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The Development of a Multidimensional College Readiness Index

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Introduction

College Readiness and College Success

As the United States continues to shift from a goods-based economy to a service-based economy, the importance of having a college degree will increase. Twelve of the 20 fastest growing professions require an associate degree or higher, and all of the 71 jobs projected to grow by 20 percent or more require some college, with most requiring one or more college degrees (Bureau of Labor Statistics; Partnership for 21st Century Skills, 2008).

Although many students in the United States do attend and graduate from college, there is still a need to increase the number of students participating in the college-going process. The National Center for Higher Education Management Systems (NCHEMS) estimates that 39 percent of adults aged 25 to 34 in the United States have an associate degree or higher (NCHEMS, 2009). While this percentage is higher than it is in a number of countries, it is notably lower than in it is in others, such as Canada, Japan and Korea, all of whom have more than half of their comparable adults holding an associate degree or higher. The United States was ranked second in the percentage of students who received a tertiary degree (postsecondary program that includes two- and four-year colleges) in 1995, but fell to 15th among 26 counties in 2005 (NCHEMS, 2009). In 2007, only 31 percent of 25-to-34-year-olds in the United States had attained a bachelor's degree, a 2 percent increase since the year 2000 (U.S. Department of Education, 2008).

A college degree has many benefits for the recipient. In 2005, the typical full-time, year-round worker in the United States with a four-year degree earned $50,900, 62 percent more than the $31,500 earned by the typical full-time, year-round worker with only a high school diploma (Baum and Ma, 2007). Males in the United States who complete tertiary education are employed at rates 50 percent higher than those with no postsecondary education, and their lifetime earnings are greater by more than $300,000 (OECD, 2009). A college degree is also associated with better citizenship, political involvement, volunteerism, job satisfaction, lawful behavior and even life satisfaction. Such externalities and positive spillover effects for the nation are an essential reason for public support of transfer systems in higher education (Bowen and Bok, 1998; Goldberg and Smith, 2008).

Because of the economic and societal benefits of obtaining a degree, colleges and universities are increasingly focused on enrolling and retaining students at their schools until degree completion. Fifty-six percent of students who entered a four-year U.S. college or university in 2001 graduated within six years, as compared to 52 percent of students entering in 1991 (NCHEMS, 2009). While this increase is noteworthy, the higher education community does anticipate an increasingly challenging environment as the population of the United States shifts. Over the next few years, the students graduating from high school each year

Between 28 percent and 40 percent of first-time freshmen in four-year public institutions, and between 42 percent and 63 percent of first-time freshmen in two-year public institutions, enroll in at least one remedial course.

will represent an increasingly diverse class of students. Currently, Hispanic and African American students are estimated to account for 30.4 percent of high school graduates. Over the next 10 years, that percentage is expected to increase to 38.4 percent (Western Interstate Commission for Higher Education, 2008). Many of these traditionally underserved students will come from communities with lower college attendance and graduation rates. They will also come from populations of students who have traditionally entered higher education having completed a less rigorous high school curriculum (Southern Regional Education Board, 2009).

An alarming number of students require some type of remedial course work when they enter a postsecondary education institution. Depending on the source, (Olson, April 25, 2006). The National Center for Education Statistics (2004) estimated that approximately 41 percent of students take at least one remedial class when entering college.

Remediation rates have been shown to be significantly associated with key student demographic variables, such as income, race/ethnicity and parental education. High school graduates from the highest income levels were three times more likely than students in the lowest income level to be academically prepared for college (Presley and Gong, 2005). A recent report by NCES divided college students into quintiles based on socioeconomic status and found that 63.2 percent of students in the bottom quintile (lowest SES) enrolled in a remedial course compared to 24.8 percent in the top quintile (highest SES) (National Center for Educational Statistics, 2004).

Remediation rates also differ by race and ethnicity. NCES estimates that 61.7 percent of African American students and 63.2 percent of Hispanic students take at least one remedial class, as compared to 34.6 percent of white students (National Center for Education Statistics, 2004). Further compounding matters, African American, Hispanic and low-income students are also more likely to be the first in their family to attend college (National Center for Education Statistics, 2005). First-generation students have generally been exposed to a less rigorous curriculum during high school than their non-first-generation counterparts (National Center for Education Statistics, 2005). Approximately 54 percent of first-generation students require remediation (at least one remedial class) about twice as often as students whose parent(s) had obtained a bachelor's degree (26.6 percent) (National Center for Education Statistics, 2005).

