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Comparing College Readiness and Career Readiness: What Admissions Tests Tell Us

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Abstract

Ensuring postsecondary readiness is a major goal of K–12 education, but it is not clear whether college readiness and career readiness are similar in terms of academic preparation. To address that issue, this study estimated benchmark scores on a college admissions test predictive of earning good grades for students in majors associated with middle-skills occupations at two-year postsecondary institutions. Results generally indicated similarity between those scores, the corresponding scores for students preparing for high-skills jobs requiring a bachelor's degree, and established readiness benchmarks for the general college-going population. Subsequent analyses revealed small variation between readiness benchmarks for different college majors. Overall, results suggest that high school graduates need a strong academic foundation regardless of the postsecondary path they choose.

Keywords: college readiness, career readiness, admissions testing

Comparing College Readiness and Career Readiness: What Admissions Tests Tell Us

Middle-skills jobs, which generally offer middle-class salaries and opportunities for advancement, account for nearly half of all jobs in the United States (Achieve, 2012). New middle-skills jobs are emerging in fields such as information technology, health science, and human services, but millions of job openings are expected in traditional fields like manufacturing (Carnevale, Smith, Kotamraju, Steuernagel, & Green, 2011). Most middle-skills jobs do not require a bachelor’s degree, but they increasingly demand postsecondary training and subsequent certification or credentialing from two-year institutions, technical schools, or formal apprenticeships. Thus, a steady stream of students completing sub-baccalaureate career and technical education (CTE) programs is needed to realize the economic growth and upward social mobility associated with expansion of the middle-skills job market. Yet, employers report that middle-skills jobs are difficult to fill (ManpowerGroup, 2017), and projections foretell significant shortfalls of qualified job candidates (Carnevale, Smith, & Strohl, 2010).

Since students who are academically prepared are more likely to complete postsecondary programs, ensuring that high school graduates are “college and career ready” is a major concern of K–12 education. The overwhelming majority of states have set policies defining college and career readiness (CCR) as a unified construct (Mishkind, 2014), even though the academic rigor of middle-skills job training may differ from bachelor’s degree programs (Conley & McGaughy, 2012). This decision partly reflects the increasing academic demands of sub-baccalaureate CTE programs, which correspond to increasing requirements of middle-skills jobs. It also reflects the policy goal of holding all students to high expectations, thereby granting them the opportunity to pursue any desired postsecondary pathway. The notion of being “choice ready” emerged recently to embody this goal while acknowledging possible differences in the academic preparation needed for different pathways (Advance CTE & Education Strategy Group, 2017).

Knowing whether college readiness and career readiness are empirically equivalent has practical value for students, parents, educators, counselors, and admissions officers making decisions about postsecondary prospects and course placement. This study was designed to supplement the small body of prior empirical research on the comparability of college readiness and career readiness. To do so, this study estimated the level of high school achievement, as indicated by scores on the ACT test, predictive of earning a first-year grade point average (FYGPA) of 3.0 or higher and B or higher grades in first-year courses at two-year postsecondary institutions. Readiness benchmark scores were estimated separately for majors associated with middle-skills and high-skills occupations, individual major families, and certain CTE courses. All results were interpreted in reference to established college readiness benchmarks for the general college-going population. By comparing readiness benchmarks for middle-skills and high-skills career paths, this study indicates whether career readiness and college readiness demand similar levels of preparation. Moreover, results broaden understanding of readiness for various postsecondary pathways and may help identify students in need of support to improve their academic knowledge and skills, thereby improving their likelihood of postsecondary success.

Background

Career and Technical Education

According to the Carl D. Perkins Career and Technical Education Act, the goal of CTE is to provide "…individuals with coherent and rigorous content aligned with challenging academic standards and relevant technical knowledge and skills needed to prepare for further education and careers in current or emerging professions” (Public Law 109-270, § 250–4). Two-year community colleges award approximately half of all undergraduate CTE credentials (Levesque, et al., 2008), so they are an essential component of the pipeline into middle-skills jobs. According to projections, middle-skills jobs accounted for 45% of all jobs in 2014 (Achieve, 2012), and 63% of new jobs created between 2010 and 2018 require postsecondary education or training (Carnevale et al., 2010).

Besides improving national economic productivity, this situation creates significant opportunities for upward social mobility. For example, the employment rate is 15% higher for people who completed a postsecondary certificate program (National Center for Education Statistics, 2016), and growth in real wages for workers with postsecondary education has consistently outpaced growth for workers with no such training (Autor, 2014). Educational attainment is also related to health outcomes such as overall well-being and lower disease and mortality rates (Grossman & Kaestner, 1997). As Carnevale and his colleagues (2010) concisely described the situation, “Postsecondary education and training is quickly becoming the only viable path to the American middle class” (p. 109).

The skills gap. Despite the clear benefits of postsecondary training, current and projected demand for workers prepared for middle-skills jobs exceeds the supply (Carnevale et al., 2010; Giffi, et al., 2015). Employers report that middle-skills jobs are difficult to fill due to lack of applicants and applicants’ lack of technical skills (ManpowerGroup, 2017). Since many students begin but do not complete a postsecondary CTE program, improving the completion rate would be a straightforward way to help meet rising demand for skilled workers. Of students who started a sub-baccalaureate CTE program in 2003–2004, only 56% had completed or were continuing their studies as of 2009 (Wine, Janson, & Hunt-White, 2012), and associate degree students in CTE fields are known to have lower completion rates than those in academic fields of study (38% vs. 57% as reported by Bailey, Alfonso, Scott, & Leinbach, 2004).

Low exposure to rigorous academic courses during high school can be a significant barrier to postsecondary completion (Bowen, Kurzweil, & Tobin, 2005). Moreover, students in career-focused fields may face greater non-academic obstacles to completion. Indeed, among associate degree students, CTE majors are more likely to have lower family income, to delay enrollment in college, to enroll part time, and to have their education interrupted (Bailey et al., 2004), and all of these factors have been linked to poorer academic outcomes (Bowen & Chingos, 2009; Taniguchi & Kaufman, 2005).

College and Career Readiness

Low completion rates at postsecondary institutions of all types have fueled the current policy focus on CCR. This section considers ways of defining CCR and what prior research suggests about how college readiness and career readiness compare. This discussion focuses on academic aspects of readiness, but it should be noted that other attributes such as study skills, conscientiousness, and persistence are important for success in postsecondary education (Camara, O'Connor, Mattern, & Hansen, 2015). For that reason, “readiness” is sometimes differentiated from “preparedness,” where readiness refers to the entire body of knowledge and skills needed to succeed, and preparedness is specific to the academic aspects of readiness (NAGB, 2009).

