	C or Higher				0.87	5,730	31						
	B or Higher				0.65	5,730	31						
	Pass							1.00	1,827	14			
Success in Social Science Course (First Time Taken)	C or Higher	0.53	8,429	34	0.54	5,794	31	0.59	1,902	14	0.69	40,480	34
	B or Higher	0.32	8,429	34	0.32	5,794	31	0.37	1,902	14	0.51	40,480	34
GPA Year 1 (or Last GPA)	2.0 or Higher	0.66	7,713	33	0.66	5,296	29	0.74	1,786	14	0.73	37,013	33
	3.0 or Higher	0.30	7,713	33	0.30	5,296	29	0.34	1,786	14	0.41	37,013	33
GPA Year 2	2.0 or Higher	0.74	4,641	32	0.73	3,313	26	0.77	1,100	13	0.86	20,847	32
	3.0 or Higher	0.24	4,641	32	0.25	3,313	26	0.24	1,100	13	0.46	20,847	32
GPA Year 3	2.0 or Higher	0.77	3,333	33	0.78	2,431	25	0.80	727	13	0.88	16,381	33
	3.0 or Higher	0.23	3,333	33	0.24	2,431	25	0.24	727	13	0.45	16,381	33
Return Fall, Any Inst.	Year 2	0.66	8,429	34	0.68	5,794	31	0.71	1,902	14	0.66	40,480	34
	Year 3	0.42	8,429	34	0.44	5,794	31	0.45	1,902	14	0.48	40,480	34
Progress to Degree	Year 2	0.29	8,339	34	0.25	5,731	31	0.50	1,878	14	0.44	39,675	34
Certificate within . . .	4 Years	0.11	4,697	21	0.11	3,958	21			6	0.12	13,848	21
	5 Years	0.12	3,307	21	0.13	2,783	21			4	0.13	9,834	21
	6 Years	0.13	2,367	21	0.14	1,976	21			4	0.14	6,696	21
Associate's Degree within . . .	4 Years	0.14	8,429	34	0.14	5,794	31	0.19	1,902	14	0.24	40,480	34
	5 Years	0.18	6,071	34	0.18	4,102	31	0.22	1,432	12	0.28	30,310	34
	6 Years	0.20	4,390	34	0.21	2,938	30	0.23	1,044	12	0.30	21,514	34
Associate's/Bachelor's Degree within . . .	4 Years	0.14	8,429	34	0.14	5,794	31	0.19	1,902	14	0.25	40,480	34
	5 Years	0.19	6,071	34	0.19	4,102	31	0.24	1,432	12	0.31	30,310	34
	6 Years	0.22	4,390	34	0.22	2,938	30	0.26	1,044	12	0.34	21,514	34

Appendix B

Pooled Descriptive Results for Students Who Took No Additional Coursework in Subject Area

Tables B-1 through B-5

Table B-1. Summary of Students Who Took Developmental English Composition and No Subsequent English Courses (Number of Institutions = 33)

		Mean/ Prop.	No. of Students
Minority		0.19	5,906
In-State Student		0.45	5,906
High School GPA		2.50	5,906
ACT Compass Writing Score		38.37	5,906
Outcome			
Type	Level		
Developmental English Composition Grade (Last Time Taken)	A–F	1.79	3,870
	P/F	0.99	283
Full-Time Enrollment Status		0.04	5,906
Age at Entry		20.86	5,906
Success in Developmental English Composition (First Time Taken)	C or Higher	0.39	5,281
	B or Higher	0.29	5,281
	Pass	0.73	384
GPA Year 1 (or Last GPA)	2.0 or Higher	0.36	4,616
	3.0 or Higher	0.17	4,616
GPA Year 2	2.0 or Higher	0.54	653
	3.0 or Higher	0.24	653
GPA Year 3	2.0 or Higher	0.60	356
	3.0 or Higher	0.21	356
Return Fall, Any Inst.	Year 2	0.18	5,906
	Year 3	0.05	5,906
Progress to Degree	Year 2	0.02	5,766
Certificate within . . .	4 Years	0.06	2,912
	5 Years	0.07	1,866
	6 Years	0.06	1,309
Associate's Degree within . . .	4 Years		5,906
	5 Years		3,962
	6 Years		2,883
Associate's/Bachelor's Degree within . . .	4 Years		5,906
	5 Years		3,962
	6 Years		2,883

Table B-2. Summary of Students Who Took Arithmetic and No Subsequent Math Courses (Number of Institutions = 34)

		Mean/ Prop.	No. of Students
Minority		0.18	5,705
Female		0.60	5,705
In-State Student		0.41	5,705
High School GPA		2.48	5,705
ACT Compass Pre-Algebra Score		29.51	5,705
Outcome			
Type	Level		
Arithmetic Grade (Last Time Taken)	A–F	1.57	3,099
	P/F	1.00	283
Full-Time Enrollment Status		0.08	5,705
Age at Entry		21.44	5,705
Success in Arithmetic (First Time Taken)	C or Higher	0.30	4,624
	B or Higher	0.23	4,624
	Pass	0.49	577
GPA Year 1 (or Last GPA)	2.0 or Higher	0.40	4,329
	3.0 or Higher	0.20	4,329
GPA Year 2	2.0 or Higher	0.64	847
	3.0 or Higher	0.24	847
GPA Year 3	2.0 or Higher	0.68	488
	3.0 or Higher	0.24	488
Return Fall, Any Inst.	Year 2	0.22	5,705
	Year 3	0.08	5,705
Progress to Degree	Year 2	0.05	5,613
Certificate within . . .	4 Years	0.06	1,901
	5 Years	0.07	1,092
	6 Years	0.06	715
Associate's Degree within . . .	4 Years	0.01	5,705
	5 Years	0.01	3,752
	6 Years	0.01	2,637
Associate's/Bachelor's Degree within . . .	4 Years	0.01	5,705
	5 Years	0.01	3,752
	6 Years	0.01	2,637

Table B-3. Summary of Students Who Took Elementary Algebra and No Subsequent Math Courses (Number of Institutions = 37)

		Mean/ Prop.	No. of Students
Minority		0.15	6,445
In-State Student		0.48	6,445
High School GPA		2.59	6,445
ACT Compass Pre-Algebra Score		39.04	6,445
Outcome			
Type	Level		
Elementary Algebra Grade (Last Time Taken)	A–F	1.50	3,806
	P/F	0.95	412
Full-Time Enrollment Status		0.08	6,445
Age at Entry		20.79	6,445
Success in Elementary Algebra (First Time Taken)	C or Higher	0.30	5,366
	B or Higher	0.23	5,366
	Pass	0.55	711
GPA Year 1 (or Last GPA)	2.0 or Higher	0.41	5,583
	3.0 or Higher	0.18	5,583
GPA Year 2	2.0 or Higher	0.59	1,207
	3.0 or Higher	0.24	1,207
GPA Year 3	2.0 or Higher	0.63	700
	3.0 or Higher	0.25	700
Return Fall, Any Inst.	Year 2	0.27	6,445
	Year 3	0.10	6,445
Progress to Degree	Year 2	0.07	6,309
Certificate within . . .	4 Years	0.06	3,602
	5 Years	0.06	2,513
	6 Years	0.06	1,750
Associate's Degree within . . .	4 Years	0.02	6,445
	5 Years	0.02	4,523
	6 Years	0.02	3,248
Associate's/Bachelor's Degree within . . .	4 Years	0.02	6,445
	5 Years	0.02	4,523
	6 Years	0.02	3,248

Table B-4. Summary of Students Who Took Intermediate Algebra and No Subsequent Math Courses (Number of Institutions = 33)

		Mean/ Prop.	No. of Students
Minority		0.22	3,186
In-State Student		0.66	3,186
High School GPA		2.80	3,186
ACT Compass Algebra Score		28.82	3,186
Outcome			
Type	Level		
Intermediate Algebra Grade (Last Time Taken)	A–F	1.78	1,751
	P/F	0.89	211
Full-Time Enrollment Status		0.16	3,186
Age at Entry		18.93	3,186
Success in Intermediate Algebra (First Time Taken)	C or Higher	0.33	2,580
	B or Higher	0.27	2,580
	Pass	0.57	329
GPA Year 1 (or Last GPA)	2.0 or Higher	0.49	2,669
	3.0 or Higher	0.22	2,669
GPA Year 2	2.0 or Higher	0.67	741
	3.0 or Higher	0.31	741
GPA Year 3	2.0 or Higher	0.73	420
	3.0 or Higher	0.30	420
Return Fall, Any Inst.	Year 2	0.34	3,186
	Year 3	0.15	3,186
Progress to Degree	Year 2	0.13	3,130
Certificate within . . .	4 Years	0.08	1,329
	5 Years	0.08	948
	6 Years	0.09	657
Associate's Degree within . . .	4 Years	0.05	3,186
	5 Years	0.05	2,201
	6 Years	0.05	1,510
Associate's/Bachelor's Degree within . . .	4 Years	0.05	3,186
	5 Years	0.05	2,201
	6 Years	0.06	1,510

Table B-5. Summary of Students Who Took Developmental Reading and No Subsequent Social Science Courses (Number of Institutions = 35)

		Mean/ Prop.	No. of Students
Minority		0.20	4,638
In-State Student		0.41	4,638
High School GPA		2.45	4,638
ACT Compass Reading Score		61.95	4,638
Outcome			
Type	Level		
Developmental Reading Grade (Last Time Taken)	A–F	2.01	2,872
	P/F	1.00	416
Full-Time Enrollment Status		0.05	4,638
Age at Entry		20.71	4,638
Success in Developmental Reading (First Time Taken)	C or Higher	0.47	3,839
	B or Higher	0.33	3,839
	Pass	0.73	570
GPA Year 1 (or Last GPA)	2.0 or Higher	0.38	3,811
	3.0 or Higher	0.19	3,811
GPA Year 2	2.0 or Higher	0.63	534
	3.0 or Higher	0.28	534
GPA Year 3	2.0 or Higher	0.66	265
	3.0 or Higher	0.22	265
Return Fall, Any Inst.	Year 2	0.19	4,638
	Year 3	0.05	4,638
Progress to Degree	Year 2	0.03	4,576
Certificate within . . .	4 Years	0.07	2,826
	5 Years	0.07	1,818
	6 Years	0.07	1,275
Associate's Degree within . . .	4 Years	0.01	4,638
	5 Years		3,017
	6 Years		2,185
Associate's/Bachelor's Degree within . . .	4 Years	0.01	4,638
	5 Years		3,017
	6 Years		2,185

Appendix C

Hierarchical Logistic Regression Models for Predicting Success in College

Tables C-1 through C-21

Notes: Certificate completion rates were based on data from only one of the two states that provided data for this study. ACT Compass Test scores are: Writing Skills (for Developmental English Composition), Pre-Algebra (for Arithmetic and Elementary Algebra), Algebra for Intermediate Algebra, and Reading (for Developmental Reading). The shaded coefficients are not statistically significantly different from zero ($p > .05$ for institution-level coefficients; $p > .01$ for all student-level coefficients). Non-statistically significant ($p > .05$) variance components are shaded.

Table C-1. Hierarchical Logistic Regression Models for Predicting Success in Developmental Courses[1]

		Fixed Effects								
		Institution-Level Effects		Student-Level Effects					Variance Components	
						FT and Age ≤ 21 Vs.				
Developmental Course	Outcome Level	Intercept	Mean ACT Compass Test Score	ACT Compass Test Score	Prop. Score	PT and Age ≤ 21	Age 22–25	Age > 25	Intercept	Standard Error
Developmental English Composition	C or Higher	0.64	-0.03	0.01	-1.47	-1.26	-1.14	-0.91	1.7814	0.5853
	B or Higher	-0.03	-0.05	0.01	-1.50	-0.83	-0.55	-0.26	1.8436	0.5759
	Pass									
Arithmetic	C or Higher	-0.07	0.12	0.03	-1.70	-1.35	-0.96	-0.76	1.8461	0.5891
	B or Higher	-0.61	0.08	0.04	-1.51	-0.88	-0.43	-0.18	1.7763	0.5600
	Pass									
Elementary Algebra	C or Higher	-0.07	-0.06	0.02	-1.15	-1.01	-0.80	-0.52	2.2461	0.6348
	B or Higher	-0.63	-0.08	0.02	-0.92	-0.70	-0.44	-0.17	2.2664	0.6720
	Pass	0.81	-0.14	0.02	-1.42	-1.85	-1.76	-1.14	3.0444	1.9466
Intermediate Algebra	C or Higher	0.38	-0.07	0.03	-1.40	-1.34	-0.78	-0.48	1.3299	0.3881
	B or Higher	-0.27	-0.09	0.04	-1.26	-1.03	-0.34	-0.08	1.4077	0.3972
	Pass	2.52	-0.28	0.03	-1.38	-2.25	-1.00	-0.87	4.5914	2.5953
Developmental Reading	C or Higher	0.54	0.03	0.02	-0.87	-1.62	-1.84	-1.60	3.1962	0.9635
	B or Higher	-0.17	<0.01	0.02	-1.37	-1.11	-1.16	-0.89	2.8863	0.8733
	Pass									

[1] The first time the course was taken.

Table C-2. Fixed Effects of Hierarchical Logistic Regression Models for Predicting Subsequent College Success for Students Who Did/Did Not Take Developmental English Composition before First Standard English Composition

Outcome			Institution-Level Effects		
			Prop. FT and Age ≤ 21 Vs.		
Type	Level	Intercept	Prop. PT and Age ≤ 21	Prop. Age 22–25	Prop. Age > 25
Success in Standard English Composition	C or Higher	0.72	<0.01	3.00	-0.63
	B or Higher	-0.10	0.08	1.83	0.70
GPA Year 1 (or Last GPA)	2.0 or Higher	0.91	-0.58	3.98	-1.49
	3.0 or Higher	-0.55	-0.47	3.43	-0.05
GPA Year 2	2.0 or Higher	1.47	0.33	4.93	-2.39
	3.0 or Higher	-0.53	-0.33	4.96	-0.73
GPA Year 3	2.0 or Higher	1.82	0.22	5.84	-1.42
	3.0 or Higher	-0.55	-0.27	5.12	-0.77
Return Fall, Any Inst.	Year 2	0.72	1.09	3.66	-1.53
	Year 3	-0.26	1.20	2.99	-1.43
Progress to Degree	Year 2	-0.72	-0.90	7.18	-5.20
Certificate within . . .	4 Years	-2.02	-6.11	-7.86	4.71
	5 Years	-1.84	-5.09	-5.71	3.40
	6 Years	-1.71	-4.60	-3.46	1.87
Associate's Degree within . . .	4 Years	-1.72	-1.75	8.45	-5.39
	5 Years	-1.48	-1.17	7.50	-4.63
	6 Years	-1.29	-0.41	6.01	-4.01
Associate's/Bachelor's Degree within . . .	4 Years	-1.70	-1.70	8.55	-5.41
	5 Years	-1.39	-0.82	6.85	-4.85
	6 Years	-1.17	-0.32	5.79	-4.13

Table C-2. (continued)

Outcome		Student-Level Effects										
								Developmental Course Taken Interaction with				
					FT and Age ≤ 21 Vs.					FT and Age ≤ 21 Vs.		
Type	Level	Developmental Course Taken	ACT Compass Writing Score	Prop. Score	PT and Age ≤ 21	Age 22–25	Age > 25	Test Score	Prop. Score	PT and Age ≤ 21	Age 22–25	Age > 25
Success in Standard English Composition	C or Higher	0.41	<0.01	-2.70	-1.87	-1.36	-0.96	<0.01	1.25	1.21	1.03	0.67
	B or Higher	0.33	0.01	-2.91	-1.37	-0.70	-0.23	<0.01	1.55	0.87	0.61	0.37
GPA Year 1 (or Last GPA)	2.0 or Higher	0.18	0.01	-3.07	-1.87	-1.02	-0.52	-0.01	2.59	1.27	0.93	0.70
	3.0 or Higher	0.01	0.01	-3.06	-1.29	-0.23	0.45	-0.01	2.60	0.78	0.50	-0.05
GPA Year 2	2.0 or Higher	0.48	0.01	-3.64	-1.32	-0.18	0.53	-0.01	2.31	0.33	-0.01	-0.34
	3.0 or Higher	0.23	0.02	-4.05	-1.01	0.15	0.94	-0.01	2.38	0.24	<0.01	-0.47
GPA Year 3	2.0 or Higher	0.38	0.01	-4.16	-1.39	-0.25	0.55	<0.01	1.92	0.42	0.12	-0.60
	3.0 or Higher	0.24	0.02	-4.23	-0.86	0.21	1.03	-0.01	2.06	0.23	0.13	-0.50
Return Fall, Any Inst.	Year 2	0.03	<0.01	-1.76	-2.06	-1.67	-1.40	-0.01	2.42	1.44	1.27	1.15
	Year 3	0.11	<0.01	-2.42	-1.78	-1.38	-0.98	-0.01	2.78	1.16	1.03	0.57
Progress to Degree	Year 2	0.24	<0.01	-2.79	-2.77	-2.09	-1.86	<0.01	0.12	0.60	0.32	0.17
Certificate within . . .	4 Years	-0.11	<0.01	0.33	-0.78	-0.25	-0.20	<0.01	0.17	-0.13	-0.32	-0.35
	5 Years	-0.18	-0.01	-0.09	-0.77	-0.23	-0.09	0.01	0.42	-0.09	-0.26	-0.37
	6 Years	-0.20	-0.01	-0.14	-0.69	-0.24	0.05	0.01	1.06	-0.08	-0.37	-0.57
Associate's Degree within . . .	4 Years	0.19	0.01	-3.60	-1.96	-1.20	-0.87	<0.01	2.12	0.89	0.47	0.15
	5 Years	0.22	<0.01	-3.75	-1.82	-1.15	-0.68	<0.01	2.46	0.85	0.41	-0.08
	6 Years	0.16	<0.01	-3.56	-1.75	-1.20	-0.62	<0.01	2.67	0.82	0.71	-0.11
Associate's/Bachelor's Degree within . . .	4 Years	0.20	0.01	-3.75	-2.03	-1.26	-0.91	<0.01	2.18	0.94	0.52	0.13
	5 Years	0.27	0.01	-4.35	-1.98	-1.28	-0.82	<0.01	3.05	0.93	0.45	-0.03
	6 Years	0.24	0.01	-4.18	-1.96	-1.40	-0.87	<0.01	2.99	0.95	0.76	0.02