Students who require remediation are at greater risk for dropping out of college. Those students who require a remedial class have graduation rates that range between 30 and 57 percent, depending on the type and number of remedial classes they take, while those who do not require remediation have a graduation rate of approximately 69 percent (National Center for Education Statistics, 2004).

While it may be challenging to determine which specific classes are associated with greater student difficulties, students that take remedial classes in reading appear to be the most at risk (National Center for Education Statistics, 2004). Approximately 11 percent of college students take at least one remedial reading class, and these students are notably more likely to need to take other remedial classes.[1] In addition, only 30 percent of students taking a reading remedial class eventually completed their degree program (certificate, two-year or four-year), and only 17 percent completed a bachelor's degree.

Approximately 11 percent of students take at least one remedial class in mathematics, but these students, while still at risk, do not appear to be at as great a risk. Approximately 31 percent of students who take a remedial class in mathematics take four or more remedial

1 Fifty-one percent of these students take at least four remedial classes, and 68 percent require at least one remedial mathematics class.

classes, and 27 percent take remedial reading classes. Approximately 42 percent of these students completed their degree program, with 27 percent obtaining a bachelor's degree.

Characteristics Associated with College Readiness

With remediation so strongly tied to graduation, more and more education initiatives have focused on defining, measuring and improving the college readiness of high school students. Many different organizations have devoted considerable time and resources to the identification of the content and skills associated with college readiness. One of the more notable efforts to define college readiness was the project, *Understanding University Success*, sponsored by the Association of American Universities and the Pew Charitable Trusts (Conley, 2003). This two-year project recruited more than 400 faculty members from 20 research universities. Faculty members identified the knowledge and skills that students needed to have in order to succeed in entry-level courses at their universities. Faculty members were recruited across all disciplines, and standards were developed in English, mathematics, natural sciences, the social sciences, second languages and the arts.

With remediation so strongly tied to graduation, more and more education initiatives have focused on defining, measuring and improving the college readiness of high school students.

Beyond knowledge and skills required in each discipline, the authors noted that habits of mind are of critical importance for college success (Conley, 2003). The habits of mind discussed included critical and analytical thinking, problem solving, inquisitiveness, and the initiative to take advantage of the resources at their attending university. Other key features included an openness to trying new things and being willing to fail at tasks the first time and the ability to accept critical feedback and adjust accordingly. These habits of mind are a critical part of the standards, and the authors note that the content knowledge included in the standards cannot be interpreted without also considering these critical cognitive skills. The authors do acknowledge that the extensive knowledge and skills included in their report may not be achieved by all students, and that even successful college students may not have all of them. However, the working hypothesis is that the number of such knowledge and skills a student possesses is positively related to college success.

The Educational Policy Improvement Center (EPIC), in conjunction with the Bill and Melinda Gates Foundation (Conley, 2007), released a second influential report, which expands the definition of college readiness and views habits of mind as being one of four concentric levels required for success. The other three areas are academic knowledge and skills, academic behaviors, and contextual skills and awareness. The habits of mind and academic knowledge and skills discussed here are very similar to those used in *Understanding University Success*; however, this report also discusses the academic behaviors and the contextual skills necessary for college readiness. The academic behaviors are primarily focused on self-awareness and monitoring, as well as on study skills. Self-monitoring is essential because it allows students to work their way through a topic area independently, and to determine if they have reached a comprehensive understanding of a

topic. Study skills represent a wide range of key behaviors, such as time management, note taking and other essential skills students must have in order to successfully navigate their way through college. The contextual skills and awareness focus on students' ability to understand the university system as a whole, and their role within the university. Without this, students may never understand how the university system works, and find themselves frustrated at their inability to navigate the requirements and obstacles in their way.

Achieve Inc. developed a series of standards that define the needed knowledge and skills for college and workplace success. Through their American Diploma Project, currently endorsed by over 35 states, they have established a series of benchmarks of English and mathematics performance that students should attain in order to be ready for college and workplace success (Achieve Inc., 2004). The benchmarks were developed through partnerships with both employers and faculty at two- and four-year colleges. As a first step, Achieve commissioned a study to identify a series of "good jobs." Good jobs were defined as those that paid well enough to support a family and that had the potential for career advancement. Using these jobs as a baseline, Achieve mapped back the required competencies to high school courses taken by people in these jobs. Once the courses were identified, a team of content experts identified the essential knowledge and skills associated with these courses. Using these draft specifications, employers reviewed these knowledge and skills to refine their list to reflect the preliminary knowledge and skills expected of employees.