A list of knowledge and skills. Various CCR definitions describe readiness as exhibiting certain attributes or meeting prerequisites required for placement into postsecondary education, success in postsecondary education, or career success. The academic aspects of readiness have been represented in different forms such as lists of high school courses (Adelman, 2006) and achievement test scores (Allen, 2013; College Board, 2016), but there must be lists of specific knowledge and skills underlying them. One such list, provided by the American Diploma Project (ADP, 2004), cataloged the knowledge and skills needed for success in postsecondary education or in “well-paid, skilled jobs” (p. 105), which included content from Algebra II as well as strong written and oral communication skills.

Likewise, the Common Core State Standards define readiness with a list of skills chosen such that “the best available evidence indicated that its mastery was essential for college and career readiness in a twenty-first-century, globally competitive society” (NGA & CCSSO, 2010, p. 3). In states that did not adopt the Common Core, content standards also often list knowledge and skills aligned to CCR. For example, the Texas College and Career Readiness Standards “specify what students must know and be able to do to succeed in entry-level courses at postsecondary institutions” (Texas Higher Education Coordinating Board & Texas Education Agency, 2009, p. iii).

CCR as an assessment score. With CCR defined, progress toward readiness can be measured using high school grades, course-taking patterns, and standardized achievement test scores, all of which are correlated with postsecondary achievement (Geiser & Santelices, 2007). In the context of achievement testing, CCR is commonly operationalized by a certain assessment score indicative of readiness. This idea is embodied by the two multi-state Common Core assessment consortia: the Partnership for Assessment of Readiness for College and Careers (PARCC) and the Smarter Balanced Assessment Consortium. Both consortia set performance standards using judgmental procedures involving panels of stakeholders making judgments about expected assessment performance for students who are just barely college and career ready

(Cizek & Bunch, 2007). PARCC (2015) claims that students who meet or exceed the CCR determination level should be “able to enter directly into and succeed in entry-level, credit-bearing courses and relevant technical courses in those content areas at two- and four-year public institutions of higher education” (p. 1). Likewise, Smarter Balanced (2013) claims that students who meet or exceed the “college content-readiness” level demonstrate “subject-area knowledge and skills associated with readiness for entry-level, transferrable, credit-bearing courses” (p. vii).

Both consortia have planned longitudinal research to examine the association between assessment performance and postsecondary achievement. Such research could validate claims about students who just met the CCR performance level having “approximately a 0.75 probability of earning college credit by attaining at least a grade of C or its equivalent” (PARCC, 2015, p. 4). This statistical method of operationalizing CCR mirrors the criterion-based approach used by college admissions tests (College Board, 2016; Allen, 2013) and the National Assessment of Educational Progress (NAEP; Schneider, Kitmitto, Muhisani, & Zhu, 2015). The major difference is that SAT, ACT, and NAEP research built claims around evidence, rather than seeking evidence to support claims. The ACT College Readiness Benchmarks, for example, indicate the ACT scores corresponding to a 50% chance of earning a B or higher grade in first-year, credit-bearing courses in a relevant content area (Allen, 2013).

Comparing college readiness and career readiness. Historically, college and career readiness were considered distinct, with career readiness being associated with job training and vocational education being separate from college-preparatory curricula (Conley & McGaughy, 2012). However, the emergence of new middle-skills jobs and evolving job requirements have established the relevance of academic skills for career success. The trend in postsecondary CTE programs is toward increasing focus on academic skills and incorporating more academic materials in vocational courses (Levesque, et al., 1995). Between 1990 and 2005, secondary and postsecondary students in CTE programs increased their average credits in core academic subjects (English, math, science, and social studies) and studied those subjects at greater levels of rigor (Levesque, et al., 2008).

Despite the trend toward CTE becoming more academic, the question remains whether college readiness and career readiness should be treated as isomorphic. A unified CCR definition is consistent with policy goals related to making expectations clear and setting high standards for all students that, if met, would make them "choice ready." Moreover, setting different standards may have unintended negative consequences such as tracking students into less rigorous high school courses (Camara, 2013). Considering that 33 of the 37 states that define college readiness and career readiness do so with a single definition, the unified approach is clearly preferred by policymakers (Mishkind, 2014).

Some studies support the similarity of college readiness and career readiness. The American Diploma Project (2004), for example, determined that taking Algebra II and four years of English were positively associated with career outcomes. Content experts identified the skills taught in those courses, and managers from industry evaluated the importance of those skills for workplace success. Overall, the analysis indicated "important convergence around the core knowledge and skills that both college and employers…require" (ADP, 2004, p. 4).

In another study, ACT (2006) examined concordance between the ACT® test and the workforce readiness assessment ACT WorkKeys®. The study revealed that ACT scores near the ACT College Readiness Benchmarks for math and reading corresponded to WorkKeys Level 5 in Applied Mathematics and Reading for Information, respectively. WorkKeys Level 5 is the achievement level connected with success in O*NET Job Zone 3 occupations (O*NET, 2017), which do not require a bachelor’s degree, but require some postsecondary training such as vocational school or an associate degree.

In validation research for the Common Core State Standards, a large sample of postsecondary instructors indicated that certain standards were important for both academic and career-oriented courses (Conley & McGaughy, 2012). Those standards included speaking and listening, reading informational texts, writing, and mathematical reasoning and problem solving. However, the relative importance of other, more specific standards varied between and within academic and vocational fields of study. For example, math skills were generally more important for computer technology courses, and knowledge of statistics was relatively important for science courses. Likewise, students must exhibit a higher level of math and science achievement to have a high probability of success in first-year courses geared toward STEM majors such as calculus, chemistry, and physics (Mattern, Radunzel, & Westrick, 2015). As those studies illustrate, differences in readiness for various fields are related to content knowledge directly relevant to those fields. Conley and McGaughy (2012) interpreted their findings as suggesting “that college readiness and career readiness share many important elements, but they’re not exactly the same” (p. 31).

Along the same lines, an attempt to set college and career readiness standards for 12th-grade NAEP indicated differences in the levels of academic preparation needed for college and job training programs (Loomis, 2012). The panels, which included college professors and CTE instructors, recommended similar readiness cut scores for reading, but the mathematics readiness cut scores were lower for job training, and they differed by occupation (e.g., highest for nursing). A follow-up study identified NAEP items that were “irrelevant” to certain disciplines. For example, many literary reading items were irrelevant, and geometry items were irrelevant to computer support specialists but highly relevant to air conditioning technicians.

Thus, college readiness may differ from career readiness in terms of which knowledge and skills are needed or the required level of achievement. Additionally, readiness requirements may differ between college majors and between occupations. Ignoring differences in readiness requirements could have negative consequences for students. If expectations are unrealistically low, students who barely meet those standards may struggle. If students are held to unnecessarily high standards, they may be discouraged from pursuing certain postsecondary paths. It would be unreasonable, for example, to set readiness standards high enough to make all students "choice ready" for advanced STEM careers. As an illustration, only 26% of students who expressed interest in STEM careers met or exceeded the ACT STEM Benchmark (ACT, 2015). Even fewer students overall met this benchmark, yet many of them were ready for other postsecondary pursuits.