Table C-3. Variance Components of Hierarchical Logistic Regression Models for Predicting Subsequent College Success for Students Who Did/Did Not Take Developmental English Composition before First Standard English Composition

Outcome		Variance Component	
Type	Level	Intercept	Standard Error
Success in Standard English Composition	C or Higher	0.1450	0.0477
	B or Higher	0.1434	0.0417
GPA Year 1 (or Last GPA)	2.0 or Higher	0.0475	0.0155
	3.0 or Higher	0.0525	0.0167
GPA Year 2	2.0 or Higher	0.1295	0.0438
	3.0 or Higher	0.0361	0.0132
GPA Year 3	2.0 or Higher	0.0676	0.0298
	3.0 or Higher	0.0175	0.0088
Return Fall, Any Inst.	Year 2	0.0185	0.0063
	Year 3	0.0281	0.0095
Progress to Degree	Year 2	0.0111	0.0053
Certificate within . . .	4 Years	0.2304	0.0879
	5 Years	0.2619	0.1022
	6 Years	0.2527	0.1011
Associate's Degree within . . .	4 Years	0.0515	0.0174
	5 Years	0.0592	0.0214
	6 Years	0.0543	0.0205
Associate's/Bachelor's Degree within . . .	4 Years	0.0492	0.0173
	5 Years	0.0464	0.0174
	6 Years	0.0453	0.0179

Table C-4. Fixed Effects of Hierarchical Logistic Regression Models for Predicting Subsequent College Success for Students Who Took Developmental English Composition (Grade Scale A–F) before Standard English Composition

Outcome			Institution-Level Effects		
			Prop. FT and Age ≤ 21 Vs.		
Type	Level	Intercept	Prop. PT and Age ≤ 21	Prop. Age 22–25	Prop. Age > 25
Success in Standard English Composition	C or Higher	0.48	1.58	2.73	1.12
	B or Higher	-0.45	1.83	0.67	1.87
GPA Year 1 (or Last GPA)	2.0 or Higher	0.90	-0.34	5.90	-2.00
	3.0 or Higher	-0.79	0.07	3.93	-0.20
GPA Year 2	2.0 or Higher	1.15	0.58	2.96	0.22
	3.0 or Higher	-1.14	0.62	3.28	-0.16
GPA Year 3	2.0 or Higher	1.47	-0.51	4.32	-2.25
	3.0 or Higher	-1.09	0.51	4.53	-2.38
Return Fall, Any Inst.	Year 2	0.94	0.75	5.55	-1.70
	Year 3	-0.23	1.86	4.63	1.03
Progress to Degree	Year 2	-1.30	-1.43	6.39	-7.17
Certificate within . . .	4 Years	-2.03	-3.46	-4.14	-0.32
	5 Years	-1.85	-3.41	-1.98	-1.42
	6 Years	-1.81	-4.14	-1.39	-4.30
Associate's Degree within . . .	4 Years	-2.17	-0.99	9.17	-4.51
	5 Years	-1.84	0.30	7.47	-3.20
	6 Years	-1.69	-0.44	9.43	-5.78
Associate's/Bachelor's Degree within . . .	4 Years	-2.16	-0.92	9.18	-4.50
	5 Years	-1.82	0.72	7.18	-3.79
	6 Years	-1.59	0.07	8.07	-4.51

Table C-4. (continued)

Outcome		Student-Level Effects						
					FT and Age ≤ 21 Vs.			
Type	Level	ACT Compass Writing Score	Prop. Score	Developmental Course Grade	PT and Age ≤ 21	Age 22–25	Age > 25	Test Score by Developmental Course Grade Interaction
Success in Standard English Composition	C or Higher	<0.01	-1.45	0.48	-0.66	-0.44	-0.40	<0.01
	B or Higher	<0.01	-1.14	0.55	-0.66	-0.28	-0.13	<0.01
GPA Year 1 (or Last GPA)	2.0 or Higher	<0.01	-1.06	0.51	-0.59	-0.11	0.12	<0.01
	3.0 or Higher	<0.01	-0.51	0.62	-0.55	0.13	0.22	<0.01
GPA Year 2	2.0 or Higher	<0.01	-1.36	0.52	-1.03	-0.35	-0.03	<0.01
	3.0 or Higher	<0.01	-1.55	0.78	-0.98	-0.11	0.10	0.01
GPA Year 3	2.0 or Higher	<0.01	-2.30	0.53	-0.90	-0.09	-0.12	<0.01
	3.0 or Higher	<0.01	-1.95	0.64	-0.79	0.08	0.18	0.01
Return Fall, Any Inst.	Year 2	-0.01	-0.64	0.26	-0.64	-0.50	-0.23	<0.01
	Year 3	-0.01	-0.33	0.34	-0.80	-0.63	-0.59	<0.01
Progress to Degree	Year 2	<0.01	-3.08	0.37	-2.20	-1.90	-1.79	<0.01
Certificate within . . .	4 Years	<0.01	0.39	0.24	-1.03	-0.74	-0.60	<0.01
	5 Years	<0.01	0.37	0.31	-0.83	-0.54	-0.44	-0.01
	6 Years	<0.01	1.40	0.36	-0.63	-0.53	-0.39	-0.01
Associate's Degree within . . .	4 Years	<0.01	-2.06	0.41	-1.29	-1.12	-1.12	<0.01
	5 Years	<0.01	-1.82	0.36	-1.19	-1.06	-1.03	<0.01
	6 Years	<0.01	-1.31	0.35	-1.15	-0.82	-1.00	<0.01
Associate's/Bachelor's Degree within . . .	4 Years	<0.01	-2.03	0.42	-1.31	-1.15	-1.12	<0.01
	5 Years	<0.01	-2.02	0.38	-1.24	-1.15	-1.06	<0.01
	6 Years	<0.01	-1.69	0.36	-1.18	-0.87	-1.03	<0.01

Table C-5. Variance Components of Hierarchical Logistic Regression Models for Predicting Subsequent College Success for Students Who Took Developmental English Composition (Grade Scale A–F) before Standard English Composition

Outcome		Variance Component	
Type	Level	Intercept	Standard Error
Success in Standard English Composition	C or Higher	0.0699	0.0330
	B or Higher	0.0643	0.0317
GPA Year 1 (or Last GPA)	2.0 or Higher	0.2067	0.0782
	3.0 or Higher	0.1741	0.0651
GPA Year 2	2.0 or Higher	0.1924	0.0880
	3.0 or Higher	0.2065	0.0943
GPA Year 3	2.0 or Higher	0.1900	0.0978
	3.0 or Higher	0.0461	0.0395
Return Fall, Any Inst.	Year 2	0.0950	0.0401
	Year 3	0.0947	0.0405
Progress to Degree	Year 2	0.1318	0.0582
Certificate within . . .	4 Years	0.3227	0.1409
	5 Years	0.2711	0.1260
	6 Years	0.2360	0.1246
Associate's Degree within . . .	4 Years	0.3234	0.1298
	5 Years	0.3118	0.1334
	6 Years	0.2414	0.1135
Associate's/Bachelor's Degree within . . .	4 Years	0.3168	0.1276
	5 Years	0.2973	0.1283
	6 Years	0.2529	0.1183

Table C-6. Fixed Effects of Hierarchical Logistic Regression Models for Predicting Subsequent College Success for Students Who Did/Did Not Take Arithmetic before Elementary Algebra

Outcome			Institution-Level Effects				
					Prop. FT and Age ≤ 21 Vs.		
Type	Level	Intercept	Mean ACT Compass Score	Prop. Developmental Course Taken by Mean Test Score Interaction	Prop. PT and Age ≤ 21	Prop. Age 22–25	Prop. Age > 25
Success in Elementary Algebra	C or Higher	0.09	-0.07	-0.03	1.50	-0.16	3.95
	B or Higher	-0.58	-0.08	-0.04	3.18	1.06	3.83
GPA Year 1 (or Last GPA)	2.0 or Higher	0.99	-0.01	0.03	-0.80	2.18	1.58
	3.0 or Higher	-0.50	-0.02	0.01	-0.23	2.31	1.79
GPA Year 2	2.0 or Higher	1.35	<0.01	0.02	-0.77	0.69	2.14
	3.0 or Higher	-0.70	-0.01	<0.01	-0.70	1.01	1.83
GPA Year 3	2.0 or Higher	1.63	0.01	0.01	-1.30	-0.07	1.06
	3.0 or Higher	-0.73	<0.01	<0.01	-0.65	-0.44	1.55
Return Fall, Any Inst.	Year 2	0.79	0.02	0.03	-0.15	2.09	1.34
	Year 3	-0.37	0.02	0.02	0.02	1.13	1.85
Progress to Degree	Year 2	-1.26	0.02	0.03	-1.95	-0.57	-1.33
Certificate within . . .	4 Years	-2.28	-0.09	0.05	-8.77	5.62	-3.71
	5 Years	-2.25	-0.03	0.02	-8.29	-0.08	-4.89
	6 Years	-1.91	-0.02	<0.01	-5.76	2.43	-6.64
Associate's Degree within . . .	4 Years	-2.22	-0.01	0.03	-1.60	2.53	-1.03
	5 Years	-1.87	0.01	0.02	-1.01	1.90	-0.93
	6 Years	-1.77	0.01	0.03	-0.59	-0.02	0.11
Associate's/Bachelor's Degree within . . .	4 Years	-2.20	<0.01	0.03	-1.50	2.37	-0.85
	5 Years	-1.81	0.01	0.02	-1.02	1.17	-0.62
	6 Years	-1.66	0.01	0.02	-0.67	-0.41	-0.10

Table C-6. (continued)

Outcome		Student-Level Effects									
								Developmental Course Taken Interaction with			
					FT and Age ≤ 21 Vs.				FT and Age ≤ 21 Vs.		
Type	Level	Developmental Course Taken	ACT Compass Pre-Algebra Score	Prop. Score	PT and Age ≤ 21	Age 22–25	Age > 25	Prop. Score	PT and Age ≤ 21	Age 22–25	Age > 25
Success in Elementary Algebra	C or Higher	-0.07	0.02	0.25	-1.18	-1.17	-0.95	-0.65	0.30	0.57	0.45
	B or Higher	0.05	0.02	0.89	-0.92	-0.83	-0.60	-1.65	0.38	0.50	0.55
GPA Year 1 (or Last GPA)	2.0 or Higher	-0.50	0.01	0.73	-1.34	-1.21	-0.99	-1.92	0.85	1.24	1.45
	3.0 or Higher	-0.34	0.01	1.54	-0.84	-0.44	-0.06	-1.18	0.79	0.98	1.04
GPA Year 2	2.0 or Higher	0.06	0.01	-0.26	-0.99	-0.43	-0.01	-1.28	0.46	0.82	0.43
	3.0 or Higher	0.01	0.02	0.02	-0.62	0.21	0.49	-1.17	0.30	0.23	0.46
GPA Year 3	2.0 or Higher	0.07	0.01	-1.21	-1.01	-0.22	0.09	-0.23	0.54	0.36	0.30
	3.0 or Higher	0.01	0.02	-0.20	-0.45	0.42	0.72	-1.21	0.22	0.11	0.25
Return Fall, Any Inst.	Year 2	-0.65	<0.01	0.31	-1.80	-1.86	-1.61	-1.13	0.78	0.97	0.98
	Year 3	-0.40	<0.01	0.13	-1.48	-1.55	-1.13	-1.06	0.53	0.94	0.80
Progress to Degree	Year 2	-0.05	0.01	-2.02	-2.55	-2.36	-2.05	1.47	0.27	0.40	0.30
Certificate within . . .	4 Years	-0.11	<0.01	0.77	-1.10	-0.80	-0.71	-0.13	0.01	0.30	<0.01
	5 Years	0.06	<0.01	0.91	-1.16	-0.74	-0.76	1.76	-0.05	0.12	-0.04
	6 Years	-0.15	<0.01	2.47	-0.98	-0.60	-0.39	-0.18	-0.58	-0.46	-0.62
Associate's Degree within . . .	4 Years	<0.01	0.01	-0.17	-1.67	-1.40	-1.07	-0.78	0.46	0.64	0.36
	5 Years	-0.04	0.01	0.33	-1.43	-1.36	-0.95	-1.94	0.36	0.41	0.31
	6 Years	0.01	0.01	-0.76	-1.44	-1.30	-0.86	-1.46	0.32	0.53	0.41
Associate's/Bachelor's Degree within . . .	4 Years	-0.01	0.01	-0.31	-1.73	-1.47	-1.12	-0.74	0.48	0.67	0.40
	5 Years	-0.03	0.01	-0.36	-1.59	-1.54	-1.10	-1.73	0.45	0.49	0.39
	6 Years	-0.01	0.01	-1.44	-1.60	-1.48	-1.03	-1.26	0.38	0.54	0.43

Table C-7. Variance Components of Hierarchical Logistic Regression Models for Predicting Subsequent College Success for Students Who Did/Did Not Take Arithmetic before Elementary Algebra

Outcome		Variance Component	
Type	Level	Intercept	Standard Error
Elementary Algebra	C or Higher	1.5840	0.4727
	B or Higher	1.4609	0.4443
GPA Year 1 (or Last GPA)	2.0 or Higher	0.0851	0.0311
	3.0 or Higher	0.0784	0.0293
GPA Year 2	2.0 or Higher	0.0292	0.0190
	3.0 or Higher	0.0334	0.0217
GPA Year 3	2.0 or Higher	0.0540	0.0395
	3.0 or Higher	0.0000	
Return Fall, Any Inst.	Year 2	0.0881	0.0340
	Year 3	0.1235	0.0487
Progress to Degree	Year 2	0.0694	0.0270
Certificate within . . .	4 Years	0.2109	0.0893
	5 Years	0.5138	0.2208
	6 Years	0.4979	0.2172
Associate's Degree within . . .	4 Years	0.0657	0.0322
	5 Years	0.0980	0.0533
	6 Years	0.0830	0.0614
Associate's/Bachelor's Degree within . . .	4 Years	0.0542	0.0273
	5 Years	0.0576	0.0356
	6 Years	0.0429	0.0362

Table C-8. Fixed Effects of Hierarchical Logistic Regression Models for Predicting Subsequent College Success for Students Who Took Arithmetic (Grade Scale A–F) before Elementary Algebra

Outcome			Institution-Level Effects			
				Prop. FT and Age ≤ 21 Vs.		
Type	Level	Intercept	Mean Developmental Course Grade	Prop. PT and Age ≤ 21	Prop. Age 22–25	Prop. Age > 25
Success in Elementary Algebra	C or Higher	0.27	0.75	0.79	-3.38	3.79
	B or Higher	-0.64	0.93	1.45	-1.77	2.24
GPA Year 1 (or Last GPA)	2.0 or Higher	1.08	-0.40	0.20	1.27	0.74
	3.0 or Higher	-0.56	-0.76	0.45	3.38	0.58
GPA Year 2	2.0 or Higher	1.42	-0.47	-0.47	0.30	0.85
	3.0 or Higher	-0.86	-0.74	-0.12	1.83	2.04
GPA Year 3	2.0 or Higher	1.75	-0.26	-1.50	-2.03	0.50
	3.0 or Higher	-0.85	-0.62	-1.04	-0.24	1.07
Return Fall, Any Inst.	Year 2	0.98	-0.24	0.87	0.05	1.99
	Year 3	-0.18	-0.44	0.97	-0.59	2.84
Progress to Degree	Year 2	-1.16	0.02	-1.61	-2.99	-2.33
Certificate within . . .	4 Years	-2.10	-0.57	-7.15	1.22	-7.10
	5 Years	-2.02	0.33	-1.31	1.64	-0.26
	6 Years	-1.81	0.57	0.78	4.22	0.91
Associate's Degree within . . .	4 Years	-2.19	-0.06	-0.15	1.98	-2.22
	5 Years	-1.77	-0.06	0.27	0.56	-1.05
	6 Years	-1.60	0.03	0.18	-1.73	0.39
Associate's/Bachelor's Degree within . . .	4 Years	-2.18	-0.08	-0.26	1.77	-2.11
	5 Years	-1.72	-0.04	-0.16	0.12	-1.21
	6 Years	-1.51	0.03	-0.28	-1.92	-0.02

Table C-8. (continued)

Outcome		Student-Level Effects					
					FT and Age ≤ 21 Vs.		
Type	Level	ACT Compass Pre-Algebra Score	Prop. Score	Developmental Course Grade	PT and Age ≤ 21	Age 22–25	Age > 25
Success in Elementary Algebra	C or Higher	0.01	-0.42	0.63	-0.74	-0.54	-0.59
	B or Higher	0.02	-0.52	0.82	-0.33	-0.19	0.02
GPA Year 1 (or Last GPA)	2.0 or Higher	<0.01	-1.07	0.40	-0.47	-0.03	0.30
	3.0 or Higher	<0.01	1.42	0.55	-0.05	0.41	0.82
GPA Year 2	2.0 or Higher	<0.01	-1.74	0.55	-0.46	0.36	0.28
	3.0 or Higher	<0.01	-0.68	0.68	-0.37	0.19	0.69
GPA Year 3	2.0 or Higher	<0.01	-2.11	0.51	-0.46	0.13	0.27
	3.0 or Higher	0.01	-1.73	0.64	-0.22	0.48	0.86
Return Fall, Any Inst.	Year 2	-0.01	-0.98	0.16	-0.97	-0.91	-0.65
	Year 3	<0.01	-0.74	0.26	-0.92	-0.62	-0.39
Progress to Degree	Year 2	0.01	-1.95	0.22	-2.13	-1.63	-1.45
Certificate within . . .	4 Years	0.01	0.58	0.25	-0.81	-0.33	-0.49
	5 Years	<0.01	2.29	0.17	-1.14	-0.60	-0.78
	6 Years	<0.01	1.48	0.15	-1.63	-1.24	-1.18
Associate's Degree within . . .	4 Years	0.01	-1.22	0.45	-1.16	-0.76	-0.73
	5 Years	<0.01	-1.71	0.40	-1.01	-1.00	-0.62
	6 Years	<0.01	-2.85	0.33	-1.06	-0.81	-0.49
Associate's/Bachelor's Degree within . . .	4 Years	0.01	-1.41	0.45	-1.18	-0.78	-0.74
	5 Years	<0.01	-2.03	0.40	-1.04	-1.04	-0.66
	6 Years	<0.01	-2.81	0.34	-1.11	-0.91	-0.57