After completing this step, Achieve worked with college faculty members from two- and four-year higher education institutions to evaluate the knowledge and skills necessary to succeed in entry-level courses at their institutions. Once these proficiencies had been identified, these standards were synchronized with the standards they had developed using employer guidance. The synchronized standards were then reviewed by a group of experts representing both the employers and the higher education community.

Finally, using the revised standards, Achieve worked with higher education institutions and employers to collect examples of the knowledge and skills they identified. The standards have eight distinct strands in English, as well as four strands in Mathematics. Strands in English include strands in Writing and Research, while strands in Mathematics include Algebra and Number Sense and Numerical Operations. In addition to creating these standards, Achieve also developed a series of standards for grades 4 to 12 to demonstrate how students can progress through their scholastic careers and what steps are necessary in order to be on track to college readiness in earlier grades.

The College Board Standards for College Success™ (College Board, n.d.) define the skills and knowledge students must develop and master to succeed in college and the workforce in the 21st century. These standards for English Language Arts, Mathematics and Science are based on empirical research conducted by the University of Oregon's Center for Educational Policy Research in collaboration with the Association of American Universities. The standards are benchmarked against the College Board's Advanced Placement Program® as well as national and international frameworks including NAEP, TIMSS and PISA. The College Board Standards are designed to:

1. Provide a model set of comprehensive standards for rigorous middle school and high school courses that lead to college and workplace readiness

2. Reflect 21st-century skills such as problem solving, critical and creative thinking, collaboration, and media and technological literacy

3. Articulate fewer, clearer, higher standards and objectives while providing in-depth performance expectations to guide instruction and curriculum development
4. Serve as both learning and performance standards to guide curriculum development, instruction, and formative and summative assessment development
5. Provide teachers, districts and states with tools for increasing the rigor and alignment of course work across grades 6–12 to college and workplace readiness
6. Assist teachers in designing lessons and classroom assessments by clearly articulating the content standards students must meet beginning in grade six to be prepared for AP® and college-level work

Several states have used the College Board Standards as a resource or benchmark in reviewing their own state standards for alignment to college readiness and identify strengths and areas needing improvement.[2]

Overall, the definition of college readiness used in this report is tied to the academic success of students. Students who are college ready should be able to succeed in entry-level, credit-bearing college courses without the need for remediation. Other factors associated with college success (e.g., motivation, study skills, attitudes) may be equally important in evaluating outcomes such as persistence, college graduation or postcollege career readiness, yet this more expansive definition of college readiness is not the focus of this report.

Efforts to Address College Preparation

The state of Texas has undergone one of the more notable processes for defining college readiness. Texas educators developed standards for their state as well as measures of college readiness. The Texas standards focus on the content areas of English/Language Arts, Social Sciences, Mathematics and Natural Sciences. The standards, created by vertical teams of high school and college teachers, specify what students must know and be able to do in order to succeed in entry-level courses in postsecondary institutions in Texas. Although content knowledge is an important component of these standards, the content knowledge is designed to stimulate students into deeper levels of thinking. The multilevel standards focus on how subject matter is organized and presented in the classroom. By doing so, it is believed that the standards will aid in students' understanding of how subject matters are organized and the structure of a particular discipline.

The Texas Education Agency (TEA) also used a variety of processes for obtaining measurements on the college readiness of students (Miller, Twing and Meyers, 2008; Twing, Miller and Meyers, 2008). In one study, the performance of Texas students on the Texas Assessment of Knowledge and Skills (TAKS) was compared to their SAT® and ACT test results to determine if the TAKS could be used to evaluate student college readiness (Miller, Twing and Meyers, 2008; Twing, Miller and Meyers, 2008). The TEA found strong correlations between the tests and were able to use TAKS scores to predict student admission test scores. Using these predicted scores, as well as benchmarks on the SAT and ACT for college readiness, it would be feasible to develop college readiness benchmarks on the TAKS. In addition to this statistical method, the TEA also conducted a contrasting groups' standard setting study to investigate how the TAKS could be used to assess college readiness. The TEA collected data on the first group of students to take the new TAKS as juniors in 2003. These

2 The standards, which cover both middle school and high school, also provide a pathway for educators to increase the rigor of their curriculum and to help students along the way toward achieving college readiness. The standards are accompanied by sets of performance expectations that are designed to guide instruction and curriculum development, as well as assessment of students across the entire spectrum of the standards.

high school juniors were compared to college students who had successfully completed their first semester of college and also taken the same TAKS examination. From this methodology, the TEA was able to develop preliminary benchmarks for college readiness.