Criteria for evaluating CCR. Camara and Quenemoen (2012) contend that, because readiness is predictive in nature, empirical prediction models are most appropriate for operationalizing college and career readiness in an assessment context. The current SAT benchmarks, for example, are called "college and career readiness" benchmarks because they are based on postsecondary grades at four-year and two-year institutions, where a significant amount of training for middle-skills jobs occurs (College Board, 2016). The ACT Benchmarks are also based on data from two-year and four-year institutions, but they are referred to as College Readiness Benchmarks because outcomes other than grades in academic courses may be more appropriate for supporting claims about career readiness (Allen, 2013). To date, neither ACT nor the College Board has reported on how readiness benchmarks might differ for students at two-year and four-year institutions or for students in different fields of study.

Examining the Comparability of College Readiness and Career Readiness

To supplement what is currently known about the comparability of college readiness and career readiness, this study estimated ACT assessment scores associated with earning a FYGPA of 3.0 or higher and earning B or higher grades in certain courses at two-year institutions. Readiness benchmark ACT scores for students in CTE majors or studying fields associated with middle-skills occupations were treated as indicators of career readiness. Results for different major groups and courses were compared to each other and to established readiness benchmarks for the larger college-going population. In doing so, this study addressed the following research questions:

1. Do readiness benchmarks differ between major groups (CTE, academic education, middle-skills, and high-skills) at two-year institutions?
2. Do readiness benchmarks for two-year institutions differ from established reference benchmarks for the college-going population?
3. Do readiness benchmarks differ across major families at two-year institutions?
4. Do readiness benchmarks for CTE courses differ from benchmarks for core academic courses?

Overall, this study provides initial empirical evidence indicating whether the level of academic preparation predictive of postsecondary success is similar across fields of study for students in two-year institutions. Results may support or call into question the common treatment of college readiness and career readiness as a single construct. Moreover, findings will provide clearer understanding of what it means to be academically prepared for a variety of postsecondary fields of study, which may be useful for advising students or identifying students in need of academic support to prepare them for their chosen fields of study.

Method

The current study uses the same statistical methodology as the study that established the ACT College Readiness Benchmarks (Allen, 2013). Those benchmarks will serve as points of reference for this study since they apply to the national population of college-going students attending two- and four-year institutions who took the ACT. Briefly, a benchmark is the ACT score associated with a .50 probability of earning a grade of B or higher in a certain course at a typical postsecondary institution. Prior research suggests that students who meet the benchmarks are more likely to enroll immediately in college after high school, persist in college, earn a college grade point average of 3.0 or higher, and complete a college degree (Radunzel & Noble, 2012; ACT, 2013).

Data

The sample comprised ACT-tested students starting between the fall of 2005 and 2014 at one of 59 two-year public institutions in three different states. Eighty-seven percent of the sample enrolled in college immediately after graduating high school, and 94% enrolled within two years. These data were unique because they included students’ declared majors and full transcripts with grades. This study focused on two-year institutions because much of the training for middle-skills jobs occurs there (Levesque, et al., 2008). Moreover, this focus prevented concerns about unaccounted-for differences between two-year and four-year institutions and their enrolled students.

Grouping majors. Institutions provided students' first-year declared major by reporting a six-digit Classification of Instruction Program (CIP) code. In analyses, student majors were grouped to estimate benchmarks that could be applied to broad categories of students. First, majors were classified as CTE or as academic education (AE) according to the National Center for Education Statistics CIP code taxonomy (Bradby & Hudson, 2007). A large number of CTE majors provide middle-skills job training, but some CTE majors are typically associated with high-skills occupations requiring a bachelor's degree (e.g., certain majors in education, business, and computer science). Thus, comparing CTE and AE majors is not the same as comparing students preparing for middle-skills and high-skills occupations.

To address that limitation, an attempt was made to group students into majors associated with middle-skills and high-skills occupations. To achieve that classification, CIP codes were transformed to Standard Occupational Classification (SOC) codes using the crosswalk provided by the National Center for Education Statistics (2017). Next, specific occupations associated with the SOC codes were gathered from O*NET (2017), which classifies middle-skills occupations in Job Zone 3 and high-skills occupations in zones 4 and 5. When a major was associated with multiple occupations, a weighted median zone was calculated, with weights reflecting national employment data (Bureau of Labor Statistics, 2017a) to give greater influence to more common occupations.

No data were available for majors including the word "Other" or "General," so a job zone was inferred based on the weighted median of all occupations in the same CIP family. Majors in the family Liberal Arts and Sciences, General Studies and Humanities were manually categorized as Job Zone 4 because students in those majors are most often completing general education requirements in preparation for transfer to a baccalaureate institution. As a quality check, the job zone for each major was compared to typical education level needed for entry and educational attainment for workers aged 25 and older (Bureau of Labor Statistics, 2017b). Job zone classifications were lowered to 3 when educational attainment data indicated that workers commonly had less than a bachelor's degree. In a few additional cases, a CTE policy expert suggested adjustments to job zones. Though some job zones increased, this process intentionally favored Job Zone 3 since most students attending two-year institutions never earn a bachelor's degree.

Data preparation. The original data set included 109,997 students with a major, ACT scores, and at least one outcome variable. Job zones were inferred for 10,612 students (9.6%), and educational attainment data changed 8,078 students (7.3%) to Job Zone 3. The majors most affected were Business Administration and Management, General (3.8%) and Business/Commerce, General (2.4%). Expert judgements changed job zones for another 3,528 students (3.2%). The majors most affected were Agriculture, General (0.8%) and Computer and Information Sciences, General (0.6%). The final sample size was 108,373 after removing 1,624 students (1.5%) because their majors were associated with Job Zone 2 (e.g., automotive body repair and correctional officers).

Measures

Institutions provided fall and spring cumulative FYGPA and course grades. For each analysis, the outcome variable was a 0/1 indicator variable set to 1 for successes (i.e., earning a 3.0 or higher FYGPA or earning a course grade of B or higher). In a given course grade analysis, the data were filtered to include only grades from a student's first standard-level course (not remedial or honors level) in the relevant subject area.

The ACT test, which is primarily used in college admissions, consists of four sections: mathematics, English, reading, and science. Each section includes between 40 and 75 multiple-choice items, and the score scale ranges from 1 to 36. Students in this study had ACT scores in the four subject areas and a Composite score equal to the average of the four sections. As in prior ACT benchmark studies, each ACT score served as a predictor of course grades from a related subject (math for college algebra, English for English composition I, reading for social science, and science for biology). ACT Composite scores were treated as a measure of overall academic achievement and were therefore used to predict FYGPA.