Table C-9. Variance Components of Hierarchical Logistic Regression Models for Predicting Subsequent College Success for Students Who Took Arithmetic (Grade Scale A–F) before Elementary Algebra

Outcome		Variance Component	
Type	Level	Intercept	Standard Error
Success in Elementary Algebra	C or Higher	0.1624	0.0757
	B or Higher	0.3244	0.1302
GPA Year 1 (or Last GPA)	2.0 or Higher	0.0000	
	3.0 or Higher	0.0550	0.0352
GPA Year 2	2.0 or Higher	0.0348	0.0540
	3.0 or Higher	0.0000	
GPA Year 3	2.0 or Higher	0.0000	
	3.0 or Higher	0.0000	
Return Fall, Any Inst.	Year 2	0.0167	0.0148
	Year 3	0.0262	0.0143
Progress to Degree	Year 2	0.1385	0.0681
Certificate within . . .	4 Years	0.1562	0.1006
	5 Years	0.3196	0.1848
	6 Years	0.3207	0.2038
Associate's Degree within . . .	4 Years	0.0000	
	5 Years	0.0000	
	6 Years	0.0113	0.0225
Associate's/Bachelor's Degree within . . .	4 Years	0.0000	
	5 Years	0.0000	
	6 Years	0.0179	0.0240

Table C-10. Fixed Effects of Hierarchical Logistic Regression Models for Predicting Subsequent College Success for Students Who Did/Did Not Take Elementary Algebra before Intermediate Algebra

Outcome		Institution-Level Effects							
							Prop. Developmental Course Taken Interaction with		
				Prop. FT and Age ≤ 21 Vs.					
Type	Level	Intercept	Mean ACT Compass Pre-Algebra Score	Prop. PT and Age ≤ 21	Prop. Age 22–25	Prop. Age > 25	Prop. PT and Age ≤ 21	Prop. Age 22–25	Prop. Age > 25
Success in Intermediate Algebra	C or Higher	0.15	-0.08	4.52	2.44	3.65	-4.87	1.49	1.30
	B or Higher	-0.53	-0.08	4.04	0.61	3.40	-4.74	1.41	3.12
GPA Year 1 (or Last GPA)	2.0 or Higher	1.20	0.01	1.02	5.24	-4.19	-0.61	-4.58	6.66
	3.0 or Higher	-0.56	0.01	0.68	1.04	-0.92	-1.28	-0.03	6.45
GPA Year 2	2.0 or Higher	1.61	0.04	-0.53	11.23	-13.27	0.39	-12.68	18.76
	3.0 or Higher	-0.67	0.03	-0.87	6.03	-15.23	0.24	-6.57	20.65
GPA Year 3	2.0 or Higher	1.93	0.02	-0.56	5.64	-2.02	0.52	-5.22	5.44
	3.0 or Higher	-0.73	0.02	-0.87	-0.05	-7.17	0.63	0.82	8.46
Return Fall, Any Inst.	Year 2	1.13	0.02	-0.40	4.31	-7.51	0.93	-2.52	10.06
	Year 3	0.02	0.02	-0.10	-0.01	-4.34	0.59	2.40	7.68
Progress to Degree	Year 2	-0.66	0.01	-1.85	6.13	-6.91	0.69	-3.13	5.49
Certificate within . . .	4 Years	-2.01	-0.06	-4.81	-2.41	6.97	1.81	1.60	-7.57
	5 Years	-1.82	-0.04	-5.54	-6.76	0.82	2.16	4.92	-2.92
	6 Years	-1.82	-0.05	-5.41	-11.22	5.38	1.44	17.15	-13.83
Associate's Degree within . . .	4 Years	-1.64	-0.01	-1.27	6.79	-7.79	0.60	-1.78	4.94
	5 Years	-1.27	<0.01	-1.29	6.34	-8.47	0.79	-2.90	6.90
	6 Years	-1.22	0.01	-1.24	7.04	-3.50	1.95	-8.31	4.02
Associate's/Bachelor's Degree within . . .	4 Years	-1.62	-0.01	-1.24	6.76	-7.56	0.62	-1.71	4.75
	5 Years	-1.21	0.01	-1.65	6.92	-8.07	1.08	-3.86	7.14
	6 Years	-1.10	0.01	-1.02	8.12	-2.80	2.13	-10.13	4.26

Table C-10. (continued)

Outcome		Student-Level Effects									
								Developmental Course Taken Interaction with			
					FT and Age ≤ 21 Vs.				FT and Age ≤ 21 Vs.		
Type	Level	Developmental Course Taken	ACT Compass Pre-Algebra Score	Prop. Score	PT and Age ≤ 21	Age 22–25	Age > 25	Prop. Score	PT and Age ≤ 21	Age 22–25	Age > 25
Success in Intermediate Algebra	C or Higher	0.11	0.01	-1.36	-1.34	-0.74	-0.63	1.37	0.77	0.37	0.30
	B or Higher	0.20	0.02	-1.11	-1.05	-0.33	-0.25	1.46	0.67	0.14	0.19
GPA Year 1 (or Last GPA)	2.0 or Higher	-0.34	<0.01	-0.54	-1.88	-1.17	-1.12	0.60	1.07	0.72	0.84
	3.0 or Higher	-0.16	0.01	-0.41	-1.14	-0.36	-0.29	1.32	0.76	0.44	0.72
GPA Year 2	2.0 or Higher	0.05	0.01	-0.93	-1.49	-0.52	-0.20	0.70	0.66	0.18	0.50
	3.0 or Higher	0.02	0.02	-0.22	-1.11	-0.27	0.20	0.77	0.61	0.51	0.32
GPA Year 3	2.0 or Higher	-0.02	0.01	-1.81	-1.52	-0.44	-0.70	1.72	0.77	0.27	1.13
	3.0 or Higher	0.05	0.02	-0.24	-0.88	-0.08	0.24	0.96	0.36	0.20	0.25
Return Fall, Any Inst.	Year 2	-0.51	-0.01	-0.82	-1.93	-1.46	-1.07	0.69	0.74	0.53	0.13
	Year 3	-0.34	<0.01	-1.21	-1.60	-1.03	-0.77	0.96	0.80	0.40	0.37
Progress to Degree	Year 2	-0.06	0.01	-1.76	-2.64	-1.82	-1.44	0.11	0.36	0.09	-0.05
Certificate within . . .	4 Years	-0.17	0.01	0.61	-0.68	-0.38	-0.90	-0.08	-0.12	-0.04	0.36
	5 Years	-0.16	<0.01	0.28	-0.64	-0.25	-0.72	0.25	-0.31	-0.27	-0.03
	6 Years	-0.14	<0.01	0.14	-0.74	-0.26	-0.97	0.53	-0.20	-0.34	0.33
Associate's Degree within . . .	4 Years	-0.08	0.01	-1.87	-1.78	-0.77	-0.28	1.10	0.65	0.04	-0.14
	5 Years	-0.17	0.01	-1.50	-1.67	-0.79	-0.23	0.60	0.80	0.21	0.05
	6 Years	-0.09	<0.01	-1.27	-1.62	-0.82	-0.44	0.39	0.81	0.39	0.31
Associate's/Bachelor's Degree within . . .	4 Years	-0.09	0.01	-1.90	-1.81	-0.81	-0.28	1.04	0.63	0.03	-0.14
	5 Years	-0.15	<0.01	-1.89	-1.74	-0.84	-0.15	0.82	0.71	0.12	-0.16
	6 Years	-0.04	<0.01	-1.78	-1.71	-0.95	-0.44	0.64	0.71	0.35	0.14

Table C-11. Variance Components of Hierarchical Logistic Regression Models for Predicting Subsequent College Success for Students Who Did/Did Not Take Elementary Algebra before Intermediate Algebra

Outcome		Variance Component	
Type	Level	Intercept	Standard Error
Success in Intermediate Algebra	C or Higher	0.6172	0.1739
	B or Higher	0.7099	0.1939
GPA Year 1 (or Last GPA)	2.0 or Higher	0.1092	0.0400
	3.0 or Higher	0.1124	0.0387
GPA Year 2	2.0 or Higher	0.0533	0.0357
	3.0 or Higher	0.0851	0.0387
GPA Year 3	2.0 or Higher	0.0887	0.0494
	3.0 or Higher	0.0527	0.0313
Return Fall, Any Inst.	Year 2	0.0594	0.0231
	Year 3	0.0759	0.0283
Progress to Degree	Year 2	0.0838	0.0336
Certificate within . . .	4 Years	0.2684	0.1111
	5 Years	0.2391	0.1045
	6 Years	0.1066	0.0648
Associate's Degree within . . .	4 Years	0.1816	0.0590
	5 Years	0.1451	0.0530
	6 Years	0.1865	0.0729
Associate's/Bachelor's Degree within . . .	4 Years	0.1774	0.0578
	5 Years	0.1334	0.0503
	6 Years	0.1521	0.0615

Table C-12. Fixed Effects of Hierarchical Logistic Regression Models for Predicting Subsequent College Success for Students Who Took Elementary Algebra (Grade Scale A–F) before Intermediate Algebra

Outcome			Institution-Level Effects	Student-Level Effects					
							FT and Age ≤ 21 Vs.		
Type	Level	Intercept	Mean ACT Compass Pre-Algebra Score	ACT Compass Pre-Algebra Score	Prop. Score	Developmental Course Grade	PT and Age ≤ 21	Age 22–25	Age > 25
Success in Intermediate Algebra	C or Higher	<0.01	-0.02	<0.01	0.02	0.75	-0.55	-0.41	-0.41
	B or Higher	-0.86	-0.03	0.01	0.48	0.92	-0.30	-0.20	-0.13
GPA Year 1 (or Last GPA)	2.0 or Higher	1.15	0.02	<0.01	-0.16	0.43	-0.77	-0.45	-0.34
	3.0 or Higher	-0.66	0.02	<0.01	0.64	0.55	-0.43	0.02	0.31
GPA Year 2	2.0 or Higher	1.61	0.02	<0.01	-0.25	0.48	-0.82	-0.36	0.19
	3.0 or Higher	-0.75	0.01	0.01	0.41	0.70	-0.52	0.23	0.44
GPA Year 3	2.0 or Higher	1.90	0.01	0.01	-0.30	0.48	-0.68	-0.15	0.37
	3.0 or Higher	-0.80	0.01	0.01	0.54	0.77	-0.52	0.11	0.38
Return Fall, Any Inst.	Year 2	1.18	0.03	-0.01	-0.07	0.21	-0.98	-0.75	-0.77
	Year 3	0.04	0.03	-0.01	-0.28	0.20	-0.70	-0.57	-0.34
Progress to Degree	Year 2	-0.80	0.02	0.01	-1.44	0.25	-2.25	-1.76	-1.59
Certificate within . . .	4 Years	-1.92	-0.02	<0.01	0.80	0.25	-0.72	-0.42	-0.52
	5 Years	-1.77	-0.02	<0.01	0.78	0.18	-0.90	-0.55	-0.76
	6 Years	-1.65	-0.02	-0.01	0.94	0.16	-0.77	-0.46	-0.52
Associate's Degree within . . .	4 Years	-1.67	<0.01	<0.01	-0.62	0.37	-1.12	-0.76	-0.54
	5 Years	-1.30	0.01	<0.01	-0.70	0.32	-0.86	-0.64	-0.33
	6 Years	-1.19	<0.01	<0.01	-0.90	0.27	-0.80	-0.46	-0.23
Associate's/Bachelor's Degree within . . .	4 Years	-1.66	<0.01	<0.01	-0.77	0.39	-1.18	-0.81	-0.55
	5 Years	-1.26	0.01	<0.01	-1.02	0.36	-1.02	-0.75	-0.42
	6 Years	-1.12	<0.01	<0.01	-1.24	0.30	-0.96	-0.60	-0.35

Table C-13. Variance Components of Hierarchical Logistic Regression Models for Predicting Subsequent College Success for Students Who Took Elementary Algebra (Grade Scale A–F) before Intermediate Algebra

Outcome		Variance Component	
Type	Level	Intercept	Standard Error
Success in Intermediate Algebra	C or Higher	0.1804	0.0683
	B or Higher	0.2527	0.0932
GPA Year 1 (or Last GPA)	2.0 or Higher	0.2286	0.1099
	3.0 or Higher	0.1748	0.0723
GPA Year 2	2.0 or Higher	0.0187	0.0302
	3.0 or Higher	0.1256	0.0645
GPA Year 3	2.0 or Higher	0.0000	
	3.0 or Higher	0.0267	0.0316
Return Fall, Any Inst.	Year 2	0.0495	0.0274
	Year 3	0.0725	0.0326
Progress to Degree	Year 2	0.1112	0.0481
Certificate within . . .	4 Years	0.3235	0.1463
	5 Years	0.4132	0.1917
	6 Years	0.4253	0.2152
Associate's Degree within . . .	4 Years	0.2026	0.0737
	5 Years	0.0931	0.0413
	6 Years	0.0910	0.0457
Associate's/Bachelor's Degree within . . .	4 Years	0.2167	0.0785
	5 Years	0.1041	0.0442
	6 Years	0.1137	0.0520

Table C-14. Fixed Effects of Hierarchical Logistic Regression Models for Predicting Subsequent College Success for Students Who Did/Did Not Take Intermediate Algebra before College Algebra

Outcome			Institution-Level Effects						
							Prop. Developmental Course Taken Interaction with		
				Prop. FT and Age ≤ 21 Vs.					
Type	Level	Intercept	Mean ACT Compass Algebra Score	Prop. PT and Age ≤ 21	Prop. Age 22–25	Prop. Age > 25	Prop. PT and Age ≤ 21	Prop. Age 22–25	Prop. Age > 25
Success in College Algebra	C or Higher	0.67	0.01	-1.70	0.49	6.19	3.74	-18.63	-4.01
	B or Higher	-0.35	-0.01	-1.16	-7.48	4.50	2.74	-5.69	-1.62
GPA Year 1 (or Last GPA)	2.0 or Higher	1.87	0.07	-2.74	-8.98	4.50	4.59	11.84	-12.35
	3.0 or Higher	-0.10	0.02	-1.07	-10.93	15.20	2.35	14.05	-14.59
GPA Year 2	2.0 or Higher	2.23	0.07	-1.97	-8.41	7.56	3.75	9.76	-27.78
	3.0 or Higher	-0.09	0.02	-1.11	-7.26	16.42	2.47	6.39	-22.65
GPA Year 3	2.0 or Higher	2.64	0.10	-3.51	-14.16	22.63	6.56	5.82	-32.54
	3.0 or Higher	-0.13	0.01	-0.63	-4.61	21.16	1.92	-5.04	-19.86
Return Fall, Any Inst.	Year 2	1.64	0.03	0.03	-9.37	16.49	1.68	7.68	-22.09
	Year 3	0.59	0.03	0.20	-14.26	16.55	1.21	17.46	-21.15
Progress to Degree	Year 2	0.61	0.01	-0.45	6.61	2.56	0.04	-5.98	-5.07
Certificate within . . .	4 Years	-2.08	<0.01	-4.43	-17.05	24.22	-0.10	33.57	-22.45
	5 Years	-1.88	-0.03	-3.85	-9.48	22.66	-0.53	15.58	-25.78
	6 Years	-1.98	<0.01	-3.90	-0.71	26.51	1.69	-12.07	-21.32
Associate's Degree within . . .	4 Years	-0.64	<0.01	-1.28	6.31	0.85	-0.56	1.67	-6.06
	5 Years	-0.48	0.01	-1.26	7.85	4.04	-0.56	-1.26	-6.58
	6 Years	-0.34	0.02	-1.08	6.75	6.77	-0.29	-3.59	-7.00
Associate's/Bachelor's Degree within . . .	4 Years	-0.61	<0.01	-1.11	6.03	1.64	-0.63	2.13	-5.87
	5 Years	-0.33	0.02	-1.12	3.80	4.85	-0.13	1.32	-5.40
	6 Years	-0.07	0.03	-0.99	2.16	8.17	-0.04	2.90	-9.07

Table C-14. (continued)