This work from Texas is one of the more noteworthy initiatives to define, measure and improve the state of student college readiness among their high school graduates. Other states and organizations are also developing similar initiatives. The common theme running through these initiatives is finding better ways to reach and educate students who have not traditionally been part of the college-going culture.

The Southern Regional Education Board (SREB, 2002) embarked on the College Readiness Policy Connections initiative that was designed to highlight student preparation for college and careers. Unlike previous efforts described above, SREB sought to go beyond standards and competencies associated with college readiness by helping states identify policy gaps and weaknesses that may hinder their students from reaching their college potential. The SREB and its three partner states (Georgia, Texas and West Virginia) identified 24 student needs associated with college readiness. These needs fall into the areas of curriculum and standards; assessment and accountability; educational support systems; qualified professional staff; community and parental partnerships; and facilities, equipment and instructional materials. By identifying and highlighting these needs, SREB hoped to outline a clear set of policies and initiatives that states could implement to encourage more students to reach the goal of college readiness at the end of their high school career.

Montgomery County in Maryland has recently developed a college readiness index comprised of seven key indicators (Von Secker, 2009):

1. Advanced reading levels in grades K–2
2. Advanced reading levels in grades 3–8
3. Successful completion of grade 6 math in grade 5
4. Algebra I by grade 8, with a C or higher
5. Algebra II by grade 11, with a C or higher
6. AP Exam of 3 or higher or IB exam score of 4 or higher by grade 12
7. SAT combined score of 1650 or higher or ACT composite score of 24 or higher

Montgomery County uses a variety of assessments to define the first two standards, including local and state tests in the definition. Using the Montgomery County Public Schools (MCPS) assessment program in primary reading, students are expected to read at level 4 by the end of kindergarten. On the Terra Nova 2nd edition, students are also expected to reach the 50th percentile by the end of grade two. Using the Maryland School Assessment (MSA), students are expected to meet the MSA reading requirements for a proficient or advanced rating in every grade from grade three to grade eight. The keys to college readiness were designed to be a pathway that parents and educators can use as a means to track students and to determine if they are on the path to college readiness upon graduation. Students are considered college ready in Montgomery County if they meet all seven indicators. The development of college readiness indicators for younger students is a key feature for Montgomery County. These early indicators will support the identification of students who are not on track at an earlier age. Once these students are identified, appropriate steps can be developed to get these students back on track to become college ready.

A consortium of New England states recently released a report summarizing the policies, procedures and goals of their states in improving college readiness (New England Board of Higher Education, 2006). This report used the definition of college readiness developed by Greene and Winters (2005) described later in this report. Using this definition of college readiness, this report highlighted the significant gap in college readiness for underrepresented minority students. The report called for a number of significant changes, including instituting a rigorous college-preparatory curriculum that would be the default for all students, and would require students and/or parents to actively opt out of such a curriculum.

The state of Illinois also released a report summarizing student college readiness using such indicators as student test scores and student high school GPA (Northern Illinois University, 2006). The report was released as part of an initiative to dramatically increase the percentage of Illinois students graduating from high school adequately prepared for college-level work. The report indicated the discrepancy in preparation across different students in Illinois, with many students from low-income families being the least prepared for college when graduating from high school. While the report encouraged the development of a more rigorous core curriculum for all students, it also emphasized that a rigorous curriculum, due to variation in instructional quality and expectations, was not a guarantee for college readiness. Using admission test scores from students, the authors estimated that slightly more than one-third of their graduating seniors left high school prepared for college-level work.