Sample description and weighting. Sample percentages for major groups were calculated for gender, ACT Composite score range, high school grade point average (HSGPA) range, and ethnicity. Sample demographics were compared to the reference population to gauge the representativeness of the available data. Frequency tables were generated to examine the distribution of majors in the sample as well as similarities and differences between the courses taken by middle-skills and high-skills majors.

The data analyzed in this study represented a convenience sample, so students and institutions were weighted to make results approximate what would be observed if they were nationally representative of ACT-tested students. Student-level weights were based on a reference population comprising the ACT-tested high school graduating class of 2015 in 30 states. The use of this population for weighting is consistent with the prior benchmarking studies, which facilitates the comparison of results, and this population is the group to which the readiness benchmarks are conveyed.

To determine the student-level weights, sample percentages were calculated for each combinations of gender, ACT Composite score range, HSGPA range, and ethnicity. Student-level weights were set equal to the population percentages divided by the sample percentages. In past ACT benchmark studies, institution-level weights were based on admission selectivity. As a substitute measure of selectivity for open-enrollment institutions, the reference population of two-year institutions was divided into thirds based on average ACT Composite scores. Then, institutional weights were calculated by dividing the population percentages by the corresponding sample percentages.

Statistical modeling. Hierarchical logistic regression was used to model the relationship between ACT scores and the probability of attaining a FYGPA of 3.0 or higher or a course grade of B or higher. Equation (1) shows the general form of that model.

$$\begin{aligned} \log \frac{p_{ij}}{1-p_{ij}} &= \beta_{0j} + \beta_{1j} ACT_{ij} + r_{ij} \\ \beta_{0j} &= \gamma_{00} + u_{0j} \\ \beta_{1j} &= \gamma_{10} + u_{1j} \end{aligned} \tag{1}$$

In equation (1), p_{ij} is the probability that student *i* in school *j* attained the desired outcome, and ACT_{ij} is that student's ACT score. In the model, β_{0j} and β_{1j} are school *j*'s regression intercept and slope, respectively. The slopes and intercepts were allowed to vary across schools.

The models were fit using the glmer function in the R package lme4 (Bates, Maechler, Bolker, & Walker, 2015), with each student being weighted according to the student-level weights. An initial model was fit using all available data, and parameter estimates were used to calculate the institution-specific cutoff for each school (i.e., the ACT score associated with a .50 probability of success). Institutions with a cutoff falling outside the reasonable range 10–36 or outside the observed range of ACT scores at the institution were removed, and the model was refit to obtain final institution-specific cutoffs. Institution-level weights were applied to the institution-specific cutoffs to calculate a weighted median cutoff, which served as the benchmark

ACT score. The procedure was repeated for different outcomes (FYGPA and course grades) and different groups of students (all, CTE, AE, middle-skills, high-skills, and individual major families). Differences between benchmarks were investigated using Wilcoxon signed-rank tests.

Results

Sample Description

Demographics. Demographic percentages for the major groups were generally similar (Table 1). The only notable difference was slightly higher ACT Composite scores for the AE and high-skills samples compared to the CTE and middle-skills samples. Compared to the reference population of 2015 ACT-tested high school graduates, the samples analyzed in this study had slightly higher percentages of female and White students. The sample also had lower average ACT Composite scores and HSGPAs, which likely reflected the lower achievement of students enrolled in two-year institutions compared to a group including students enrolled in four-year institutions.

======Table 1======

Distributions of majors. Of the 108,373 students, 50.2% was classified as CTE, 49.8% as AE, 37.9% as middle-skills, and 62.1% as high-skills (Table 2). There was notable overlap between CTE and middle-skills and between AE and high-skills. Indeed, 37.5% of students were classified into CTE/middle-skills majors, and 49.4% of students were classified in AE/high-skills majors. As another gauge of sample representation, the distribution of majors in the sample was compared to the larger population of two-year postsecondary students from which the sample was drawn. The distributions were very similar except the sample included 6% more students in the major family Liberal Arts and Sciences, General Studies, and Humanities.

Demographics and HSGPA were only available for ACT test takers, so further comparisons were not possible.

======Table 2======

The largest CTE major families were Health Professions and Related Clinical Sciences (15.2% of the entire sample; Table 2), Business, Management, Marketing, and Related Support Services (8.4%), Education (5.9%), and Engineering Technologies/Technicians (4.0%). The most common CTE major families were consistent with nationally representative samples (Levesque, et al., 2008). Liberal Arts and Sciences, General Studies, and Humanities accounted for 84.2% of AE majors (39.0% of the entire sample). The next largest AE major families were Social Sciences (1.4%) and Biological and Biomedical Sciences (1.2%).

First-year courses. High-skills majors were somewhat more likely than middle-skills majors to take the courses used to set the ACT Benchmarks (80% vs. 74% for English composition, 32% vs. 22% for college algebra, 24% vs. 19% for social science, and 23% vs. 11% for biology). For those four courses, middle-skills and high-skills majors at the same institution generally took the same course (as indicated by course names). The same trends were observed when comparing students in CTE and AE majors. Thus, if estimated benchmarks for different major groups are similar, it could be due to overlap in courses taken.

Benchmarks for Major Groups

The first research question concerned the comparison of readiness benchmarks for different major groups at two-year institutions. Table 3 shows the estimated benchmarks for all students, CTE majors, AE majors, middle-skills majors, and high-skills majors. Given the overlap between groups, results were expected to be similar for CTE and middle-skills and for AE and high-skills. Generally, the estimated benchmarks were identical or within one point of each other. Considering that the standard error of measurement is approximately 2 for subject-area test scores and 1 for Composite scores (ACT, 2014), a difference of 1 point should not be considered practically significant. That is, when comparing students with ACT scores differing by 1 point, one should not infer that their levels of readiness differ in a meaningful way.

======Table 3======

The general trend in results indicates, for example, that the ACT math score associated with a .50 probability of earning a B or higher in college algebra was very similar for all major groups. An analogous inference can also be drawn for ACT reading as a predictor of social science grades. In a similar manner, the level of broad high school achievement (indicated by ACT Composite scores) associated with a .50 probability of earning a FYGPA of 3.0 or higher was very similar for all major groups.

Two results stood out as somewhat different. The middle-skills ACT English benchmark was 2 points higher than the high-skills benchmark, but a paired Wilcoxon signed-rank test indicated that the difference was not statistically significant ($p = .28$). The other deviant result was the CTE benchmark for ACT science, which was 2 points higher than the AE benchmark. In this case, the difference was statistically significant ($p < .05$). Thus, when comparing students with the same ACT science scores, AE majors were slightly more likely to earn a B or higher in biology than CTE majors. This trend is apparent from Figure 1, which shows the relationship between ACT science scores and the probability of earning a B or higher based on the estimates of γ_{00} and γ_{10}. Note that the benchmark cannot be ready directly from Figure 1 (or subsequent figures) because benchmarks are based on the weighted median of many institution-specific cut scores. Still, Figure 1 illustrates the difference between benchmarks.