Outcome		Student-Level Effects									
					FT and Age ≤ 21 Vs.			Developmental Course Taken Interaction with	FT and Age ≤ 21 Vs.		
Type	Level	Developmental Course Taken	ACT Compass Algebra Score	Prop. Score	PT and Age ≤ 21	Age 22–25	Age > 25	Prop. Score	PT and Age ≤ 21	Age 22–25	Age > 25
Success in College Algebra	C or Higher	-0.05	0.02	-1.20	-1.68	-0.84	-0.48	0.98	0.76	0.54	0.51
	B or Higher	<0.01	0.03	-1.00	-1.33	-0.54	-0.04	1.22	0.72	0.45	0.50
GPA Year 1 (or Last GPA)	2.0 or Higher	-0.35	<0.01	-1.52	-2.36	-1.30	-0.78	0.69	1.06	0.87	0.53
	3.0 or Higher	-0.22	0.01	-1.76	-1.64	-0.37	0.66	1.22	0.82	0.42	-0.46
GPA Year 2	2.0 or Higher	0.07	<0.01	-2.19	-1.80	-0.67	0.49	0.78	0.81	0.28	-0.36
	3.0 or Higher	0.04	0.01	-2.57	-1.33	-0.04	1.09	1.86	0.45	0.08	-0.68
GPA Year 3	2.0 or Higher	-0.16	<0.01	-1.35	-1.76	-0.44	0.05	-0.84	0.55	0.21	-0.05
	3.0 or Higher	0.09	0.02	-2.27	-1.15	0.12	1.30	1.59	0.35	0.14	-0.72
Return Fall, Any Inst.	Year 2	-0.48	-0.01	-1.10	-2.17	-1.39	-1.01	0.77	0.98	0.49	0.09
	Year 3	-0.34	<0.01	-1.71	-1.85	-1.15	-0.48	0.87	0.91	0.48	-0.23
Progress to Degree	Year 2	-0.39	>-0.01	-1.29	-2.91	-1.60	-1.33	-0.38	0.70	0.12	0.13
Certificate within . . .	4 Years	-0.17	<0.01	-0.07	-0.80	-0.62	-0.28	1.50	0.41	0.34	-1.51
	5 Years	-0.26	<0.01	0.47	-0.66	-0.42	0.13	0.80	0.23	0.43	-1.72
	6 Years	-0.11	<0.01	0.66	-0.49	-0.49	0.20	0.55	-0.20	0.49	-1.89
Associate's Degree within . . .	4 Years	-0.25	<0.01	-1.65	-1.94	-0.92	-0.40	0.14	0.77	0.53	0.13
	5 Years	-0.21	<0.01	-1.38	-1.77	-1.02	-0.37	0.24	0.67	0.62	0.06
	6 Years	-0.27	<0.01	-1.42	-1.76	-0.95	-0.39	0.14	0.72	0.47	0.14
Associate's/Bachelor's Degree within . . .	4 Years	-0.22	<0.01	-1.79	-2.02	-0.95	-0.45	0.18	0.80	0.52	0.20
	5 Years	-0.17	<0.01	-1.70	-1.98	-1.11	-0.38	0.27	0.76	0.59	0.08
	6 Years	-0.23	<0.01	-1.82	-2.03	-1.10	-0.54	0.07	0.83	0.43	0.21

Table C-15. Variance Components of Hierarchical Logistic Regression Models for Predicting Subsequent College Success for Students Who Did/Did Not Take Intermediate Algebra before College Algebra

Outcome		Variance Component	
Type	Level	Intercept	Standard Error
Success in College Algebra	C or Higher	0.1511	0.0453
	B or Higher	0.1793	0.0572
GPA Year 1 (or Last GPA)	2.0 or Higher	0.0434	0.0188
	3.0 or Higher	0.0689	0.0256
GPA Year 2	2.0 or Higher	0.1315	0.0453
	3.0 or Higher	0.0429	0.0175
GPA Year 3	2.0 or Higher	0.0494	0.0261
	3.0 or Higher	0.0363	0.0157
Return Fall, Any Inst.	Year 2	0.0184	0.0098
	Year 3	0.0086	0.0060
Progress to Degree	Year 2	0.0105	0.0065
Certificate within . . .	4 Years	0.1858	0.0796
	5 Years	0.2036	0.0847
	6 Years	0.2071	0.0907
Associate's Degree within . . .	4 Years	0.0254	0.0101
	5 Years	0.0105	0.0072
	6 Years	0.0000	
Associate's/Bachelor's Degree within . . .	4 Years	0.0168	0.0077
	5 Years	0.0000	
	6 Years	0.0000	

Table C-16. Fixed Effects of Hierarchical Logistic Regression Models for Predicting Subsequent College Success for Students Who Took Intermediate Algebra (Grade Scale A–F) before College Algebra

Outcome			Institution-Level Effects	Student-Level Effects					
							FT and Age ≤ 21 Vs.		
Type	Level	Intercept	Mean Developmental Course Grade	ACT Compass Algebra Score	Prop. Score	Developmental Course Grade	PT and Age ≤ 21	Age 22–25	Age > 25
Success in College Algebra	C or Higher	0.45	-0.37	0.01	0.14	0.75	-0.96	-0.71	-0.32
	B or Higher	-0.78	-0.09	0.02	0.33	0.93	-0.67	-0.42	0.20
GPA Year 1 (or Last GPA)	2.0 or Higher	1.75	-0.34	<0.01	-0.89	0.56	-1.53	-0.74	-0.92
	3.0 or Higher	-0.44	-0.60	<0.01	-0.45	0.74	-0.88	-0.29	-0.27
GPA Year 2	2.0 or Higher	2.05	-0.45	<0.01	-1.73	0.54	-1.18	-0.69	-0.37
	3.0 or Higher	-0.49	-0.69	0.01	-0.86	0.74	-1.01	-0.29	-0.13
GPA Year 3	2.0 or Higher	2.45	-0.19	<0.01	-2.58	0.43	-1.49	-0.64	-0.92
	3.0 or Higher	-0.55	-0.74	0.02	-0.85	0.73	-0.88	-0.10	0.20
Return Fall, Any Inst.	Year 2	1.58	0.14	-0.01	-0.40	0.04	-1.08	-0.92	-0.98
	Year 3	0.51	-0.04	-0.01	-0.78	0.11	-0.91	-0.82	-0.96
Progress to Degree	Year 2	0.40	0.02	-0.01	-1.84	0.19	-2.15	-1.54	-1.43
Certificate within . . .	4 Years	-2.21	0.74	0.01	1.39	0.27	-0.26	-0.20	-1.72
	5 Years	-1.89	0.32	0.01	1.13	0.22	-0.35	0.09	-1.58
	6 Years	-1.99	0.23	<0.01	0.98	0.20	-0.69	-0.03	-1.73
Associate's Degree within . . .	4 Years	-0.79	-0.56	-0.01	-1.66	0.30	-1.23	-0.60	-0.44
	5 Years	-0.58	-0.47	-0.01	-1.17	0.28	-1.14	-0.53	-0.53
	6 Years	-0.47	-0.25	-0.01	-1.07	0.27	-1.04	-0.54	-0.43
Associate's/Bachelor's Degree within . . .	4 Years	-0.77	-0.49	-0.01	-1.69	0.30	-1.27	-0.65	-0.42
	5 Years	-0.49	-0.43	-0.01	-1.36	0.29	-1.22	-0.64	-0.46
	6 Years	-0.28	-0.19	-0.01	-1.44	0.29	-1.16	-0.76	-0.47

Table C-17. Variance Components of Hierarchical Logistic Regression Models for Predicting Subsequent College Success for Students Who Took Intermediate Algebra (Grade Scale A–F) before College Algebra

Outcome		Variance Component	
Type	Level	Intercept	Standard Error
Success in College Algebra	C or Higher	0.0801	0.0379
	B or Higher	0.1857	0.0762
GPA Year 1 (or Last GPA)	2.0 or Higher	0.1282	0.0719
	3.0 or Higher	0.1472	0.0605
GPA Year 2	2.0 or Higher	0.0948	0.0648
	3.0 or Higher	0.1204	0.0584
GPA Year 3	2.0 or Higher	0.1327	0.1055
	3.0 or Higher	0.1141	0.0664
Return Fall, Any Inst.	Year 2	0.0298	0.0212
	Year 3	0.0302	0.0178
Progress to Degree	Year 2	0.0472	0.0257
Certificate within . . .	4 Years	0.4593	0.2188
	5 Years	0.3589	0.1735
	6 Years	0.3761	0.2059
Associate's Degree within . . .	4 Years	0.1569	0.0600
	5 Years	0.0883	0.0457
	6 Years	0.0337	0.0277
Associate's/Bachelor's Degree within . . .	4 Years	0.1443	0.0567
	5 Years	0.0463	0.0316
	6 Years	0.0359	0.0305

Table C-18. Fixed Effects of Hierarchical Logistic Regression Models for Predicting Subsequent College Success for Students Who Did/Did Not Take Developmental Reading before First Social Science Course

Outcome			Institution-Level Effects						
							Prop. Developmental Course Taken Interaction with		
				Prop. FT and Age ≤ 21 Vs.					
Type	Level	Intercept	Mean ACT Compass Reading Score	Prop. PT and Age ≤ 21	Prop. Age 22–25	Prop. Age > 25	Prop. PT and Age ≤ 21	Prop. Age 22–25	Prop. Age > 25
Success in First Social Science Course	C or Higher	0.46	0.02	-0.27	-2.46	4.28	5.23	-1.57	-5.82
	B or Higher	-0.48	-0.01	-0.13	-0.54	1.71	4.94	-9.09	-1.25
GPA Year 1 (or Last GPA)	2.0 or Higher	1.02	-0.01	-0.24	0.54	-0.12	1.36	1.10	5.71
	3.0 or Higher	-0.59	-0.03	-0.18	2.07	0.13	0.91	-5.00	9.42
GPA Year 2	2.0 or Higher	1.51	0.04	-0.03	-0.96	-2.00	2.94	9.74	3.03
	3.0 or Higher	-0.69	-0.03	-0.13	5.74	-2.12	0.42	-7.53	10.06
GPA Year 3	2.0 or Higher	1.77	0.01	0.29	0.04	1.05	2.20	5.81	-3.35
	3.0 or Higher	-0.78	-0.04	0.03	5.78	-1.26	-0.32	-5.15	6.27
Return Fall, Any Inst.	Year 2	0.89	0.07	0.85	-1.97	-0.41	1.50	7.29	10.77
	Year 3	-0.14	0.07	0.95	-1.75	-1.40	0.65	5.55	15.80
Progress to Degree	Year 2	-0.46	0.06	-1.51	1.19	-3.00	3.38	5.45	-0.03
Certificate within . . .	4 Years	-2.07	0.09	-6.26	10.71	2.61	12.34	-8.51	-19.68
	5 Years	-1.91	<0.01	-6.12	13.64	2.84	8.53	-22.35	-13.15
	6 Years	-1.87	<0.01	-5.39	4.40	2.01	5.31	8.53	-16.42
Associate's Degree within . . .	4 Years	-1.63	0.06	-2.71	6.87	-2.43	7.10	-15.60	-0.38
	5 Years	-1.34	0.06	-1.96	3.24	-2.39	5.41	-4.78	2.81
	6 Years	-1.18	0.08	-1.55	-0.07	-1.63	5.16	3.14	4.11
Associate's/Bachelor's Degree within . . .	4 Years	-1.61	0.06	-2.58	6.69	-2.56	7.07	-15.51	0.55
	5 Years	-1.25	0.07	-1.48	2.42	-2.85	4.86	-3.97	5.65
	6 Years	-1.02	0.07	-0.84	1.03	-3.06	3.81	0.33	7.91

Table C-18. (continued)

Outcome		Student-Level Effects										
					FT and Age ≤ 21 Vs.			Developmental Course Taken Interaction with		FT and Age ≤ 21 Vs.		
Type	Level	Developmental Course Taken	ACT Compass Reading Score	Prop. Score	PT and Age ≤ 21	Age 22–25	Age > 25	Test Score	Prop. Score	PT and Age ≤ 21	Age 22–25	Age > 25
Success in First Social Science Course	C or Higher	0.46	0.02	-2.32	-1.61	-1.07	-0.71	-0.01	1.17	0.75	0.40	0.11
	B or Higher	0.44	0.02	-2.58	-1.15	-0.47	-0.06	-0.01	0.86	0.66	0.18	-0.12
GPA Year 1 (or Last GPA)	2.0 or Higher	0.16	0.01	-2.91	-1.86	-1.15	-0.69	-0.01	1.44	0.91	0.37	0.11
	3.0 or Higher	0.11	0.02	-3.34	-1.27	-0.28	0.26	-0.02	1.79	0.83	0.06	-0.25
GPA Year 2	2.0 or Higher	0.48	0.01	-3.57	-1.45	-0.65	0.01	-0.01	1.34	0.56	0.31	-0.13
	3.0 or Higher	0.43	0.03	-4.57	-1.03	0.01	0.59	-0.01	2.07	0.31	-0.22	-0.41
GPA Year 3	2.0 or Higher	0.39	0.02	-3.91	-1.39	-0.45	0.01	-0.01	1.47	0.30	-0.06	-0.30
	3.0 or Higher	0.48	0.03	-4.56	-0.86	0.14	0.69	-0.02	1.03	0.32	-0.20	-0.27
Return Fall, Any Inst.	Year 2	-0.09	<0.01	-1.39	-2.02	-1.72	-1.40	<0.01	1.01	0.55	0.27	0.10
	Year 3	0.03	<0.01	-2.08	-1.74	-1.44	-1.05	<0.01	1.54	0.60	0.45	0.18
Progress to Degree	Year 2	0.06	0.01	-2.65	-2.80	-2.16	-1.87	<0.01	-1.13	0.06	-0.49	-0.48
Certificate within . . .	4 Years	-0.12	<0.01	0.25	-0.77	-0.20	-0.15	0.01	0.10	-0.23	-0.46	-0.82
	5 Years	-0.12	-0.01	0.29	-0.70	-0.20	-0.12	0.02	0.41	-0.20	-0.37	-0.82
	6 Years	-0.06	-0.01	0.38	-0.66	-0.15	-0.01	0.01	0.12	-0.06	-0.52	-0.61
Associate's Degree within . . .	4 Years	0.12	0.01	-3.37	-1.91	-1.30	-0.99	<0.01	1.58	0.45	-0.19	-0.22
	5 Years	0.12	0.01	-3.15	-1.76	-1.32	-0.87	<0.01	1.57	0.47	0.11	-0.36
	6 Years	0.08	0.01	-3.05	-1.70	-1.26	-0.84	<0.01	1.70	0.44	0.21	-0.22
Associate's/Bachelor's Degree within . . .	4 Years	0.16	0.01	-3.60	-1.98	-1.36	-1.03	<0.01	1.78	0.50	-0.16	-0.19
	5 Years	0.18	0.01	-3.75	-1.92	-1.49	-1.02	<0.01	2.06	0.56	0.20	-0.29
	6 Years	0.14	0.01	-3.78	-1.90	-1.50	-1.09	<0.01	2.17	0.55	0.34	-0.10

Table C-19. Variance Components of Hierarchical Logistic Regression Models for Predicting Subsequent College Success for Students Who Did/Did Not Take Developmental Reading before First Social Science Course

Outcome		Variance Component	
Type	Level	Intercept	Standard Error
Success in First Social Science Course	C or Higher	0.1294	0.0364
	B or Higher	0.1201	0.0314
GPA Year 1 (or Last GPA)	2.0 or Higher	0.0670	0.0199
	3.0 or Higher	0.0760	0.0225
GPA Year 2	2.0 or Higher	0.1122	0.0342
	3.0 or Higher	0.0528	0.0174
GPA Year 3	2.0 or Higher	0.0256	0.0134
	3.0 or Higher	0.0199	0.0088
Return Fall, Any Inst.	Year 2	0.0185	0.0064
	Year 3	0.0115	0.0043
Progress to Degree	Year 2	0.0220	0.0077
Certificate within . . .	4 Years	0.1732	0.0642
	5 Years	0.1571	0.0601
	6 Years	0.1782	0.0684
Associate's Degree within . . .	4 Years	0.0226	0.0072
	5 Years	0.0217	0.0074
	6 Years	0.0196	0.0072
Associate's/Bachelor's Degree within . . .	4 Years	0.0202	0.0066
	5 Years	0.0173	0.0062
	6 Years	0.0176	0.0066

Table C-20. Fixed Effects of Hierarchical Logistic Regression Models for Predicting Subsequent College Success for Students Who Took Developmental Reading (Grade Scale A–F) before First Social Science Course

Outcome			Institution-Level Effects				
					Prop. FT and Age ≤ 21 Vs.		
Type	Level	Intercept	Mean ACT Compass Reading Score	Mean Developmental Course Grade	Prop. PT and Age ≤ 21	Prop. Age 22–25	Prop. Age > 25
Success in First Social Science Course	C or Higher	0.18	0.04	-0.19	0.10	2.12	-0.56
	B or Higher	-0.90	<0.01	-0.12	0.56	0.35	-0.33
GPA Year 1 (or Last GPA)	2.0 or Higher	0.71	0.03	-0.43	-0.59	6.83	-4.07
	3.0 or Higher	-1.04	0.05	-0.46	0.69	5.28	-0.13
GPA Year 2	2.0 or Higher	1.17	0.06	-0.84	0.30	0.12	0.39
	3.0 or Higher	-1.29	0.03	-1.22	0.99	1.16	3.11
GPA Year 3	2.0 or Higher	1.39	<0.01	-0.63	0.23	0.14	-0.35
	3.0 or Higher	-1.39	0.01	-1.12	0.10	1.43	2.82
Return Fall, Any Inst.	Year 2	0.77	0.08	-0.37	-0.05	4.34	3.49
	Year 3	-0.41	0.08	-0.40	0.98	4.47	2.56
Progress to Degree	Year 2	-1.44	0.05	-0.60	-0.75	2.81	-4.99
Certificate within . . .	4 Years	-2.19	0.03	-0.28	-4.16	1.23	-2.47
	5 Years	-2.00	0.03	-0.17	-3.39	-0.92	-1.78
	6 Years	-1.91	0.02	-0.04	-3.40	-1.55	-2.79
Associate's Degree within . . .	4 Years	-2.12	0.07	-0.74	0.25	4.69	-3.70
	5 Years	-1.70	0.04	-0.57	0.91	2.21	-1.48
	6 Years	-1.53	0.04	-0.57	1.55	-0.02	-0.17
Associate's/Bachelor's Degree within . . .	4 Years	-2.12	0.07	-0.74	0.29	4.72	-3.71
	5 Years	-1.68	0.04	-0.58	0.95	2.24	-1.38
	6 Years	-1.47	0.05	-0.59	1.66	0.53	-0.46

Table C-20. (continued)