College Readiness Metrics

In addition to research on the knowledge and skills required to be ready for college, there has been a significant focus on metrics used to estimate the percentage of high school graduates who are adequately prepared for success in college. The work cited up to this point has adopted a comprehensive view of college readiness, involving multiple components that include habits of mind, academic behaviors, academic knowledge and contextual skills (Conley, 2007). Recently, more practical approaches have attempted to define or measure college readiness constrained by data that are readily available. Given the limitations of K–16 systems in many states and the relatively recent focus on college readiness indicators, existing research has largely been restricted to performance on tests. However, it is important to remember that models which incorporate academic course taking and grades, in addition to test scores, are viewed as superior to models that are based on test scores alone (Consortium on Chicago School Research, 2008). Each of the college readiness metrics reviewed below serve as a proxy for a very complex construct and are most useful in providing educators and policymakers with simple indicators for analysis at the group level (e.g., school, district, state).

In addition to its content-oriented standards for college success described above, the SREB (Lord, 2003) also identified college readiness benchmarks based on the SAT and ACT score scales. Following the National Assessment of Educational Progress (NAEP) performance levels, SREB defined four categories of college readiness: Basic, Admissible, Standard and Proficient. Of the Basic category, the report states that these scores are "generally sufficient for admission to degree programs at nonselective institutions, but students with these scores are generally required to take remedial courses" (Lord, 2003, p. 16). Of the Proficient category, the report states that these scores are "typically required for admission to selective programs (e.g., engineering) or selective/competitive institutions" (Lord, 2003, p. 16). The percentage of students in SREB states in 2002 who were meeting the benchmarks was 80–85 percent for the Basic category, 65–71 percent for the Admissible category, 46–57 percent for the Standard category and 16–26 percent for the Proficient category. The report advises that when evaluating the percentage of students meeting the benchmarks, it is important to

consider the proportion of high school seniors taking the tests in each state, because not all students take a college admission test.

Greene and Winters (2005) developed a measure of public high school college readiness designed to reproduce the minimum standards of the least selective four-year colleges. The standard includes earning a regular high school diploma, completing a minimum set of course requirements and being able to read at a basic level (scoring at or above the basic level on the National Assessment of Educational Progress reading assessment). In order to determine the minimum level for each of the three requirements, Greene and Winters completed an extensive review of the admission requirements of the least selective four-year institutions. The lowest level requirement of the schools surveyed was used to determine the minimum behavior associated with college readiness. Greene and Winters required that a student meet or exceed the minimum requirement on all three criteria, rather than allowing one criteria to compensate for one of the other criteria. According to their measure of college readiness, Greene and Winters estimated that in 2002 only 34 percent of high school graduates in the nation had the skills and qualifications necessary to attend college.

The National Center for Educational Statistics (NCES) constructed a measure of college readiness based on a student's cumulative grades in high school academic course work, senior class rank, National Education Longitudinal Study (NELS) 1992 test scores and college entrance examination scores (Berkner and Chavez, 1997). Using subject-matter experts' judgment of the college admission process, cut scores on each measure were established and students were assigned to one of five categories using these cut scores. Scales ranged from very highly qualified to marginally or not qualified, and students were assigned based upon the highest value of any of the academic criteria. In addition, students were moved up one category if they took rigorous academic course work (at least four years of English; three years each of a natural science, social science and math; and two years of a foreign language) and demoted one category if they did not take such course work. According to this college qualification index, among all 1992 high school graduates, nearly two-thirds (65 percent) appeared to have been at least minimally qualified for admission to a four-year college or university. Among those seniors classified as marginally or not qualified for regular four-year college admission, half entered postsecondary education, but only 15 percent enrolled in a four-year college or university. Among those seniors who were minimally qualified, three-quarters enrolled in some postsecondary education and 35 percent attended a four-year institution. Fifty-six percent of the somewhat qualified, 73 percent of the highly qualified and 87 percent of the very highly qualified high school graduates enrolled in four-year institutions.

The National Assessment Governing Board (NAGB) is currently undertaking an aggressive research agenda on college and career preparedness. Based on recommendations from a technical panel on 12th-grade NAEP (2008), NAGB is examining whether it is feasible to use NAEP as an indicator of college preparedness. The panel recommended a multipronged approach to gather validity evidence for such a use that includes content alignment with admission and placement tests, statistical linking studies between NAEP and SAT, traditional standard setting approaches and a comprehensive survey of postsecondary institutions.

In 2005, ACT reported that most U.S. high school students were not ready for college-level course work (ACT, 2005). Using the criteria of a 75 percent chance of earning a grade of C or better and a 50 percent chance of earning a B or better in first-year college English composition, algebra and biology courses, only 26 percent of ACT-tested high school graduates met the benchmark in biology, 40 percent in algebra and 68 percent in English composition. Only 22 percent of the 1.2 million students tested in 2004 met all three benchmarks.