To address the second research question, the benchmarks for major groups were compared to reference benchmarks for the college-going population (Allen, 2013). The estimated benchmarks—including those for FYGPA—were often within 1 point of the reference benchmarks. Exceptions included the ACT English benchmarks for CTE and middle-skills majors, which were 2 and 3 points higher than the reference benchmark, respectively. Wilcoxon tests indicated that those benchmarks were both significantly greater than 18 ($p < .001$). Thus, CTE and middle-skills majors at two-year institutions were less likely to earn a B or higher in English composition than students in the college-going population when controlling for ACT English scores (Figure 2). Another exception was the ACT math benchmark for CTE majors, which was 2 points higher than the reference benchmark of 22. This difference was also statistically significant ($p < .001$), so CTE students in two-year institutions were less likely to earn B or higher grades in college algebra than students with the same ACT math scores in the reference population (Figure 3). The last exception was the ACT science benchmark for AE majors, which was 2 points lower than the reference benchmark of 23 ($p < .001$). As shown in Figure 1, AE majors had higher probabilities of earning B or higher grades in Biology.

======Figure 1======

======Figure 2======

======Figure 3======

Benchmarks for Major Families

The next set of analyses addressed the third research question by estimating readiness benchmarks for college major families. Statistical models were fit only with sample sizes of at least 1,000. Table 4 lists the benchmarks for FYGPA and the four content areas for nine CTE major families and five AE major families.

======Table 4======

For all AE and high-skills CTE major families, the ACT Composite benchmark for predicting FYGPA equaled the reference benchmark of 23 or was within 1 point. Most of the ACT Composite benchmarks for CTE and middle-skills major families were also within 1 point of the reference benchmark, but there were three CTE/middle-skills major families for which the benchmark fell 2 points below the reference benchmark: Computer and Information Sciences and Support Services, Family and Consumer Sciences/Human Sciences, Mechanic and Repair Technologies/Technicians. Those differences were statistically significant ($p < .001$) except for Mechanic and Repair Technologies/Technicians, which had only 17 schools represented in the data, so statistical power was low. This result suggests that students in those major families had a greater chance of earning 3.0 or higher FYGPAs than students with similar ACT Composite scores in other major families.

The ACT English benchmarks for majority middle-skills majors ranged from 20 to 22, which were significantly higher than the reference benchmark by 2–4 points ($p < .05$ or $p < .001$). Two of the high-skills major families had ACT English benchmarks that were also significantly greater than 18 ($p < .05$ for Education, $p < .01$ for Visual and Performing Arts). In contrast, the ACT English benchmark for Liberal Arts and Sciences, General Studies, and Humanities was only 1 point higher than the reference benchmark. Of the four ACT Math benchmarks estimated, only the Liberal Arts and Sciences, General Studies, and Humanities benchmark differed from the reference value by 2 points ($p < .01$). Of the reading benchmarks, six out of seven were within 1 point of the reference benchmark, but the benchmark for Engineering Technologies/Technicians was 3 points higher than the reference benchmark ($p < .01$). Two of the three ACT Science benchmarks were 1 point below the reference benchmark of

23 (Education and Health Professions). The ACT Science benchmark for Liberal Arts and Sciences, General Studies, and Humanities was lower than the reference benchmark by 2 points (p < .001).

Benchmarks for CTE Courses

The final set of analyses addressed the fourth research question by estimating readiness benchmarks for CTE courses. These values may be compared to readiness benchmarks for core academic courses (Tables 3 and 4) but with one notable caveat. Namely, the CTE content areas do not match neatly with the content of ACT subject-area tests. Effort was made to match course content and ACT content as closely as possible. Reading benchmarks were estimated for business, criminal justice, and teacher education courses, a math benchmark was estimated for computer courses, and a science benchmark was estimated for nursing or dental courses.

======Table 5======

The reading benchmark was 22 for business courses, and the math benchmark was 22 for computer courses. Those benchmarks were identical to the comparable ACT benchmarks. In contrast, the science benchmark for dental and nursing courses was 4 points lower than the reference benchmark for biology (p < .001), and the reading benchmark for criminal justice courses fell 3 points below the reference benchmark for social science (p < .001). Similarly, the reading benchmark for teacher education courses was 2 points below the reference benchmark (p < .01). The larger differences observed for nursing and dental, criminal justice, and teacher education courses indicated that students with a given ACT score had greater chances of earning B or higher grades in those CTE courses than core academic courses.

Discussion

In this study, career readiness was operationalized by the level of high school achievement (i.e., ACT scores) associated with a reasonable chance of earning good grades in postsecondary courses at two-year institutions for students majoring in fields associated with middle-skills occupations. College readiness was operationalized in the same way, except it was evaluated for students majoring in fields associated with high-skills occupations requiring a bachelor's degree. Comparisons were also drawn to CTE and AE majors, which overlap significantly with the middle-skills and high-skills groups, respectively.

When analyzing large groups of majors together, the bulk of the statistical evidence pointed to similarity between college readiness and career readiness for students at two-year institutions. Based on transcript data, students in a variety of majors tended to take the same core academic courses, suggesting that a similar level of academic preparation would be needed for those courses regardless of one's postsecondary plans. Moreover, the estimated ACT benchmarks for grades in college algebra, English composition, and biology were not significantly different between major groups. This finding could partly reflect students taking the same courses, but the FYGPA analyses, which included all courses taken during the first year, also indicated that students in different major groups needed similar levels of academic preparation to achieve first-year academic success.

Besides being similar to each other, many of the estimated benchmarks for major groups at two-year institutions were within 1 point of the ACT College Readiness Benchmarks based on students attending two-year and four-year institutions. This finding further supports the notion that all students should take rigorous courses in high school to be well prepared for postsecondary pursuits. Exceptions included the ACT science benchmark for AE majors, which was 2 points lower than the reference benchmark. In contrast, the CTE and middle-skills benchmarks for ACT English were 2–3 points higher than the reference benchmarks. Likewise, the math benchmark for CTE majors was 2 points higher than the reference benchmark. Such results might seem contrary to the intuitive expectation that benchmarks for two-year institutions would be lower because courses are less difficult (i.e., easier to earn a B or higher) than similar courses offered at four-year institutions.

The English and math results likely embody multiple, competing factors influencing benchmarks. For example, students in CTE and middle-skills majors might earn lower grades in English composition because they are worse at writing research papers and essays—skills that are not directly assessed by the ACT English test. Such students may also be less motivated and engaged in a course not closely related to their majors. Moreover, students attending two-year institutions tend to be less successful in college, including earning lower grades, than students attending four-year institutions (Bowen & Chingos, 2009; Mattern, Shaw, & Kobrin, 2010), which would tend to make benchmarks for two-year institutions higher. There are many possible explanations why this may be the case, including less institutional support and resources (Mullin, 2010) and personal barriers (Ma & Baum, 2016).