Outcome		Student-Level Effects								
								Developmental Course Taken Interaction with		
					Prop. FT and Age ≤ 21 Vs.					
Type	Level	ACT Compass Reading Score	Prop. Score	Developmental Course Grade	PT and Age ≤ 21	Age 22–25	Age > 25	PT and Age ≤ 21	Age 22–25	Age > 25
Success in First Social Science Course	C or Higher	0.01	-1.39	0.49	-0.89	-0.84	-0.75	0.04	-0.10	0.05
	B or Higher	0.01	-1.74	0.52	-0.53	-0.38	-0.37	0.04	0.09	0.16
GPA Year 1 (or Last GPA)	2.0 or Higher	<0.01	-1.33	0.62	-0.85	-0.71	-0.49	0.13	0.02	0.32
	3.0 or Higher	<0.01	-1.15	0.75	-0.31	-0.15	-0.05	-0.28	-0.23	<0.01
GPA Year 2	2.0 or Higher	<0.01	-1.77	0.64	-0.70	-0.20	-0.02	-0.08	-0.12	-0.13
	3.0 or Higher	0.01	-2.13	0.76	-0.94	-0.49	-0.16	0.14	0.27	0.33
GPA Year 3	2.0 or Higher	<0.01	-1.84	0.59	-0.88	-0.34	-0.21	0.10	-0.07	-0.07
	3.0 or Higher	0.01	-2.99	0.84	-0.62	-0.24	0.06	0.28	0.30	0.59
Return Fall, Any Inst.	Year 2	-0.01	-0.79	0.43	-1.31	-1.45	-1.30	0.08	0.18	0.29
	Year 3	-0.01	-0.85	0.45	-1.19	-1.15	-1.01	0.09	0.02	0.21
Progress to Degree	Year 2	<0.01	-2.67	0.51	-2.61	-2.76	-2.54	0.33	0.27	0.42
Certificate within . . .	4 Years	<0.01	0.62	0.28	-1.06	-0.66	-1.00	0.25	0.24	0.33
	5 Years	<0.01	1.02	0.30	-1.01	-0.57	-0.95	0.35	0.33	0.35
	6 Years	<0.01	0.65	0.26	-0.84	-0.67	-0.66	0.41	0.43	0.46
Associate's Degree within . . .	4 Years	0.01	-1.05	0.60	-1.57	-1.69	-1.39	0.31	-0.09	0.22
	5 Years	<0.01	-0.86	0.57	-1.36	-1.37	-1.39	0.29	-0.09	0.35
	6 Years	<0.01	-0.83	0.61	-1.22	-1.03	-1.11	0.10	-0.18	0.14
Associate's/Bachelor's Degree within . . .	4 Years	0.01	-1.08	0.60	-1.58	-1.71	-1.41	0.32	-0.09	0.22
	5 Years	<0.01	-1.00	0.57	-1.42	-1.45	-1.45	0.32	-0.08	0.38
	6 Years	0.01	-1.19	0.63	-1.28	-1.12	-1.17	0.06	-0.23	0.16

Table C-21. Variance Components of Hierarchical Logistic Regression Models for Predicting Subsequent College Success for Students Who Took Developmental Reading (Grade Scale A–F) before First Social Science Course

Outcome		Variance Component	
Type	Level	Intercept	Standard Error
Success in First Social Science Course	C or Higher	0.2191	0.0757
	B or Higher	0.2015	0.0702
GPA Year 1 (or Last GPA)	2.0 or Higher	0.3870	0.1357
	3.0 or Higher	0.4087	0.1458
GPA Year 2	2.0 or Higher	0.2360	0.1124
	3.0 or Higher	0.2621	0.1053
GPA Year 3	2.0 or Higher	0.0705	0.0517
	3.0 or Higher	0.0680	0.0506
Return Fall, Any Inst.	Year 2	0.2453	0.0976
	Year 3	0.1906	0.0809
Progress to Degree	Year 2	0.1111	0.0544
Certificate within . . .	4 Years	0.3508	0.1388
	5 Years	0.2804	0.1184
	6 Years	0.2380	0.1145
Associate's Degree within . . .	4 Years	0.1421	0.0655
	5 Years	0.0743	0.0480
	6 Years	0.1076	0.0635
Associate's/Bachelor's Degree within . . .	4 Years	0.1426	0.0655
	5 Years	0.0617	0.0434
	6 Years	0.1039	0.0653

Appendix D

Differences in Estimated Probabilities of Success for All Students and by Developmental Course Grade

Tables D-1 through D-5

Note: Shaded cells correspond to course grade regression coefficients (main effects and interactions) that are not statistically significantly different from zero ($p > .01$). Percentiles (Pctl.) correspond to the 5th and 95th percentiles of the associated ACT Compass scores of students who took the lower-level course.

Table D-1. Differences between Estimated Probabilities of Longer-Term College Outcomes for Students Who Enrolled in Developmental English Composition/Standard English Composition and Those Who Enrolled in Only Standard English Composition, for All Students and by Developmental English Composition Grade

Outcome		Difference between Probability Associated with Lower-Level Course and Probability Associated with Higher-Level Course											
		All Students in Lower-Level Course			Students with an A Grade in Lower-Level Course			Students with a B Grade in Lower-Level Course			Students with a C Grade in Lower-Level Course		
Type	Level	5th Pctl.	Median	95th Pctl.	5th Pctl.	Median	95th Pctl.	5th Pctl.	Median	95th Pctl.	5th Pctl.	Median	95th Pctl.
Success in Standard English Composition	C or Higher	0.13	0.10	0.08	0.12	0.08	0.06	0.03	-0.02	-0.05	-0.07	-0.14	-0.18
	B or Higher	0.15	0.11	0.08	0.17	0.13	0.10	0.06	-0.01	-0.06	-0.04	-0.13	-0.19
GPA Year 1 (or Last GPA)	2.0 or Higher	0.12	0.07	0.04	0.17	0.13	0.11	0.10	0.04	0.00	0.02	-0.08	-0.14
	3.0 or Higher	0.11	0.05	0.00	0.23	0.18	0.14	0.13	0.03	-0.04	0.04	-0.09	-0.18
GPA Year 2	2.0 or Higher	0.15	0.09	0.06	0.11	0.07	0.05	0.04	-0.01	-0.04	-0.05	-0.12	-0.16
	3.0 or Higher	0.13	0.10	0.06	0.17	0.15	0.11	0.07	-0.02	-0.11	-0.01	-0.14	-0.25
GPA Year 3	2.0 or Higher	0.09	0.06	0.04	0.10	0.05	0.03	0.02	-0.02	-0.04	-0.08	-0.11	-0.12
	3.0 or Higher	0.15	0.11	0.06	0.16	0.13	0.09	0.08	-0.01	-0.10	0.02	-0.11	-0.22
Return Fall, Any Inst.	Year 2	0.11	0.05	0.01	0.20	0.10	0.02	0.14	0.05	-0.02	0.07	0.00	-0.06
	Year 3	0.11	0.06	0.03	0.22	0.10	0.03	0.11	0.02	-0.03	0.00	-0.06	-0.09
Progress to Degree	Year 2	0.09	0.07	0.06	0.02	-0.02	-0.05	-0.06	-0.09	-0.11	-0.13	-0.15	-0.17
Certificate within . . .	4 Years	-0.03	-0.02	-0.01	0.04	0.02	0.01	-0.01	-0.01	-0.01	-0.04	-0.03	-0.02
	5 Years	-0.08	-0.04	-0.02	0.03	0.02	0.02	-0.05	-0.02	0.00	-0.10	-0.05	-0.02
	6 Years	-0.11	-0.06	-0.02	0.01	0.02	0.02	-0.09	-0.03	0.00	-0.15	-0.07	-0.02
Associate's Degree within . . .	4 Years	0.02	0.03	0.03	0.05	0.02	-0.01	0.00	-0.03	-0.05	-0.04	-0.06	-0.08
	5 Years	0.05	0.04	0.04	0.08	0.02	-0.02	0.01	-0.03	-0.05	-0.04	-0.06	-0.08
	6 Years	0.02	0.03	0.03	0.05	0.01	-0.01	-0.01	-0.04	-0.06	-0.06	-0.08	-0.09
Associate's/Bachelor's Degree within . . .	4 Years	0.03	0.03	0.03	0.05	0.02	-0.01	0.00	-0.03	-0.05	-0.03	-0.06	-0.08
	5 Years	0.07	0.06	0.05	0.09	0.02	-0.02	0.02	-0.03	-0.06	-0.04	-0.07	-0.10
	6 Years	0.05	0.05	0.05	0.07	0.02	-0.02	0.00	-0.04	-0.06	-0.05	-0.08	-0.10

Table D-2. Differences between Estimated Probabilities of Longer-Term College Outcomes for Students Who Enrolled in Arithmetic/ Elementary Algebra and Those Who Enrolled in Only Elementary Algebra, for All Students and by Arithmetic Grade

Outcome		Difference between Probability Associated with Lower-Level Course and Probability Associated with Higher-Level Course											
		All Students in Lower-Level Course			Students with an A Grade in Lower-Level Course			Students with a B Grade in Lower-Level Course			Students with a C Grade in Lower-Level Course		
Type	Level	5th Pctl.	Median	95th Pctl.	5th Pctl.	Median	95th Pctl.	5th Pctl.	Median	95th Pctl.	5th Pctl.	Median	95th Pctl.
Success in Elementary Algebra	C or Higher	-0.02	-0.02	-0.02	0.25	0.23	0.19	0.10	0.09	0.06	-0.06	-0.07	-0.09
	B or Higher	0.01	0.01	0.01	0.23	0.23	0.22	0.04	0.03	0.02	-0.10	-0.13	-0.17
GPA Year 1 (or Last GPA)	2.0 or Higher	-0.12	-0.11	-0.11	0.13	0.10	0.06	0.06	0.04	-0.01	-0.02	-0.04	-0.09
	3.0 or Higher	-0.07	-0.07	-0.08	0.19	0.15	0.09	0.05	0.02	-0.05	-0.07	-0.10	-0.16
GPA Year 2	2.0 or Higher	0.01	0.01	0.01	0.11	0.10	0.07	0.03	0.02	0.01	-0.07	-0.08	-0.09
	3.0 or Higher	0.00	0.00	0.00	0.19	0.16	0.08	0.04	0.00	-0.08	-0.09	-0.12	-0.20
GPA Year 3	2.0 or Higher	0.01	0.01	0.01	0.11	0.08	0.04	0.05	0.03	-0.01	-0.02	-0.05	-0.09
	3.0 or Higher	0.00	0.00	0.00	0.16	0.14	0.11	0.02	0.00	-0.04	-0.09	-0.12	-0.17
Return Fall, Any Inst.	Year 2	-0.15	-0.15	-0.15	0.09	0.08	0.05	0.06	0.05	0.01	0.03	0.01	-0.02
	Year 3	-0.09	-0.09	-0.09	0.15	0.12	0.09	0.08	0.06	0.02	0.02	0.00	-0.04
Progress to Degree	Year 2	-0.01	-0.01	-0.01	0.07	0.07	0.07	0.03	0.03	0.03	-0.01	-0.01	-0.02
Certificate within . . .	4 Years	-0.01	-0.01	-0.01	0.04	0.05	0.06	0.02	0.02	0.03	0.00	0.00	0.00
	5 Years	0.00	0.01	0.00	0.05	0.04	0.03	0.03	0.02	0.01	0.01	0.01	0.00
	6 Years	-0.02	-0.02	-0.02	0.05	0.04	0.02	0.03	0.02	0.00	0.01	0.00	-0.02
Associate's Degree within . . .	4 Years	0.00	0.00	0.00	0.05	0.06	0.08	0.01	0.01	0.02	-0.02	-0.02	-0.03
	5 Years	0.00	0.00	-0.01	0.10	0.08	0.06	0.04	0.03	0.00	-0.01	-0.02	-0.04
	6 Years	0.00	0.00	0.00	0.10	0.09	0.06	0.04	0.03	0.01	0.00	-0.01	-0.03
Associate's/Bachelor's Degree within . . .	4 Years	0.00	0.00	0.00	0.05	0.06	0.07	0.01	0.01	0.01	-0.02	-0.02	-0.03
	5 Years	0.00	0.00	0.00	0.10	0.09	0.06	0.04	0.03	0.00	-0.01	-0.02	-0.05
	6 Years	0.00	0.00	0.00	0.10	0.09	0.07	0.05	0.03	0.01	0.00	-0.01	-0.03

Table D-3. Differences between Estimated Probabilities of Longer-Term College Outcomes for Students Who Enrolled in Elementary Algebra/Intermediate Algebra and Those Who Enrolled in Only Intermediate Algebra, for All Students and by Elementary Algebra Grade

Outcome		Difference between Probability Associated with Lower-Level Course and Probability Associated with Higher-Level Course											
		All Students in Lower-Level Course			Students with an A Grade in Lower-Level Course			Students with a B Grade in Lower-Level Course			Students with a C Grade in Lower-Level Course		
Type	Level	5th Pctl.	Median	95th Pctl.	5th Pctl.	Median	95th Pctl.	5th Pctl.	Median	95th Pctl.	5th Pctl.	Median	95th Pctl.
Success in Intermediate Algebra	C or Higher	0.03	0.03	0.02	0.26	0.20	0.10	0.08	0.03	-0.07	-0.10	-0.16	-0.26
	B or Higher	0.04	0.04	0.05	0.25	0.22	0.12	0.04	-0.01	-0.11	-0.12	-0.17	-0.29
GPA Year 1 (or Last GPA)	2.0 or Higher	-0.07	-0.07	-0.06	0.10	0.08	0.04	0.03	0.01	-0.02	-0.05	-0.07	-0.11
	3.0 or Higher	-0.03	-0.03	-0.04	0.18	0.15	0.10	0.04	0.02	-0.04	-0.07	-0.10	-0.16
GPA Year 2	2.0 or Higher	0.01	0.01	0.01	0.10	0.07	0.03	0.04	0.02	-0.03	-0.03	-0.06	-0.10
	3.0 or Higher	0.00	0.00	0.00	0.20	0.19	0.16	0.03	0.02	-0.02	-0.09	-0.11	-0.17
GPA Year 3	2.0 or Higher	0.00	0.00	0.00	0.07	0.06	0.03	0.02	0.01	0.00	-0.06	-0.05	-0.05
	3.0 or Higher	0.01	0.01	0.01	0.21	0.21	0.17	0.04	0.02	-0.02	-0.09	-0.12	-0.19
Return Fall, Any Inst.	Year 2	-0.10	-0.10	-0.11	0.06	0.05	0.02	0.04	0.02	-0.03	0.00	-0.02	-0.07
	Year 3	-0.08	-0.08	-0.08	0.09	0.07	0.02	0.04	0.02	-0.03	-0.01	-0.03	-0.07
Progress to Degree	Year 2	-0.01	-0.01	-0.01	0.05	0.04	0.03	-0.01	-0.01	-0.02	-0.06	-0.06	-0.08
Certificate within . . .	4 Years	-0.02	-0.02	-0.02	0.07	0.05	0.02	0.04	0.02	-0.01	0.01	-0.01	-0.04
	5 Years	-0.02	-0.02	-0.02	0.06	0.04	0.01	0.03	0.01	-0.02	0.01	-0.01	-0.04
	6 Years	-0.02	-0.02	-0.02	0.07	0.05	0.01	0.05	0.03	-0.01	0.02	0.01	-0.02
Associate's Degree within . . .	4 Years	-0.01	-0.01	-0.01	0.08	0.07	0.05	0.02	0.01	-0.01	-0.02	-0.03	-0.06
	5 Years	-0.02	-0.03	-0.03	0.08	0.07	0.06	0.02	0.01	-0.01	-0.03	-0.04	-0.06
	6 Years	-0.01	-0.01	-0.02	0.08	0.07	0.05	0.03	0.02	0.00	-0.02	-0.03	-0.05
Associate's/Bachelor's Degree within . . .	4 Years	-0.01	-0.01	-0.01	0.08	0.07	0.05	0.02	0.01	-0.01	-0.02	-0.04	-0.06
	5 Years	-0.02	-0.03	-0.03	0.08	0.08	0.07	0.01	0.01	-0.01	-0.04	-0.05	-0.07
	6 Years	-0.01	-0.01	-0.01	0.08	0.07	0.05	0.02	0.01	-0.01	-0.03	-0.04	-0.06

Table D-4. Differences between Estimated Probabilities of Longer-Term College Outcomes for Students Who Enrolled in Intermediate Algebra/College Algebra and Those Who Enrolled in Only College Algebra, for All Students and by Intermediate Algebra Grade

Outcome		Difference between Probability Associated with Lower-Level Course and Probability Associated with Higher-Level Course											
		All Students in Lower-Level Course			Students with an A Grade in Lower-Level Course			Students with a B Grade in Lower-Level Course			Students with a C Grade in Lower-Level Course		
Type	Level	5th Pctl.	Median	95th Pctl.	5th Pctl.	Median	95th Pctl.	5th Pctl.	Median	95th Pctl.	5th Pctl.	Median	95th Pctl.
Success in College Algebra	C or Higher	-0.01	-0.01	-0.01	0.23	0.19	0.13	0.06	0.04	0.00	-0.12	-0.15	-0.18
	B or Higher	0.00	0.00	0.00	0.25	0.23	0.18	0.04	0.01	-0.04	-0.11	-0.16	-0.23
GPA Year 1 (or Last GPA)	2.0 or Higher	-0.05	-0.05	-0.05	0.06	0.06	0.05	0.01	0.00	-0.01	-0.07	-0.08	-0.09
	3.0 or Higher	-0.05	-0.05	-0.06	0.18	0.16	0.13	0.00	-0.02	-0.06	-0.15	-0.18	-0.22
GPA Year 2	2.0 or Higher	0.01	0.01	0.01	0.04	0.03	0.03	0.00	-0.01	-0.01	-0.07	-0.07	-0.08
	3.0 or Higher	0.01	0.01	0.01	0.16	0.15	0.13	-0.02	-0.03	-0.06	-0.17	-0.19	-0.22
GPA Year 3	2.0 or Higher	-0.01	-0.01	-0.01	0.02	0.02	0.02	-0.01	-0.01	-0.01	-0.04	-0.04	-0.04
	3.0 or Higher	0.02	0.02	0.02	0.14	0.14	0.14	-0.04	-0.04	-0.04	-0.17	-0.19	-0.21
Return Fall, Any Inst.	Year 2	-0.07	-0.07	-0.08	0.00	-0.01	-0.02	-0.01	-0.01	-0.03	-0.01	-0.02	-0.04
	Year 3	-0.08	-0.08	-0.08	0.02	0.00	-0.03	0.00	-0.02	-0.06	-0.03	-0.05	-0.08
Progress to Degree	Year 2	-0.09	-0.09	-0.09	0.02	-0.01	-0.05	-0.02	-0.05	-0.10	-0.07	-0.09	-0.14
Certificate within . . .	4 Years	-0.02	-0.02	-0.02	0.00	0.01	0.03	-0.02	-0.01	0.00	-0.04	-0.03	-0.02
	5 Years	-0.03	-0.03	-0.03	0.03	0.03	0.04	0.00	0.00	0.01	-0.02	-0.02	-0.01
	6 Years	-0.01	-0.01	-0.01	0.02	0.02	0.03	0.00	0.00	0.01	-0.02	-0.02	-0.01
Associate's Degree within . . .	4 Years	-0.05	-0.05	-0.05	0.07	0.05	0.02	0.00	-0.02	-0.05	-0.06	-0.08	-0.11
	5 Years	-0.05	-0.05	-0.05	0.10	0.06	0.00	0.03	-0.01	-0.06	-0.04	-0.07	-0.12
	6 Years	-0.06	-0.06	-0.06	0.09	0.05	-0.02	0.02	-0.02	-0.08	-0.04	-0.08	-0.14
Associate's/Bachelor's Degree within . . .	4 Years	-0.05	-0.05	-0.05	0.07	0.05	0.01	0.00	-0.02	-0.05	-0.07	-0.08	-0.11
	5 Years	-0.04	-0.04	-0.04	0.08	0.04	-0.01	0.01	-0.03	-0.08	-0.06	-0.09	-0.14
	6 Years	-0.06	-0.06	-0.06	0.06	0.03	-0.03	-0.01	-0.04	-0.10	-0.08	-0.12	-0.16