Outcomes based solely on one predictor (e.g., test scores or grades) have consistently proven to be inferior to prediction models that employ multiple predictors (Zwick, 2002). In admission, hundreds of validity studies have established that college grades are best predicted by a combination of high school grades and SAT scores (Zwick, 1999), while other research has shown the importance of course intensity or academic rigor in predicting college outcomes (Adelman, 2006). Recent research by the Consortium of Chicago School Research (2008) has reported that grades in academic courses taken in high school were an excellent predictor of college performance, which again suggests the importance of models that incorporate multiple measures in predicting college success. This research has led us to question the efficacy of any college readiness models based solely on test scores.

Purpose

This report will investigate a method of setting benchmarks for three metrics used to predict college success: SAT scores, high school grades and academic rigor of high school course work. The development of such benchmarks based on multiple measures could greatly aid in the transmittal of information regarding college readiness to students, parents, educators and policymakers, as well as improve the accuracy of predictions concerning college readiness.

Prior research has demonstrated the utility of the SAT and HSGPA in predicting freshman year GPA (FYGPA). Kobrin, Patterson, Shaw, Mattern and Barbuti (2008) investigated the predictive validity of the SAT and found that the SAT sections combined correlated .35 with FYGPA, but when correcting for restriction of range the correlation was .53 (adj. r = .53). HSGPA had a similar correlation of .36 with FYGPA (adj. r = .54). Together, SAT and HSGPA correlated .46 with FYGPA (adj. r = .62), and thus the results suggested that the combination of SAT and HSGPA was the best predictor of FYGPA.

Mattern, Patterson, Shaw, Kobrin and Barbuti (2008) followed with a study that investigated the differential validity and prediction of the SAT using FYGPA as the outcome criteria. Their results indicated that the SAT slightly overpredicted for male students and underpredicted for female students. The FYGPA's of Asian American and white students were slightly underpredicted, while the FYGPA of African American, American Indian and Hispanic students were slightly overpredicted. However, these differences in prediction by group were minor and the results indicated that SAT scores were a fair and valid predictor for first-year GPA across demographic groups.

Kobrin (2007) estimated the SAT scores associated with college success. SAT scores of 800 and 1150 were associated with a 65 percent likelihood of obtaining a first-year GPA of 2.00 and 2.70, respectively. But this research was based only on SAT scores prior to March 2005, which did not include the Writing section of the SAT. This report utilized a benchmarking strategy similar to that of Kobrin (2007), but it uses the sum of all three SAT scores (with Writing), HSGPA and academic rigor.

The ability to easily track the college readiness of students has been a desired goal for many researchers interested in school reform (Center for American Progress, 2009). The College Board provides schools, districts and states with aggregate data and reports on student performance each year. These reports contain a wealth of information on students' performance over time, including detailed information on students' performance by gender, race/ethnicity socioeconomic status (SES) and language status. However, while school districts and state departments of education have access to the average SAT scores of their students and can examine trends over the years, there is no point of reference, such as a

benchmark that delineates likely college ready from not likely college ready, to help these educators and policymakers determine how many of their students are actually prepared to succeed in college.

The goal of this study was to design and validate a multidimensional index of college readiness that combined SAT scores with other academic information available about students. In addition to the SAT, the proposed index uses high school performance, or high school GPA, and the rigor of the course work being completed by the student. Through the sharing of this data, the College Board could assist schools, districts and states in tracking the state of college readiness in their schools and developing appropriate interventions to improve the rate of college readiness in their student body.

Method

Beginning in 2006, the College Board collaborated with four-year institutions that would provide college performance data on entering freshmen. The target population of institutions was identified as the 726 four-year colleges and universities that received at least 200 SAT score reports in 2005. Several research studies (Kobrin, Patterson, Shaw, Mattern and Barbuti, 2008; Mattern, Patterson, Shaw, Kobrin and Barbuti, 2009) have been published using data from the 110 institutions that participated in the 2006 cohort of entering freshmen — the first cohort to take the new SAT that included writing.

The goal of this study was to design and validate a multidimensional index of college readiness that combined SAT scores with other academic information available about students.