The third research question concerned differences in benchmarks for individual major families. FYGPA benchmarks for AE and high-skills major families were within 1 point of the reference benchmark, as were most FYGPA benchmarks for CTE and middle-skills major families. Among CTE major families, lower FYGPA benchmarks were observed for majors that might require lower levels of readiness in core academic fields (e.g., Family and Consumer Sciences/Human Sciences and Computer and Information Sciences and Support Services), and higher FYGPA benchmarks were observed for majors that might require higher levels of achievement (e.g., Physical Sciences). This is consistent with previous findings indicating that a higher level of academic preparation is required of STEM majors (Chen & Ho, 2012; Mattern, Radunzel, & Westrick, 2015).

With only one exception, the estimated college algebra, social science, and biology benchmarks never differed by more than 1 point between major families, which is consistent with the notion that students pursuing different fields of study at two-year institutions need similar levels of academic preparation. However, the ACT English benchmarks for CTE major families were 1–3 points higher than the benchmark for the AE major family Liberal Arts and Sciences, General Studies, and Humanities. As noted previously, differences in benchmarks could reflect various factors such as writing ability, interest, and motivation.

The final research question asked whether estimated benchmarks for specific groups of CTE courses were higher or lower than previously established college readiness benchmarks. Results of these analyses were mixed. For business and computer courses, estimated benchmarks were similar to corresponding reference benchmarks. However, the benchmarks for nursing and dental, criminal justice, and teacher education courses were several points lower than the reference benchmarks. Such results indicate that students were more likely to earn B or higher grades in the CTE courses or, equivalently, that lower levels of preparation were needed for the CTE courses than core academic courses. Again, this may be a reflection of factors other than the skills measured by the ACT. For example, biology may be a more difficult course than some nursing and dental courses. Additionally, students may be more invested in CTE courses closely aligned to their career goals (Holland, 1997). These results should be interpreted with caution given the small number of CTE courses with sufficient sample sizes coupled with the possible misalignment between course content and ACT content.

Limitations

There are several limitations of the study worth noting. First, data were available for only three states, so generalizability may be limited. The data were weighted to make results estimate what would have been observed if a nationally representative sample of high school graduates was available, but for that to work, the students in the available data must be like students across the country in ways other than gender, ethnicity, ACT scores, and HSGPA. The fact that these students took the ACT and that so many majored in Liberal Arts and Sciences points to the sample being of higher average ability than the larger population of students enrolling in two-year institutions. Moreover, for results to generalize as intended, the two-year institutions in the sample must be similar to two-year institutions nationally. Future research should evaluate whether the current findings are consistent with analyses of larger, more nationally representative samples.

The methods for identifying middle-skills and high-skills majors was another limitation. This process depended on the sample of occupations in O*NET, which is not representative of all occupations. Moreover, it depended on assumptions about students' educational and career goals based on their declared majors at two-year institutions. For some students, assuming that they wanted to pursue a middle-skills or high-skills career may have been inaccurate. Institutions confirmed that Liberal Arts and Sciences majors were generally preparing for baccalaureate studies, but it may be pragmatic in future research to partner with two-year institutions to better understand the typical educational and career goals of students in different majors.

Determining what constitutes a meaningful difference in benchmarks was a subjective decision and may be viewed as a limitation of this research. In the current study, a 2-point differences were considered meaningful because they were generally found to be statistically significant; however, this may not be a valid interpretation. Benchmark scores are known to be sensitive to sample differences, as was observed with the revised ACT Benchmarks (Allen & Sconing, 2005; Allen, 2013). Moreover, the standard error of measurement is approximately 2 for ACT subject-area tests, so such differences did not necessarily reflect meaningful differences in academic preparation between students.

Finally, this study highlights challenges inherent to the interpretation of readiness benchmarks like the ACT College Readiness Benchmarks. Common methodology for estimating benchmarks accounts only for prior achievement, but other student and institutional variables are relevant to postsecondary success. Future studies could explore estimating benchmarks for an index reflecting multiple aspects of readiness such as academic factors, motivation, and other social and emotional learning variables.

Conclusions

In sum, this study contributes to the national dialogue on college and career readiness. A high-level analysis of major groups produced results indicating that all students need a similar level of academic preparation upon graduating high school to have the same likelihood of postsecondary academic success, regardless of their plans. The notion that students enrolling in CTE programs or pursuing middle-skills occupations need less academic preparation was not supported. In finer-grained analyses, results suggested that different career pathways may demand slightly different levels of knowledge, skills, and abilities in core academic subjects. From a policy perspective, results align with current educational initiatives holding all students to the same level of academic mastery, regardless of their postsecondary plans. From a career counseling perspective, understanding a student's strengths and weaknesses, along with their interests and other factors, can help students make personally-relevant college and career choices.

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Table 1
Sample Sizes and Demographic Percentages from FYGPA Analyses

Category	Level	Middle-Skills	High-Skills	Total Sample	Population[1]
Gender	Female	55.1	55.2	55.1	51.6
	Male	44.4	43.8	44.1	47.3
	Unknown	0.6	1.0	0.8	1.0
Ethnicity	African American	13.3	11.9	12.4	14.9
	Caucasian	66.6	67.7	67.3	57.5
	Hispanic	5.9	5.6	5.7	12.6
	Asian	1.8	1.8	1.8	3.1
	Other	8.0	8.2	8.1	5.2
	Unknown	4.4	4.8	4.6	6.8
ACT Composite Score Range	1–15	21.5	18.4	19.6	19.8
	16–19	41.4	39.3	40.1	27.1
	20–23	27.7	29.6	28.9	24.9
	24–27	8.2	10.8	9.8	16.7
	28–36	1.3	1.9	1.7	11.5
HSGPA Range	0.00–1.99	3.1	2.9	3.0	4.5
	2.00–2.49	11.6	11.0	11.3	9.1
	2.50–2.99	21.0	19.9	20.3	15.0
	3.00–3.49	27.6	27.0	27.2	23.7
	3.50–3.74	10.9	11.1	11.0	13.0
	3.75–4.00	10.1	11.0	10.6	20.3
	Unknown	15.8	17.1	16.6	14.4
Sample Size		38,107	62,629	101,049	1,395,418

[1] The reference population is the ACT-tested high school graduating class of 2015.