Table D-5. Differences between Estimated Probabilities of Longer-Term College Outcomes for Students Who Enrolled in Developmental Reading/First Social Science Course and Those Who Enrolled in Only First Social Science course, for All Students and by Developmental Reading Grade

Outcome		Difference between Probability Associated with Lower-Level Course and Probability Associated with Higher-Level Course											
		All Students in Lower-Level Course			Students with an A Grade in Lower-Level Course			Students with a B Grade in Lower-Level Course			Students with a C Grade in Lower-Level Course		
Type	Level	5th Pctl.	Median	95th Pctl.	5th Pctl.	Median	95th Pctl.	5th Pctl.	Median	95th Pctl.	5th Pctl.	Median	95th Pctl.
Success in First Social Science Course	C or Higher	0.16	0.12	0.10	0.19	0.12	0.09	0.07	0.01	-0.02	-0.05	-0.11	-0.14
	B or Higher	0.18	0.14	0.11	0.18	0.12	0.09	0.06	0.00	-0.03	-0.02	-0.10	-0.14
GPA Year 1 (or Last GPA)	2.0 or Higher	0.08	0.04	0.03	0.17	0.10	0.07	0.05	-0.02	-0.04	-0.09	-0.16	-0.19
	3.0 or Higher	0.14	0.07	0.03	0.25	0.17	0.12	0.08	-0.01	-0.05	-0.04	-0.13	-0.18
GPA Year 2	2.0 or Higher	0.12	0.08	0.06	0.13	0.07	0.05	0.02	-0.03	-0.05	-0.11	-0.17	-0.18
	3.0 or Higher	0.15	0.13	0.11	0.17	0.10	0.06	0.03	-0.05	-0.10	-0.06	-0.15	-0.20
GPA Year 3	2.0 or Higher	0.09	0.06	0.04	0.10	0.05	0.03	0.02	-0.03	-0.05	-0.10	-0.14	-0.16
	3.0 or Higher	0.19	0.15	0.12	0.20	0.12	0.08	0.04	-0.04	-0.09	-0.04	-0.14	-0.20
Return Fall, Any Inst.	Year 2	-0.02	-0.02	-0.02	0.11	0.07	0.05	0.03	-0.01	-0.04	-0.06	-0.11	-0.14
	Year 3	0.02	0.01	0.01	0.13	0.07	0.05	0.02	-0.04	-0.06	-0.09	-0.14	-0.16
Progress to Degree	Year 2	0.00	0.01	0.01	-0.05	-0.06	-0.07	-0.14	-0.16	-0.17	-0.21	-0.23	-0.24
Certificate within . . .	4 Years	-0.06	-0.03	-0.01	0.00	0.02	0.03	-0.03	-0.01	0.00	-0.05	-0.03	-0.02
	5 Years	-0.09	-0.04	-0.01	-0.01	0.03	0.04	-0.05	-0.01	0.00	-0.08	-0.04	-0.03
	6 Years	-0.05	-0.02	-0.01	0.02	0.03	0.03	-0.02	0.00	0.00	-0.05	-0.03	-0.03
Associate's Degree within . . .	4 Years	0.01	0.02	0.02	0.06	0.06	0.05	-0.01	-0.02	-0.03	-0.05	-0.07	-0.09
	5 Years	0.02	0.02	0.02	0.11	0.08	0.06	0.01	-0.02	-0.04	-0.05	-0.08	-0.10
	6 Years	-0.01	0.01	0.01	0.10	0.09	0.08	0.00	-0.02	-0.03	-0.08	-0.10	-0.11
Associate's/Bachelor's Degree within . . .	4 Years	0.02	0.02	0.02	0.07	0.06	0.05	0.00	-0.02	-0.03	-0.05	-0.07	-0.09
	5 Years	0.04	0.03	0.03	0.10	0.07	0.05	0.01	-0.03	-0.04	-0.05	-0.09	-0.11
	6 Years	0.00	0.02	0.03	0.10	0.08	0.07	-0.02	-0.04	-0.05	-0.09	-0.12	-0.14

Appendix E

Probabilities of Success for Students Who Did and Did Not Take Lower-Level Course in a Course Pair, by Enrollment Status and Age

Tables E-1 through E-5

Note: Non-statistically significant differences with full-time, age ≤ 21 students ($p > .01$) are shaded. Non-statistically significant interactions of dummy variables with course sequence taken ($p > .05$) are noted with superscript letters.

Table E-1. Probabilities of Success for Students Who Did and Did Not Take Developmental English Composition before Standard English Composition, by Enrollment Status and Age

Outcome						
Type	Level	Group	FT and Age ≤ 21	PT and Age ≤ 21	Age 22–25	Age > 25
Success in Standard English Composition	C or Higher	Took Standard English Composition Only	0.87	0.51	0.63	0.72
		Took Developmental English Composition and Standard English Composition	0.82	0.71	0.77	0.78
	B or Higher	Took Standard English Composition Only	0.67	0.34	0.50	0.62
		Took Developmental English Composition and Standard English Composition	0.62	0.50	0.60	0.65
GPA Year 1 (or Last GPA)	2.0 or Higher	Took Standard English Composition Only	0.88	0.53	0.73	0.81
		Took Developmental English Composition and Standard English Composition	0.80	0.69	0.79	0.83
	3.0 or Higher	Took Standard English Composition Only	0.52[c]	0.23	0.46	0.63[c]
		Took Developmental English Composition and Standard English Composition	0.42[c]	0.30	0.48	0.51[c]
GPA Year 2	2.0 or Higher	Took Standard English Composition Only	0.88[c]	0.66	0.86	0.93[c]
		Took Developmental English Composition and Standard English Composition	0.91[c]	0.80	0.90	0.93[c]
	3.0 or Higher	Took Standard English Composition Only	0.45[b]	0.23	0.49[b]	0.68
		Took Developmental English Composition and Standard English Composition	0.49[b]	0.31	0.53[b]	0.61
GPA Year 3	2.0 or Higher	Took Standard English Composition Only	0.92[b]	0.73	0.90[b]	0.95
		Took Developmental English Composition and Standard English Composition	0.93[b]	0.84	0.92[b]	0.93
	3.0 or Higher	Took Standard English Composition Only	0.43[b]	0.25	0.49[b]	0.68
		Took Developmental English Composition and Standard English Composition	0.48[b]	0.33	0.56[b]	0.61

Table E-1. (continued)

Outcome						
Type	Level	Group	FT and Age ≤ 21	PT and Age ≤ 21	Age 22–25	Age > 25
Return Fall, Any Inst.	Year 2	Took Standard English Composition Only	0.89	0.50	0.59	0.66
		Took Developmental English Composition and Standard English Composition	0.76	0.62	0.67	0.71
	Year 3	Took Standard English Composition Only	0.70	0.29	0.37	0.47
		Took Developmental English Composition and Standard English Composition	0.56	0.41	0.47	0.46
Progress to Degree	Year 2	Took Standard English Composition Only	0.74[a,c]	0.15[a]	0.26	0.31[c]
		Took Developmental English Composition and Standard English Composition	0.72[a,c]	0.23[a]	0.30	0.32[c]
Certificate within . . .	4 Years	Took Standard English Composition Only	0.18[a,c]	0.09[a]	0.14	0.15[c]
		Took Developmental English Composition and Standard English Composition	0.18[a,c]	0.08[a]	0.11	0.12[c]
	5 Years	Took Standard English Composition Only	0.20[a,c]	0.11[a]	0.17	0.19[c]
		Took Developmental English Composition and Standard English Composition	0.19[a,c]	0.09[a]	0.13	0.13[c]
	6 Years	Took Standard English Composition Only	0.21[a,c]	0.12[a]	0.18	0.22[c]
		Took Developmental English Composition and Standard English Composition	0.21[a,c]	0.11[a]	0.12	0.13[c]
Associate's Degree within . . .	4 Years	Took Standard English Composition Only	0.37[c]	0.08	0.15	0.20[c]
		Took Developmental English Composition and Standard English Composition	0.30[c]	0.13	0.17	0.17[c]
	5 Years	Took Standard English Composition Only	0.41[c]	0.10	0.18	0.26[c]
		Took Developmental English Composition and Standard English Composition	0.35[c]	0.17	0.20	0.20[c]
	6 Years	Took Standard English Composition Only	0.44[c]	0.12	0.19	0.30[c]
		Took Developmental English Composition and Standard English Composition	0.37[c]	0.19	0.26	0.22[c]
Associate's/Bachelor's Degree within . . .	4 Years	Took Standard English Composition Only	0.39[c]	0.08	0.15	0.20[c]
		Took Developmental English Composition and Standard English Composition	0.31[c]	0.13	0.18	0.17[c]
	5 Years	Took Standard English Composition Only	0.46[c]	0.10	0.19	0.27[c]
		Took Developmental English Composition and Standard English Composition	0.39[c]	0.18	0.22	0.22[c]
	6 Years	Took Standard English Composition Only	0.51[c]	0.13	0.20	0.30[c]
		Took Developmental English Composition and Standard English Composition	0.43[c]	0.22	0.28	0.24[c]

Table E-2. Probabilities of Success for Students Who Did and Did Not Take Arithmetic before Elementary Algebra, by Enrollment Status and Age

Outcome						
Type	Level	Group	FT and Age ≤ 21	PT and Age ≤ 21	Age 22–25	Age > 25
Success in Elementary Algebra	C or Higher	Took Elementary Algebra Only	0.75	0.48	0.48	0.53
		Took Arithmetic and Elementary Algebra	0.67	0.45	0.52	0.55
	B or Higher	Took Elementary Algebra Only	0.54	0.32	0.34	0.39
		Took Arithmetic and Elementary Algebra	0.46	0.33	0.38	0.45
GPA Year 1 (or Last GPA)	2.0 or Higher	Took Elementary Algebra Only	0.89	0.68	0.70	0.75
		Took Arithmetic and Elementary Algebra	0.67	0.55	0.68	0.76
	3.0 or Higher	Took Elementary Algebra Only	0.51	0.31	0.41	0.50
		Took Arithmetic and Elementary Algebra	0.26	0.25	0.38	0.49
GPA Year 2	2.0 or Higher	Took Elementary Algebra Only	0.87[c]	0.72	0.82	0.87[c]
		Took Arithmetic and Elementary Algebra	0.83[c]	0.74	0.88	0.88[c]
	3.0 or Higher	Took Elementary Algebra Only	0.38[b]	0.25	0.44[b]	0.50
		Took Arithmetic and Elementary Algebra	0.33[b]	0.26	0.43[b]	0.55
GPA Year 3	2.0 or Higher	Took Elementary Algebra Only	0.90[b,c]	0.76	0.88[b]	0.91[c]
		Took Arithmetic and Elementary Algebra	0.87[b,c]	0.80	0.88[b]	0.91[c]
	3.0 or Higher	Took Elementary Algebra Only	0.34[a,b,c]	0.25[a]	0.44[b]	0.52[c]
		Took Arithmetic and Elementary Algebra	0.31[a,b,c]	0.26[a]	0.43[b]	0.54[c]
Return Fall, Any Inst.	Year 2	Took Elementary Algebra Only	0.91	0.63	0.61	0.67
		Took Arithmetic and Elementary Algebra	0.72	0.48	0.52	0.58
	Year 3	Took Elementary Algebra Only	0.71	0.35	0.34	0.44
		Took Arithmetic and Elementary Algebra	0.48	0.26	0.33	0.40
Progress to Degree	Year 2	Took Elementary Algebra Only	0.70[c]	0.16	0.18	0.23[c]
		Took Arithmetic and Elementary Algebra	0.64[c]	0.15	0.20	0.23[c]
Certificate within . . .	4 Years	Took Elementary Algebra Only	0.21[a,b,c]	0.08[a]	0.10[b]	0.11[c]
		Took Arithmetic and Elementary Algebra	0.18[a,b,c]	0.07[a]	0.12[b]	0.10[c]
	5 Years	Took Elementary Algebra Only	0.22[a,b,c]	0.08[a]	0.12[b]	0.12[c]
		Took Arithmetic and Elementary Algebra	0.23[a,b,c]	0.08[a]	0.14[b]	0.12[c]
	6 Years	Took Elementary Algebra Only	0.25[a,b,c]	0.11[a]	0.15[b]	0.18[c]
		Took Arithmetic and Elementary Algebra	0.32[b,c]	0.09[a]	0.14[b]	0.15[c]
Associate's Degree within . . .	4 Years	Took Elementary Algebra Only	0.29[c]	0.07	0.09	0.12[c]
		Took Arithmetic and Elementary Algebra	0.21[c]	0.07	0.11	0.12[c]
	5 Years	Took Elementary Algebra Only	0.33[b,c]	0.10	0.11[b]	0.16[c]
		Took Arithmetic and Elementary Algebra	0.26[b,c]	0.11	0.12[b]	0.15[c]
	6 Years	Took Elementary Algebra Only	0.35[a,c]	0.11[a]	0.13	0.18[c]
		Took Arithmetic and Elementary Algebra	0.28[a,c]	0.11[a]	0.15	0.20[c]
Associate's/Bachelor's Degree within . . .	4 Years	Took Elementary Algebra Only	0.31	0.07	0.09	0.13
		Took Arithmetic and Elementary Algebra	0.22	0.08	0.11	0.12
	5 Years	Took Elementary Algebra Only	0.37[c]	0.11	0.11	0.17[c]
		Took Arithmetic and Elementary Algebra	0.28[c]	0.11	0.12	0.16[c]
	6 Years	Took Elementary Algebra Only	0.41[c]	0.12	0.13	0.20[c]
		Took Arithmetic and Elementary Algebra	0.32[c]	0.12	0.16	0.21[c]

Table E-3. Probabilities of Success for Students Who Did and Did Not Take Elementary Algebra before Intermediate Algebra, by Enrollment Status and Age

Outcome						
Type	Level	Group	FT and Age ≤ 21	PT and Age ≤ 21	Age 22–25	Age > 25
Success in Intermediate Algebra	C or Higher	Took Intermediate Algebra Only	0.75[b,c]	0.44	0.59[b]	0.61[c]
		Took Elementary Algebra and Intermediate Algebra	0.66[b,c]	0.52	0.58[b]	0.58[c]
	B or Higher	Took Intermediate Algebra Only	0.54[b,c]	0.29	0.46[b]	0.48[c]
		Took Elementary Algebra and Intermediate Algebra	0.48[b,c]	0.39	0.43[b]	0.47[c]
GPA Year 1 (or Last GPA)	2.0 or Higher	Took Intermediate Algebra Only	0.93	0.67	0.80	0.81
		Took Elementary Algebra and Intermediate Algebra	0.81	0.65	0.73	0.76
	3.0 or Higher	Took Intermediate Algebra Only	0.55	0.28	0.46	0.48
		Took Elementary Algebra and Intermediate Algebra	0.37	0.29	0.39	0.48
GPA Year 2	2.0 or Higher	Took Intermediate Algebra Only	0.93[b,c]	0.74	0.88[b]	0.91[c]
		Took Elementary Algebra and Intermediate Algebra	0.90[b,c]	0.79	0.86[b]	0.92[c]
	3.0 or Higher	Took Intermediate Algebra Only	0.49[c]	0.24	0.43	0.55[c]
		Took Elementary Algebra and Intermediate Algebra	0.40[c]	0.28	0.45	0.53[c]
GPA Year 3	2.0 or Higher	Took Intermediate Algebra Only	0.95[b]	0.80	0.92[b]	0.90
		Took Elementary Algebra and Intermediate Algebra	0.91[b]	0.83	0.90[b]	0.94
	3.0 or Higher	Took Intermediate Algebra Only	0.45[b,c]	0.25	0.43[b]	0.50[c]
		Took Elementary Algebra and Intermediate Algebra	0.40[b,c]	0.28	0.43[b]	0.52[c]
Return Fall, Any Inst.	Year 2	Took Intermediate Algebra Only	0.93[b,c]	0.65	0.75[b]	0.81[c]
		Took Elementary Algebra and Intermediate Algebra	0.82[b,c]	0.58	0.64[b]	0.64[c]
	Year 3	Took Intermediate Algebra Only	0.76[b,c]	0.39	0.53[b]	0.60[c]
		Took Elementary Algebra and Intermediate Algebra	0.56[b,c]	0.37	0.41[b]	0.47[c]
Progress to Degree	Year 2	Took Intermediate Algebra Only	0.78[b,c]	0.20	0.36[b]	0.45[c]
		Took Elementary Algebra and Intermediate Algebra	0.72[b,c]	0.21	0.32[b]	0.37[c]
Certificate within . . .	4 Years	Took Intermediate Algebra Only	0.19[a,b,c]	0.11[a]	0.14[b]	0.09[c]
		Took Elementary Algebra and Intermediate Algebra	0.17[a,b,c]	0.09[a]	0.12[b]	0.11[c]
	5 Years	Took Intermediate Algebra Only	0.21[a,b,c]	0.12[a]	0.17[b]	0.12[c]
		Took Elementary Algebra and Intermediate Algebra	0.22[a,b,c]	0.10[a]	0.15[b]	0.12[c]
	6 Years	Took Intermediate Algebra Only	0.23[a,b,c]	0.12[a]	0.19[b]	0.10[c]
		Took Elementary Algebra and Intermediate Algebra	0.23[a,b,c]	0.10[a]	0.14[b]	0.14[c]