This project continued with a second cohort, the 2007 entering class, also with 110 participating institutions (though not an identical sample from the 2006 sample). It is the second cohort of entering freshmen in 2007 that has been used in this study. Complete details of the 2007 sample can be found in Patterson, Mattern and Kobrin (2009). All 110 institutions in the 2007 sample agreed to provide first-year performance data for 2007 high school graduates who had taken the SAT.

Table 1 provides a comparison of the target college population to our sample in terms of location (region), admission selectivity, size and control (public or nonpublic). The College Board data on students who completed the SAT were matched to college and university records from the 110 participating institutions for which freshman-year GPA (FYGPA) and individual course grades were available.

The number of graduating seniors in 2007 who took the SAT, self-reported their HSGPA and attended one of these 110 institutions was 159,283. In summer 2006, the College Board modified the SAT Questionnaire to collect more detailed records of student course-taking patterns in high school. These revised questions provided the data that were used to compute the academic rigor index (ARI). Students indicated which courses were completed in each grade and whether the courses

were honors, dual enrollment or AP. Approximately one-third of the students were excluded from this study because they took the SAT before these changes were incorporated into the SAT Questionnaire. The remaining two-thirds of students (n= 116,799) had been given the opportunity to complete the revised SAT Questionnaire. This dataset (116,799 students) was further restricted to those students who had fully completed the section on course work, resulting in a final sample of 67,644 students.

Measures

The College Readiness indicator consists of three indicators: SAT scores, high school GPA scores (HSGPA) and an academic rigor score.

SAT® Scores

SAT scores were obtained from the 2007 college-bound seniors cohort, which included students who graduated from high school in 2007 and had taken an SAT. The SAT consists of three sections: Critical Reading (SAT-CR), Mathematics (SAT-M) and Writing (SAT-W), each measured on a 200–800 scale. The Critical Reading section is 70 minutes in length and measures skills in identifying main and supporting ideas, determining the meaning of words in context, understanding authors' purposes, and understanding the structure and function of sentences. The Mathematics section is also 70 minutes in length and tests students' skills in number and operations; algebra and functions; geometry and measurement; and data analysis, statistics and probability. These skills are assessed through 44 multiple-choice questions and 10 constructed response questions. The Writing section is 60 minutes in length with 35 minutes allocated to 49 multiple-choice questions and 25 minutes for one essay. The scores from all three sections (SAT-CR, SAT-M and SAT-W) were summed to create a single SAT score on a 600–2400 scale.

HSGPA

Cumulative high School GPA data is self-reported by students registering to take the SAT. Scores are reported in letter grades ranging from an F (below 65) to an A+ (97–100).[3] High school grades were then converted to a 0–4.33 scale.[4]

As noted earlier, self-reported high school grades are a sufficiently accurate indicator of actual high school GPA and are frequently employed in validity studies. A number of studies have found correlations between self-reported HSGPA and actual HSGPA of approximately 0.75 to 0.85. Maxey and Ormsby (1971) analyzed a sample from 134 high schools and found the correlation ranged between 0.81 and 0.86. Schiel and Noble (1991) found the median correlation between self-reported and actual grades in various courses by sophomores from 83 high schools in one state to be 0.79. More recently, Kuncel, Credé and Thomas (2005) conducted a meta-analysis of the validity of self-reported HSGPA and examined 37

The academic rigor index (ARI) is a composite measure of the level of difficulty or rigor associated with students' high school course work.

3 Students are asked to report their cumulative GPA for high school by selecting one of the following options: A+ (97–100), A (93–96), A- (90–92), B+ (87–89), B (83–86), B- (80–82), C+ (77–79), C (73–76), C- (70–72), D+ (67–69), D (65–66), or E or F (below 65).

4 An A+ is converted to 4.33, A to 4.00, A- to 3.67, B+ to 3.33, B to 3.00, B- to 2.67, C+ to 2.33, C to 2.00, C- to 1.67, D+ to 1.33, D to 1.00, and E or F to 0.00.

studies that included 60,926 students. Their results indicated a correlation between self-reported HSGPA and actual HSGPA of 0.82.

Academic Rigor

The academic rigor index (ARI) is a composite measure of the level of difficulty or rigor associated with students' high school course work. The ARI was developed for this study and the complete description of the development and validation can be found in Wyatt and Wiley (in press). The index is calculated from student responses to the SAT Questionnaire, which collects information on English, math, science, social science/history, and foreign and classical language courses completed during high school. In addition, students indicated the academic level of each course completed, such as honors, dual enrollment and Advanced Placement® (AP).