Table 2

Percentages of Students in CIP (Major) Families Accounting for at Least 0.5% of the Sample

		% by Skills Level		CIP Family %	
CIP Family	Type	Middle-Skills	High-Skills	Total Sample	Population[1]
Agriculture, Agriculture Operations, and Related Sciences	CTE	99.9	0.1	1.1	0.7
Communication, Journalism, and Related Programs	CTE	10.1	89.9	0.6	0.5
Computer and Information Sciences and Support Services	CTE	81.7	18.3	1.8	2.4
Education	CTE	9.5	90.5	5.9	4.8
Engineering	CTE	0.0	100.0	1.4	1.0
Engineering Technologies/Technicians	CTE	99.0	1.0	4.0	5.9
Family and Consumer Sciences/Human Sciences	CTE	73.3	26.7	1.2	1.5
Liberal Arts and Sci., General Studies and Humanities	AE	0.0	100.0	39.0	32.7
Biological and Biomedical Sciences	AE	0.0	100.0	1.2	0.8
Multi/Interdisciplinary Studies	AE	0.0	100.0	0.8	0.8
Parks, Recreation, Leisure, and Fitness Studies	CTE	73.7	26.3	0.5	0.5
Physical Sciences	AE	0.0	100.0	1.1	0.8
Psychology	AE	0.0	100.0	1.0	0.8
Security and Protective Services	CTE	99.4	0.6	2.8	3.6
Social Sciences	AE	0.0	100.0	1.4	1.1
Mechanic and Repair Technologies/Technicians	CTE	100.0	0.0	0.9	1.7
Visual and Performing Arts[2]	AE/CTE	24.4	75.6	1.8	2.0
Health Professions and Related Clinical Sciences	CTE	96.9	3.1	15.2	17.1
Business, Management, Marketing, and Support Services	CTE	80.6	19.4	8.4	10.6
Sample Size				116,550	306,466

[1] The population is the full sample of students attending two-year institutions from the three states. The sample includes only ACT-tested students.

[2] Visual and Performing Arts included 61.8% AE majors and 38.2% CTE majors.

Table 3

Distributions of Institution-Specific Cut Scores for Aggregate Groups

			Sample Size		Cut Score			
Outcome	Predictor	Group	Stud.	Inst.	Median (Benchmark)	25th %ile	75th %ile	Reference Benchmark[1]
FYGPA ≥ 3.0	ACT Composite	All	101,049	59	23	21	25	23
		CTE	49,974	58	23	22	25	
		AE	50,845	57	22	21	25	
		Middle-Skills	38,107	57	23	21	25	
		High-Skills	62,629	58	23	21	26	
Eng. Comp ≥ B	ACT English	All	57,584	58	19	17	23	18
		CTE	24,238	48	20	18	25	
		AE	30,035	56	19	17	23	
		Middle-Skills	19,093	52	21	18	24	
		High-Skills	37,141	57	19	17	23	
College Alg. ≥ B	ACT Math	All	23,169	52	24	22	25	22
		CTE	9,564	46	24	22	25	
		AE	12,801	49	23	22	25	
		Middle-Skills	6,522	41	23	21	25	
		High-Skills	16,406	52	23	22	25	
Social Sci. ≥ B	ACT Reading	All	64,181	57	22	21	24	22
		CTE	27,235	57	23	21	24	
		AE	35,061	57	22	20	24	
		Middle-Skills	19,749	55	23	21	24	
		High-Skills	43,562	57	22	20	24	
Biology ≥ B	ACT Science	All	18,131	49	21	19	23	23
		CTE	7,182	45	23	21	25	
		AE	10,829	46	21	20	22	
		Middle-Skills	4,964	37	22	21	24	
		High-Skills	12,813	47	22	20	22	

[1] The reference benchmarks are the ACT College Readiness Benchmarks used nationally. The FYGPA benchmark is taken from Allen and Radunzel (2017), and the course benchmarks are from Allen (2013).

Table 4

Median Institution-Specific Cut Scores for Major Families

		Majority	Sample Size[1]		Median Cut Score (Benchmark)				
Major Family	Type	Skills Level	Stud.	Inst.	FYGPA	Eng. Comp.	Coll. Alg.	Soc. Science	Biology
Agriculture and Related Sci.	CTE	Middle	1,122	14	22				
Computer and Info. Sci. and Support	CTE	Middle	1,468	29	21				
Education	CTE	High	5,869	41	23	22	23	22	22
Engineering	CTE	High	1,421	13	23			21	
Engineering Technologies/Technicians	CTE	Middle	3,669	34	22	22		25	
Family and Consumer Sci./Human Sci.	CTE	Middle	1,153	26	21				
Security and Protective Services	CTE	Middle	2,053	26	22	21			
Mechanic and Repair Technologies	CTE	Middle	807	17	21				
Health Professions and Clinical Sci.	CTE	Middle	15,023	51	23	22	23	22	22
Business and Support	CTE	Middle	7,837	49	22	20	23	22	
Liberal Arts and Sci. and Humanities	AE	High	43,146	55	23	19	24	22	21
Biological and Biomedical Sciences	AE	High	1,161	14	23				
Physical Sciences	AE	High	1,167	8	24				
Social Sciences	AE	High	1,369	9	23			22	
Visual and Performing Arts	AE/CTE	High	1,787	20	22	21			

[1] Sample size is for FYGPA analysis. Sample sizes for course analyses were smaller.

[2] Visual and Performing Arts includes 62% AE majors and 38% CTE majors.

Table 5
Distributions of Institution-Specific Cut Scores for Select CTE Courses

		Sample Size		Cut Score		
CTE Subject	Predictor	Stud.	Inst.	Median (Benchmark)	25^{th} %ile	75^{th} %ile
Business	ACT Reading	5,067	52	22	20	24
Computer	ACT Math	14,426	41	22	18	26
Nursing/Dental	ACT Science	11,148	51	19	18	21
Criminal Justice	ACT Reading	1,019	22	19	17	21
Teacher Education	ACT Reading	2,368	36	20	16	22