Table E-3. (continued)

Outcome						
Type	Level	Group	FT and Age ≤ 21	PT and Age ≤ 21	Age 22–25	Age > 25
Associate's Degree within . . .	4 Years	Took Intermediate Algebra Only	0.39[b,c]	0.10	0.23[b]	0.33[c]
		Took Elementary Algebra and Intermediate Algebra	0.28[b,c]	0.11	0.16[b]	0.21[c]
	5 Years	Took Intermediate Algebra Only	0.46[b,c]	0.14	0.28[b]	0.41[c]
		Took Elementary Algebra and Intermediate Algebra	0.30[b,c]	0.15	0.20[b]	0.27[c]
	6 Years	Took Intermediate Algebra Only	0.47[b,c]	0.15	0.28[b]	0.37[c]
		Took Elementary Algebra and Intermediate Algebra	0.32[bc]	0.17	0.23[b]	0.29[c]
Associate's/Bachelor's Degree within . . .	4 Years	Took Intermediate Algebra Only	0.40[b,c]	0.10	0.23[b]	0.33[c]
		Took Elementary Algebra and Intermediate Algebra	0.29[b,c]	0.11	0.16[b]	0.21[c]
	5 Years	Took Intermediate Algebra Only	0.49[b,c]	0.14	0.29[b]	0.45[c]
		Took Elementary Algebra and Intermediate Algebra	0.35[b,c]	0.16	0.21[b]	0.28[c]
	6 Years	Took Intermediate Algebra Only	0.52[b,c]	0.16	0.29 [b]	0.41[c]
		Took Elementary Algebra and Intermediate Algebra	0.39[b,c]	0.19	0.26[b]	0.32[c]

Table E-4. Probabilities of Success for Students Who Did and Did Not Take Intermediate Algebra before College Algebra, by Enrollment Status and Age

Outcome						
Type	Level	Group	FT and Age ≤ 21	PT and Age ≤ 21	Age 22–25	Age > 25
Success in College Algebra	C or Higher	Took College Algebra Only	0.81	0.44	0.65	0.73
		Took Intermediate Algebra and College Algebra	0.74	0.53	0.68	0.75
	B or Higher	Took College Algebra Only	0.56	0.26	0.43	0.56
		Took Intermediate Algebra and College Algebra	0.48	0.33	0.46	0.59
GPA Year 1 (or Last GPA)	2.0 or Higher	Took College Algebra Only	0.95[c]	0.65	0.84	0.90[c]
		Took Intermediate Algebra and College Algebra	0.89[c]	0.69	0.84	0.87[c]
	3.0 or Higher	Took College Algebra Only	0.65[c]	0.27	0.57	0.79[c]
		Took Intermediate Algebra and College Algebra	0.51[c]	0.31	0.52	0.56[c]
GPA Year 2	2.0 or Higher	Took College Algebra Only	0.95[b,c]	0.74	0.90[b]	0.97[c]
		Took Intermediate Algebra and College Algebra	0.93[b,c]	0.84	0.91[b]	0.94[c]
	3.0 or Higher	Took College Algebra Only	0.59[b]	0.27	0.58[b]	0.81
		Took Intermediate Algebra and College Algebra	0.56[b]	0.35	0.57[b]	0.66
GPA Year 3	2.0 or Higher	Took College Algebra Only	0.96[b,c]	0.82	0.95[b]	0.97[c]
		Took Intermediate Algebra and College Algebra	0.95[b,c]	0.85	0.94[b]	0.95[c]
	3.0 or Higher	Took College Algebra Only	0.57[b,c]	0.29	0.60[b]	0.83[c]
		Took Intermediate Algebra and College Algebra	0.56[b,c]	0.36	0.62[b]	0.69[c]
Return Fall, Any Inst.	Year 2	Took College Algebra Only	0.94[c]	0.62	0.78	0.84[c]
		Took Intermediate Algebra and College Algebra	0.85[c]	0.63	0.70	0.69[c]
	Year 3	Took College Algebra Only	0.81[c]	0.40	0.58	0.73[c]
		Took Intermediate Algebra and College Algebra	0.67[c]	0.44	0.51	0.50[c]
Progress to Degree	Year 2	Took College Algebra Only	0.88[b,c]	0.28	0.60[b]	0.66[c]
		Took Intermediate Algebra and College Algebra	0.78[b,c]	0.28	0.45[b]	0.52[c]
Certificate within . . .	4 Years	Took College Algebra Only	0.17[b]	0.08	0.10[b]	0.13
		Took Intermediate Algebra and College Algebra	0.12[b]	0.08	0.09[b]	0.02
	5 Years	Took College Algebra Only	0.18[a,b]	0.10[a]	0.13[b]	0.20
		Took Intermediate Algebra and College Algebra	0.13[a,b]	0.09[a]	0.13[b]	0.03
	6 Years	Took College Algebra Only	0.15[a,b]	0.10[a]	0.10[b]	0.18
		Took Intermediate Algebra and College Algebra	0.16[a,b]	0.09[a]	0.16[b]	0.03

Table E-4. (continued)

Outcome						
Type	Level	Group	FT and Age ≤ 21	PT and Age ≤ 21	Age 22–25	Age > 25
Associate's Degree within . . .	4 Years	Took College Algebra Only	0.56[c]	0.16	0.34	0.47[c]
		Took Intermediate Algebra and College Algebra	0.41[c]	0.18	0.32	0.35[c]
	5 Years	Took College Algebra Only	0.59[c]	0.19	0.34	0.50[c]
		Took Intermediate Algebra and College Algebra	0.46[c]	0.22	0.36	0.38[c]
	6 Years	Took College Algebra Only	0.62[b,c]	0.22	0.38[b]	0.52[c]
		Took Intermediate Algebra and College Algebra	0.47[b,c]	0.24	0.35[b]	0.41[c]
Associate's/Bachelor's Degree within . . .	4 Years	Took College Algebra Only	0.58[c]	0.16	0.35	0.47[c]
		Took Intermediate Algebra and College Algebra	0.43[c]	0.18	0.33	0.37[c]
	5 Years	Took College Algebra Only	0.64[c]	0.20	0.37	0.55[c]
		Took Intermediate Algebra and College Algebra	0.52[c]	0.24	0.39	0.44[c]
	6 Years	Took College Algebra Only	0.70[b,c]	0.24	0.44[b]	0.58[c]
		Took Intermediate Algebra and College Algebra	0.56[b,c]	0.28	0.40[b]	0.48[c]

Table E-5. Probabilities of Success for Students Who Did and Did Not Take Developmental Reading before First Social Science Course, by Enrollment Status and Age

Outcome						
Type	Level	Group	FT and Age ≤ 21	PT and Age ≤ 21	Age 22–25	Age > 25
Success in First Social Science Course	C or Higher	Took First Social Science Course Only	0.80[c]	0.45	0.58	0.67[c]
		Took Developmental Reading and First Social Science Course	0.81[c]	0.64	0.68	0.70[c]
	B or Higher	Took First Social Science Course Only	0.53[b,c]	0.27	0.42[b]	0.52[c]
		Took Developmental Reading and First Social Science Course	0.56[b,c]	0.44	0.49[b]	0.51[c]
GPA Year 1 (or Last GPA)	2.0 or Higher	Took First Social Science Course Only	0.89[c]	0.55	0.72	0.80[c]
		Took Developmental Reading and First Social Science Course	0.85[c]	0.69	0.72	0.76[c]
	3.0 or Higher	Took First Social Science Course Only	0.51[b]	0.23	0.44[b]	0.57
		Took Developmental Reading and First Social Science Course	0.44[b]	0.34	0.39[b]	0.44
GPA Year 2	2.0 or Higher	Took First Social Science Course Only	0.89[b,c]	0.66	0.81[b]	0.89[c]
		Took Developmental Reading and First Social Science Course	0.91[b,c]	0.81	0.88[b]	0.91[c]
	3.0 or Higher	Took First Social Science Course Only	0.42[b]	0.21	0.42[b]	0.57
		Took Developmental Reading and First Social Science Course	0.51[b]	0.33	0.45[b]	0.55
GPA Year 3	2.0 or Higher	Took First Social Science Course Only	0.91[b,c]	0.73	0.87[b]	0.92[c]
		Took Developmental Reading and First Social Science Course	0.93[b,c]	0.83	0.90[b]	0.92[c]
	3.0 or Higher	Took First Social Science Course Only	0.38[b,c]	0.21	0.41[b]	0.55[c]
		Took Developmental Reading and First Social Science Course	0.47[b,c]	0.34	0.46[b]	0.58[c]
Return Fall, Any Inst.	Year 2	Took First Social Science Course Only	0.90[c]	0.53	0.61	0.68[c]
		Took Developmental Reading and First Social Science Course	0.85[c]	0.57	0.58	0.61[c]
	Year 3	Took First Social Science Course Only	0.72[c]	0.31	0.37	0.47[c]
		Took Developmental Reading and First Social Science Course	0.65[c]	0.37	0.41	0.43[c]
Progress to Degree	Year 2	Took First Social Science Course Only	0.78[a]	0.18[a]	0.29	0.35
		Took Developmental Reading and First Social Science Course	0.80[a]	0.20[a]	0.22	0.27
Certificate within . . .	4 Years	Took First Social Science Course Only	0.17[a]	0.09[a]	0.14	0.15
		Took Developmental Reading and First Social Science Course	0.19[a]	0.08[a]	0.11	0.08
	5 Years	Took First Social Science Course Only	0.19[a,b]	0.10[a]	0.16[b]	0.17
		Took Developmental Reading and First Social Science Course	0.20[a,b]	0.09[a]	0.12[b]	0.09
	6 Years	Took First Social Science Course Only	0.19[a,b,c]	0.11[a]	0.16[b]	0.18[c]
		Took Developmental Reading and First Social Science Course	0.20[a,b,c]	0.11[a]	0.11[b]	0.12[c]

Table E-5. (continued)

Outcome						
Type	Level	Group	FT and Age ≤ 21	PT and Age ≤ 21	Age 22–25	Age > 25
Associate's Degree within . . .	4 Years	Took First Social Science Course Only	0.38[b,c]	0.08	0.14[b]	0.19[c]
		Took Developmental Reading and First Social Science Course	0.36[b,c]	0.12	0.11[b]	0.15[c]
	5 Years	Took First Social Science Course Only	0.43[b]	0.11	0.17[b]	0.24
		Took Developmental Reading and First Social Science Course	0.40[b]	0.16	0.17[b]	0.17
	6 Years	Took First Social Science Course Only	0.46[b,c]	0.13	0.19[b]	0.27[c]
		Took Developmental Reading and First Social Science Course	0.42[b,c]	0.17	0.20[b]	0.20[c]
Associate's/Bachelor's Degree within . . .	4 Years	Took First Social Science Course Only	0.39[b,c]	0.08	0.14[b]	0.19[c]
		Took Developmental Reading and First Social Science Course	0.38[b,c]	0.12	0.12[b]	0.15[c]
	5 Years	Took First Social Science Course Only	0.47[b,c]	0.12	0.17[b]	0.25[c]
		Took Developmental Reading and First Social Science Course	0.45[b,c]	0.17	0.18[b]	0.18[c]
	6 Years	Took First Social Science Course Only	0.53[b,c]	0.14	0.20[b]	0.27[c]
		Took Developmental Reading and First Social Science Course	0.49[b,c]	0.20	0.23[b]	0.23[c]

Appendix F

Probabilities of Success for Students Who Did and Did Not Take Lower-Level Course in a Course Pair, by Enrollment Status, Age, and Lower-Level Course Grade

Tables F-1 through F-5

Note: Non-statistically significant differences with full-time, age ≤ 21 students ($p > .01$) are shaded. Non-statistically significant interactions of dummy variables with developmental course grade ($p > .05$) are noted with superscript letters.

Table F-1. Probabilities of Success in Standard English Composition for Students Who Did and Did Not Take Developmental English Composition, by Developmental English Composition Grade, Enrollment Status, and Age

Outcome						
Type	Level	Developmental English Composition Grade	FT and Age ≤ 21	PT and Age ≤ 21	Age 22–25	Age > 25
Success in Standard English Composition	C or Higher	A Grade	0.82	0.70	0.75	0.75
		B Grade	0.74	0.60	0.65	0.66
		C Grade	0.64	0.48	0.53	0.54
	B or Higher	A Grade	0.65	0.49	0.58	0.62
		B Grade	0.52	0.36	0.45	0.49
		C Grade	0.38	0.24	0.32	0.35
GPA Year 1 (or Last GPA)	2.0 or Higher	A Grade	0.86	0.77	0.85	0.87
		B Grade	0.79	0.67	0.77	0.81
		C Grade	0.69	0.55	0.66	0.71
	3.0 or Higher	A Grade	0.54	0.40	0.57	0.59
		B Grade	0.39	0.27	0.42	0.44
		C Grade	0.26	0.17	0.28	0.30
GPA Year 2	2.0 or Higher	A Grade	0.91	0.79	0.88	0.91
		B Grade	0.86	0.69	0.82	0.86
		C Grade	0.79	0.57	0.72	0.78
	3.0 or Higher	A Grade	0.56	0.32	0.53	0.59
		B Grade	0.37	0.18	0.34	0.39
		C Grade	0.21	0.09	0.19	0.23
GPA Year 3	2.0 or Higher	A Grade	0.93	0.84	0.92	0.92
		B Grade	0.88	0.76	0.87	0.87
		C Grade	0.82	0.65	0.80	0.80
	3.0 or Higher	A Grade	0.50	0.31	0.52	0.54
		B Grade	0.34	0.19	0.36	0.38
		C Grade	0.22	0.11	0.23	0.25

Table F-1. (continued)

Outcome						
Type	Level	Developmental English Composition Grade	FT and Age ≤ 21	PT and Age ≤ 21	Age 22–25	Age > 25
Return Fall, Any Inst.	Year 2	A Grade	0.85	0.75	0.77	0.82
		B Grade	0.81	0.70	0.72	0.77
		C Grade	0.77	0.64	0.67	0.72
	Year 3	A Grade	0.69	0.50	0.54	0.55
		B Grade	0.61	0.42	0.46	0.47
		C Grade	0.53	0.34	0.37	0.38
Progress to Degree	Year 2	A Grade	0.73	0.23	0.28	0.31
		B Grade	0.65	0.17	0.22	0.23
		C Grade	0.56	0.12	0.16	0.17
Certificate within . . .	4 Years	A Grade	0.29	0.13	0.16	0.18
		B Grade	0.24	0.10	0.13	0.15
		C Grade	0.20	0.08	0.11	0.12
	5 Years	A Grade	0.31	0.16	0.20	0.22
		B Grade	0.24	0.12	0.16	0.17
		C Grade	0.19	0.09	0.12	0.13
	6 Years	A Grade	0.29	0.18	0.20	0.22
		B Grade	0.23	0.13	0.15	0.16
		C Grade	0.17	0.10	0.11	0.12
Associate's Degree within . . .	4 Years	A Grade	0.35	0.13	0.15	0.15
		B Grade	0.26	0.09	0.10	0.10
		C Grade	0.19	0.06	0.07	0.07
	5 Years	A Grade	0.39	0.17	0.18	0.19
		B Grade	0.31	0.12	0.14	0.14
		C Grade	0.24	0.09	0.10	0.10
	6 Years	A Grade	0.41	0.18	0.23	0.20
		B Grade	0.33	0.14	0.18	0.15
		C Grade	0.26	0.10	0.13	0.11
Associate's/Bachelor's Degree within . . .	4 Years	A Grade	0.36	0.13	0.15	0.15
		B Grade	0.27	0.09	0.10	0.11
		C Grade	0.19	0.06	0.07	0.07
	5 Years	A Grade	0.42	0.17	0.18	0.20
		B Grade	0.33	0.12	0.13	0.14
		C Grade	0.25	0.09	0.10	0.10
	6 Years	A Grade	0.45	0.20	0.25	0.22
		B Grade	0.36	0.15	0.19	0.17
		C Grade	0.28	0.11	0.14	0.12

Table F-2. Probabilities of Success in Elementary Algebra for Students Who Did and Did Not Take Arithmetic, by Arithmetic Grade, Enrollment Status, and Age

Outcome						
Type	Level	Arithmetic Grade	FT and Age ≤ 21	PT and Age ≤ 21	Age 22–25	Age > 25
Success in Elementary Algebra	C or Higher	A Grade	0.82	0.68	0.73	0.72
		B Grade	0.71	0.53	0.58	0.57
		C Grade	0.56	0.38	0.43	0.41
	B or Higher	A Grade	0.61	0.53	0.56	0.61
		B Grade	0.41	0.33	0.36	0.41
		C Grade	0.23	0.18	0.20	0.23
GPA Year 1 (or Last GPA)	2.0 or Higher	A Grade	0.85	0.78	0.84	0.88
		B Grade	0.79	0.70	0.78	0.83
		C Grade	0.71	0.61	0.71	0.77
	3.0 or Higher	A Grade	0.47	0.45	0.57	0.66
		B Grade	0.33	0.32	0.43	0.53
		C Grade	0.22	0.22	0.30	0.40
GPA Year 2	2.0 or Higher	A Grade	0.89	0.84	0.92	0.92
		B Grade	0.83	0.75	0.87	0.86
		C Grade	0.73	0.63	0.80	0.78
	3.0 or Higher	A Grade	0.47	0.38	0.51	0.64
		B Grade	0.31	0.24	0.35	0.47
		C Grade	0.18	0.14	0.21	0.31
GPA Year 3	2.0 or Higher	A Grade	0.92	0.87	0.93	0.94
		B Grade	0.87	0.81	0.88	0.90
		C Grade	0.80	0.72	0.82	0.84
	3.0 or Higher	A Grade	0.42	0.37	0.54	0.63
		B Grade	0.27	0.23	0.38	0.47
		C Grade	0.17	0.14	0.24	0.32
Return Fall, Any Inst.	Year 2	A Grade	0.87	0.71	0.73	0.78
		B Grade	0.85	0.68	0.70	0.75
		C Grade	0.83	0.65	0.66	0.72
	Year 3	A Grade	0.68	0.45	0.53	0.58
		B Grade	0.62	0.39	0.47	0.52
		C Grade	0.55	0.33	0.40	0.46
Progress to Degree	Year 2	A Grade	0.66	0.19	0.27	0.31
		B Grade	0.61	0.16	0.23	0.27
		C Grade	0.55	0.13	0.19	0.23

Table F-2. (continued)

Outcome						
Type	Level	Arithmetic Grade	FT and Age ≤ 21	PT and Age ≤ 21	Age 22–25	Age > 25
Certificate within . . .	4 Years	A Grade	0.23	0.12	0.17	0.15
		B Grade	0.19	0.09	0.14	0.12
		C Grade	0.15	0.07	0.11	0.10
	5 Years	A Grade	0.28	0.11	0.18	0.15
		B Grade	0.25	0.10	0.16	0.13
		C Grade	0.22	0.08	0.14	0.12
	6 Years	A Grade	0.44	0.13	0.19	0.20
		B Grade	0.40	0.12	0.16	0.17
		C Grade	0.37	0.10	0.14	0.15
Associate's Degree within . . .	4 Years	A Grade	0.29	0.12	0.16	0.17
		B Grade	0.21	0.08	0.11	0.11
		C Grade	0.15	0.05	0.07	0.08
	5 Years	A Grade	0.36	0.17	0.17	0.23
		B Grade	0.27	0.12	0.12	0.17
		C Grade	0.20	0.08	0.09	0.12
	6 Years	A Grade	0.38	0.17	0.21	0.27
		B Grade	0.30	0.13	0.16	0.21
		C Grade	0.24	0.10	0.12	0.16
Associate's/Bachelor's Degree within . . .	4 Years	A Grade	0.30	0.12	0.16	0.17
		B Grade	0.21	0.08	0.11	0.12
		C Grade	0.15	0.05	0.07	0.08
	5 Years	A Grade	0.38	0.18	0.18	0.24
		B Grade	0.29	0.13	0.13	0.17
		C Grade	0.21	0.09	0.09	0.12
	6 Years	A Grade	0.41	0.19	0.22	0.29
		B Grade	0.33	0.14	0.17	0.22
		C Grade	0.26	0.10	0.12	0.17

Table F-3. Probabilities of Success in Intermediate Algebra for Students Who Did and Did Not Take Elementary Algebra, by Elementary Algebra Grade, Enrollment Status, and Age

Outcome						
Type	Level	Elementary Algebra Grade	FT and Age ≤ 21	PT and Age ≤ 21	Age 22–25	Age > 25
Success in Intermediate Algebra	C or Higher	A Grade	0.80	0.69	0.72	0.72
		B Grade	0.65	0.51	0.55	0.55
		C Grade	0.46	0.33	0.36	0.36
	B or Higher	A Grade	0.62	0.54	0.57	0.59
		B Grade	0.39	0.32	0.34	0.36
		C Grade	0.20	0.16	0.17	0.18
GPA Year 1 (or Last GPA)	2.0 or Higher	A Grade	0.90	0.81	0.86	0.87
		B Grade	0.86	0.74	0.79	0.81
		C Grade	0.80	0.65	0.72	0.74
	3.0 or Higher	A Grade	0.55	0.45	0.56	0.63
		B Grade	0.42	0.32	0.42	0.50
		C Grade	0.29	0.21	0.30	0.36
GPA Year 2	2.0 or Higher	A Grade	0.94	0.86	0.91	0.95
		B Grade	0.90	0.80	0.86	0.92
		C Grade	0.85	0.71	0.79	0.87
	3.0 or Higher	A Grade	0.57	0.44	0.62	0.67
		B Grade	0.39	0.28	0.45	0.50
		C Grade	0.24	0.16	0.29	0.33
GPA Year 3	2.0 or Higher	A Grade	0.94	0.89	0.94	0.96
		B Grade	0.91	0.84	0.90	0.94
		C Grade	0.87	0.76	0.85	0.90
	3.0 or Higher	A Grade	0.58	0.45	0.61	0.67
		B Grade	0.39	0.27	0.42	0.48
		C Grade	0.23	0.15	0.25	0.30
Return Fall, Any Inst.	Year 2	A Grade	0.90	0.78	0.81	0.81
		B Grade	0.88	0.74	0.78	0.78
		C Grade	0.86	0.70	0.74	0.74
	Year 3	A Grade	0.70	0.53	0.56	0.62
		B Grade	0.65	0.48	0.51	0.57
		C Grade	0.60	0.43	0.46	0.52
Progress to Degree	Year 2	A Grade	0.79	0.28	0.39	0.43
		B Grade	0.74	0.23	0.33	0.37
		C Grade	0.69	0.19	0.28	0.31

Table F-3. (continued)

Outcome						
Type	Level	Elementary Algebra Grade	FT and Age ≤ 21	PT and Age ≤ 21	Age 22–25	Age > 25
Certificate within . . .	4 Years	A Grade	0.26	0.15	0.19	0.18
		B Grade	0.22	0.12	0.16	0.14
		C Grade	0.18	0.10	0.12	0.11
	5 Years	A Grade	0.31	0.16	0.21	0.18
		B Grade	0.28	0.13	0.18	0.15
		C Grade	0.24	0.11	0.16	0.13
	6 Years	A Grade	0.31	0.17	0.22	0.21
		B Grade	0.27	0.15	0.19	0.18
		C Grade	0.24	0.13	0.17	0.16
Associate's Degree within . . .	4 Years	A Grade	0.41	0.18	0.24	0.29
		B Grade	0.32	0.13	0.18	0.22
		C Grade	0.25	0.10	0.13	0.16
	5 Years	A Grade	0.43	0.25	0.29	0.35
		B Grade	0.36	0.19	0.23	0.29
		C Grade	0.29	0.15	0.18	0.23
	6 Years	A Grade	0.43	0.25	0.32	0.37
		B Grade	0.36	0.21	0.27	0.31
		C Grade	0.30	0.16	0.22	0.26
Associate's/Bachelor's Degree within . . .	4 Years	A Grade	0.43	0.19	0.25	0.30
		B Grade	0.34	0.13	0.18	0.23
		C Grade	0.26	0.10	0.13	0.17
	5 Years	A Grade	0.49	0.25	0.31	0.38
		B Grade	0.40	0.19	0.24	0.30
		C Grade	0.32	0.14	0.18	0.23
	6 Years	A Grade	0.49	0.27	0.34	0.40
		B Grade	0.42	0.21	0.28	0.33
		C Grade	0.34	0.17	0.22	0.27

Table F-4. Probabilities of Success in College Algebra for Students Who Did and Did Not Take Intermediate Algebra, by Intermediate Algebra Grade, Enrollment Status, and Age

Outcome						
Type	Level	Intermediate Algebra Grade	FT and Age ≤ 21	PT and Age ≤ 21	Age 22–25	Age > 25
Success in College Algebra	C or Higher	A Grade	0.87	0.71	0.76	0.82
		B Grade	0.75	0.54	0.60	0.69
		C Grade	0.59	0.36	0.42	0.51
	B or Higher	A Grade	0.66	0.49	0.55	0.70
		B Grade	0.43	0.28	0.33	0.48
		C Grade	0.23	0.13	0.16	0.27
GPA Year 1 (or Last GPA)	2.0 or Higher	A Grade	0.97	0.86	0.93	0.92
		B Grade	0.94	0.78	0.88	0.87
		C Grade	0.90	0.67	0.81	0.79
	3.0 or Higher	A Grade	0.72	0.51	0.65	0.66
		B Grade	0.55	0.33	0.48	0.48
		C Grade	0.37	0.19	0.30	0.31
GPA Year 2	2.0 or Higher	A Grade	0.97	0.90	0.93	0.95
		B Grade	0.94	0.83	0.89	0.92
		C Grade	0.90	0.75	0.83	0.87
	3.0 or Higher	A Grade	0.71	0.47	0.65	0.68
		B Grade	0.54	0.30	0.47	0.51
		C Grade	0.36	0.17	0.30	0.33
GPA Year 3	2.0 or Higher	A Grade	0.98	0.91	0.96	0.95
		B Grade	0.97	0.87	0.94	0.92
		C Grade	0.95	0.81	0.91	0.89
	3.0 or Higher	A Grade	0.68	0.47	0.66	0.72
		B Grade	0.51	0.30	0.48	0.56
		C Grade	0.33	0.17	0.31	0.38
Return Fall, Any Inst.	Year 2	A Grade	0.91	0.77	0.80	0.79
		B Grade	0.90	0.76	0.79	0.78
		C Grade	0.90	0.76	0.78	0.77
	Year 3	A Grade	0.77	0.57	0.59	0.56
		B Grade	0.75	0.55	0.57	0.53
		C Grade	0.73	0.52	0.54	0.50
Progress to Degree	Year 2	A Grade	0.87	0.44	0.59	0.62
		B Grade	0.85	0.39	0.54	0.57
		C Grade	0.82	0.35	0.50	0.53

Table F-4. (continued)

Outcome						
Type	Level	Intermediate Algebra Grade	FT and Age ≤ 21	PT and Age ≤ 21	Age 22–25	Age > 25
Certificate within . . .	4 Years	A Grade	0.16	0.13	0.13	0.03
		B Grade	0.12	0.10	0.10	0.02
		C Grade	0.10	0.08	0.08	0.02
	5 Years	A Grade	0.20	0.15	0.22	0.05
		B Grade	0.17	0.12	0.18	0.04
		C Grade	0.14	0.10	0.15	0.03
	6 Years	A Grade	0.22	0.12	0.22	0.05
		B Grade	0.19	0.10	0.18	0.04
		C Grade	0.16	0.09	0.15	0.03
Associate's Degree within . . .	4 Years	A Grade	0.56	0.28	0.42	0.45
		B Grade	0.49	0.22	0.35	0.38
		C Grade	0.42	0.17	0.28	0.32
	5 Years	A Grade	0.60	0.32	0.47	0.47
		B Grade	0.53	0.27	0.40	0.40
		C Grade	0.46	0.21	0.33	0.33
	6 Years	A Grade	0.61	0.35	0.47	0.50
		B Grade	0.54	0.30	0.41	0.44
		C Grade	0.48	0.24	0.35	0.37
Associate's/Bachelor's Degree within . . .	4 Years	A Grade	0.57	0.27	0.41	0.47
		B Grade	0.50	0.22	0.34	0.40
		C Grade	0.43	0.17	0.28	0.33
	5 Years	A Grade	0.63	0.34	0.48	0.52
		B Grade	0.56	0.28	0.41	0.45
		C Grade	0.49	0.22	0.34	0.38
	6 Years	A Grade	0.68	0.40	0.49	0.56
		B Grade	0.61	0.33	0.42	0.49
		C Grade	0.54	0.27	0.35	0.42

Table F-5. Probabilities of Success in First Social Science Course for Students Who Did and Did Not Take Developmental Reading, by Developmental Reading Grade, Enrollment Status, and Age

Outcome						
Type	Level	Developmental Reading Grade	FT and Age ≤ 21	PT and Age ≤ 21	Age 22–25	Age > 25
Success in First Social Science Course	C or Higher	A Grade	0.82[a,b,c]	0.66[a]	0.63[b]	0.69[c]
		B Grade	0.73[a,b,c]	0.53[a]	0.54[b]	0.57[c]
		C Grade	0.63[a,b,c]	0.41[a]	0.45[b]	0.44[c]
	B or Higher	A Grade	0.52[a,b,c]	0.40[a]	0.46[b]	0.48[c]
		B Grade	0.39[a,b,c]	0.29[a]	0.32[b]	0.33[c]
		C Grade	0.30[a,b,c]	0.19[a]	0.21[b]	0.20[c]
GPA Year 1 (or Last GPA)	2.0 or Higher	A Grade	0.88[a,b]	0.78[a]	0.78[b]	0.87
		B Grade	0.80[a,b]	0.66[a]	0.68[b]	0.74
		C Grade	0.73[a,b]	0.51[a]	0.56[b]	0.56
	3.0 or Higher	A Grade	0.58[b,c]	0.42	0.47[b]	0.57[c]
		B Grade	0.39[b,c]	0.27	0.30[b]	0.33[c]
		C Grade	0.17[b,c]	0.16	0.17[b]	0.16[c]
GPA Year 2	2.0 or Higher	A Grade	0.91[a,b,c]	0.83[a]	0.88[b]	0.90[c]
		B Grade	0.85[a,b,c]	0.72[a]	0.81[b]	0.83[c]
		C Grade	0.71[a,b,c]	0.57[a]	0.70[b]	0.74[c]
	3.0 or Higher	A Grade	0.49[a,b,c]	0.30[a]	0.44[b]	0.53[c]
		B Grade	0.31[a,b,c]	0.17[a]	0.24[b]	0.31[c]
		C Grade	0.22[a,b,c]	0.09[a]	0.12[b]	0.15[c]
GPA Year 3	2.0 or Higher	A Grade	0.93[a,b]	0.85[a]	0.89[b]	0.91
		B Grade	0.88[a,b]	0.75[a]	0.84[b]	0.86
		C Grade	0.81[a,b]	0.62[a]	0.77[b]	0.79
	3.0 or Higher	A Grade	0.40[a,b]	0.32[a]	0.41[b]	0.55
		B Grade	0.22[a,b]	0.16[a]	0.22[b]	0.28
		C Grade	0.17[a,b]	0.08[a]	0.11[b]	0.11
Return Fall, Any Inst.	Year 2	A Grade	0.91[a,b]	0.75[a]	0.75[b]	0.80
		B Grade	0.87[a,b]	0.66[a]	0.64[b]	0.68
		C Grade	0.84[a,b]	0.57[a]	0.51[b]	0.53
	Year 3	A Grade	0.74[a,b,c]	0.49[a]	0.48[b]	0.57[c]
		B Grade	0.64[a,b,c]	0.38[a]	0.38[b]	0.43[c]
		C Grade	0.58[a,b,c]	0.28[a]	0.30[b]	0.29[c]
Progress to Degree	Year 2	A Grade	0.75[b]	0.25	0.21[b]	0.28
		B Grade	0.65[b]	0.16	0.14[b]	0.17
		C Grade	0.66[b]	0.10	0.09[b]	0.10

Table F-5. (continued)

Outcome						
Type	Level	Developmental Reading Grade	FT and Age ≤ 21	PT and Age ≤ 21	Age 22–25	Age > 25
Certificate within . . .	4 Years	A Grade	0.23[a,b,c]	0.13[a]	0.18[b]	0.14[c]
		B Grade	0.19[a,b,c]	0.10[a]	0.14[b]	0.10[c]
		C Grade	0.22[a,b,c]	0.08[a]	0.11[b]	0.08[c]
	5 Years	A Grade	0.24[a,b,c]	0.15[a]	0.22[b]	0.16[c]
		B Grade	0.19[a,b,c]	0.12[a]	0.17[b]	0.12[c]
		C Grade	0.25[a,b,c]	0.09[a]	0.13[b]	0.09[c]
	6 Years	A Grade	0.21[a,b,c]	0.16[a]	0.19[b]	0.20[c]
		B Grade	0.17[a,b,c]	0.13[a]	0.15[b]	0.15[c]
		C Grade	0.26[a,b,c]	0.10[a]	0.12[b]	0.11[c]
Associate's Degree within . . .	4 Years	A Grade	0.42[b,c]	0.18	0.11[b]	0.19[c]
		B Grade	0.29[b,c]	0.10	0.08[b]	0.11[c]
		C Grade	0.26[b,c]	0.05	0.06[b]	0.07[c]
	5 Years	A Grade	0.47[b,c]	0.24	0.17[b]	0.25[c]
		B Grade	0.33[b,c]	0.14	0.13[b]	0.14[c]
		C Grade	0.31[b,c]	0.08	0.11[b]	0.08[c]
	6 Years	A Grade	0.53[a,b,c]	0.27[a]	0.24[b]	0.30[c]
		B Grade	0.38[a,b,c]	0.16[a]	0.18[b]	0.18[c]
		C Grade	0.27[a,b,c]	0.09[a]	0.13[b]	0.10[c]
Associate's/Bachelor's Degree within . . .	4 Years	A Grade	0.43[b,c]	0.18	0.11[b]	0.19[c]
		B Grade	0.29[b,c]	0.10	0.08[b]	0.11[c]
		C Grade	0.26[b,c]	0.05	0.06[b]	0.07[c]
	5 Years	A Grade	0.48[b,c]	0.25	0.17[b]	0.26[c]
		B Grade	0.35[b,c]	0.15	0.14[b]	0.14[c]
		C Grade	0.33[b,c]	0.08	0.11[b]	0.08[c]
	6 Years	A Grade	0.57[a,b,c]	0.28[a]	0.25[b]	0.33[c]
		B Grade	0.41[a,b,c]	0.17[a]	0.19[b]	0.19[c]
		C Grade	0.29[a,b,c]	0.10[a]	0.14[b]	0.10[c]

ACT is an independent, nonprofit organization that provides assessment, research, information, and program management services in the broad areas of education and workforce development. Each year, we serve millions of people in high schools, colleges, professional associations, businesses, and government agencies, nationally and internationally. Though designed to meet a wide array of needs, all ACT programs and services have one guiding purpose—helping people achieve education and workplace success.

For more information, visit www.act.org.

* 0 5 0 2 0 9 1 5 0 * Rev 1