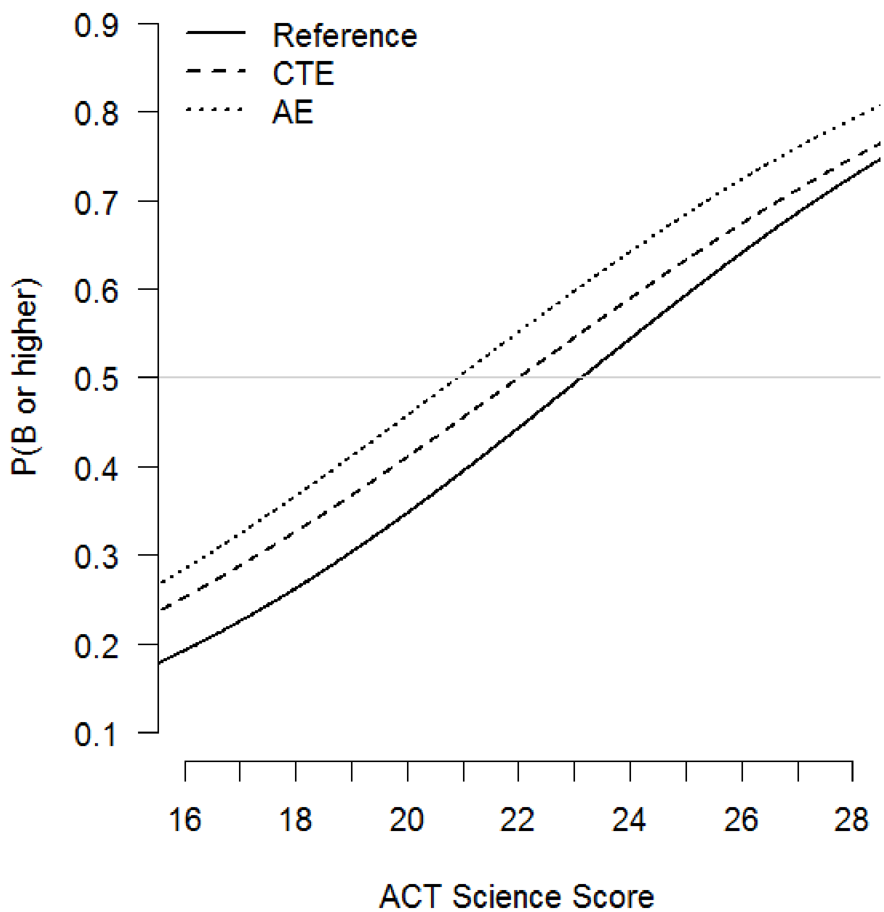

Figure 1. Probability of earning a B or higher in Biology at a typical institution given ACT Science score.

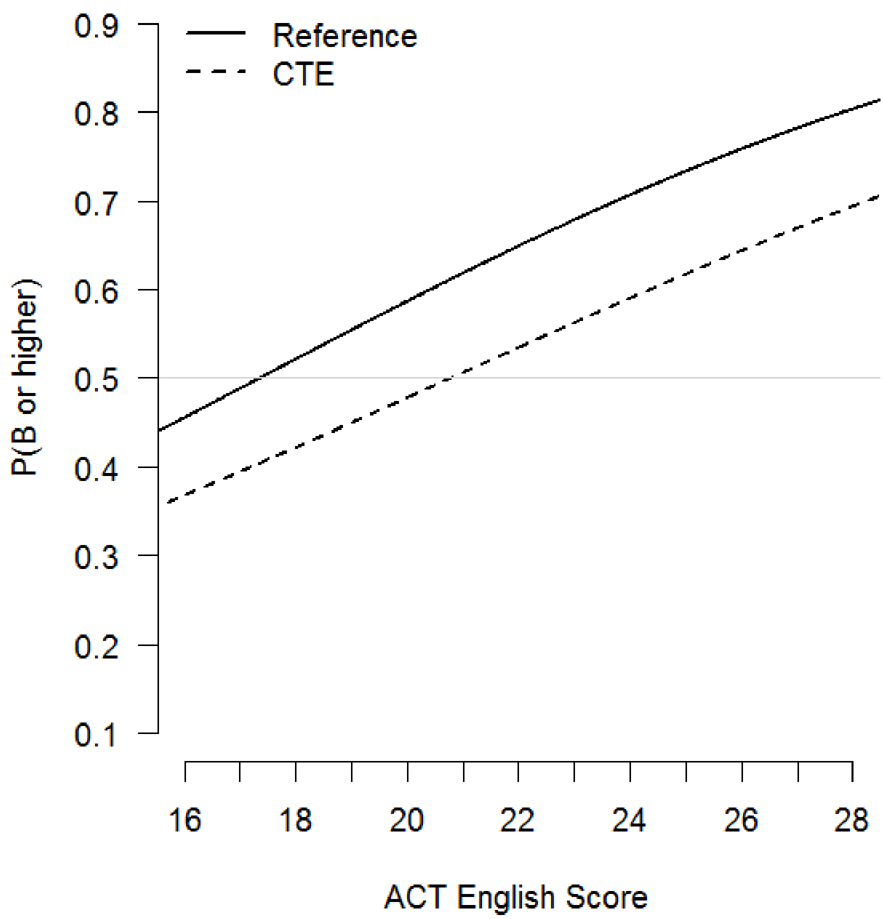

Figure 2. Probability of earning a B or higher in English Composition at a typical institution given ACT English score.

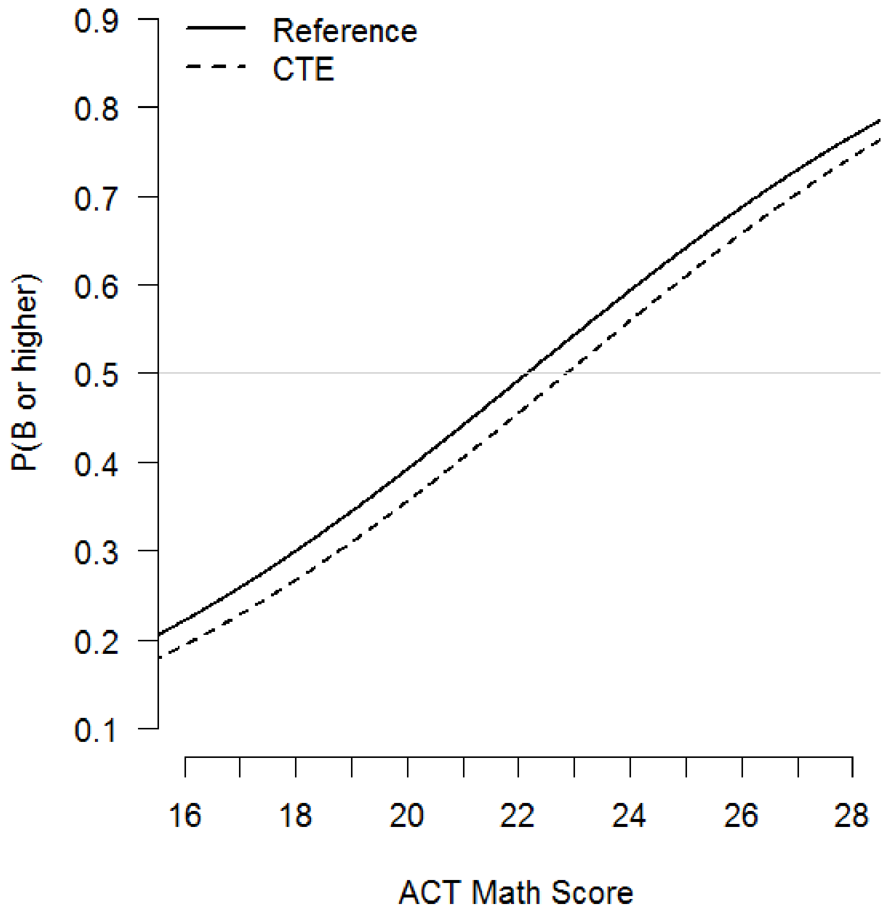

Figure 3. Probability of earning a B or higher in College Algebra at a typical institution given ACT Math score.