Within each subject area (English, math, science, the social sciences and foreign/classical languages), between 0 and 5 points are awarded for each student depending on the rigor of the student's course work. Each of the scores from these five subscales is summed yielding a total score on a 0–25 scale. The algorithm for the scale and subscales was empirically based and derived by evaluating the relationship between course work and freshman year GPA. The complete algorithm is presented in Appendix A.

Freshman Year GPA

Institutions provided both individual course grades and cumulative GPAs (FYGPA) for freshman students, with FYGPA chosen as the criterion variable to validate the college readiness indicator. FYGPA had a number of advantages as a criterion. First, the curriculum is more uniform for students in the first year than in later years. Because of this uniformity, FYGPA is based upon a more similar criterion than in any other year of college. A second reason is that FYGPA is a broad measure of performance in college, incorporating the entirety of students' first-year academic performance, making it more appropriate and representative than individual course grades. Finally, FYGPA is strongly correlated with eventual graduation from college (Allen, 1999; Murtaugh, Burns and Schuster, 1999). Thus, FYGPA is an appropriate criterion to measure college readiness because it (FYGPA) provides a complete measure of student achievement in a single quantifiable number. Freshman year GPAs ranged from 0 to 4.19. Only two of the institutions comprising 1,277 students or 1.9 percent of the sample reported any students with GPAs above 4.0.

There are alternate outcomes of college that are also worth considering. Some researchers have examined performance in specific college courses (e.g., Biology, College Algebra). However, using specific course grades has several disadvantages. It will result in a high number of students being partially ready (meeting the metric in some subjects and missing it in other subjects). It also can omit some students who may not take a course in a particular subject during their freshman year. Using FYGPA should provide a more complete picture as to whether students are ready to tackle college-level work. Longer-term outcomes such as persistence and graduation are relevant and will be examined in the future as more data becomes available. However, it is also important to reiterate that many nonacademic factors play an influential role in these outcomes.

Analysis

College readiness was defined as having at least a 65 percent probability of obtaining a B- (or 2.67 FYGPA) or higher on each of the three indicators of college readiness: SAT scores, HSGPA and the ARI. For each of these indicators, the minimum score or benchmark associated with a 65 percent probability of obtaining a B- was calculated within each of the 110 institutions. These calculations were computed using logistic regression and produced SAT, HSGPA and ARI benchmarks for each of the 110 institutions separately. The benchmark

of any institution that was outside of the range of possible values (600–2400 for SAT, 0–4.33 for HSGPA or 0–25 for the ARI) was deemed invalid and dropped. Because of this adjustment, the number of institutions used in the calculation was reduced to 107 schools for the SAT, 95 schools for the HSGPA and 93 schools for the ARI. The valid institutional benchmarks were weighted by the number of students attending each institution and averaged to obtain an overall college readiness benchmark. Once a benchmark score was obtained, it was rounded down to the nearest legitimate interval (e.g., an SAT score of 1428 would be rounded down to 1420 since it is not possible for a student to score between 1420 and 1430). Students who meet all three college benchmarks (SAT, HSGPA and ARI) were determined to be ready for college-level course work.

College readiness was defined as having at least a 65 percent probability of obtaining a B- (or 2.67 FYGPA) or higher on each of the three indicators of college readiness: SAT scores, HSGPA and the ARI.

The college readiness benchmark is based on a conjunctive model in which students have to obtain the benchmark score for the SAT, HSGPA and ARI. As with the benchmark developed by Greene and Winters (2005), failure to obtain any one of these three benchmarks precluded the student from being considered "college ready" according to our indicator. A compensatory model in which superior performance in one or more indicators could compensate for subpar performance in another was considered but ultimately not adopted for a number of reasons. A primary reason for not adopting a compensatory model is that while all three criteria are measures of academic preparedness, each of the three was considered sufficiently unique that not meeting any one criterion indicated a significant deficit in student preparedness for college. A compensatory model might also lead to unnecessary complexity in reporting results to schools and districts by making it very difficult to provide feedback on which indicators (SAT, HSGPA and ARI) students excelled and on which they faltered. The feedback is considered a very important component of the value provided by this index. For example, a school or district might consider it valuable information to know that a large percentage of its students fail to meet the ARI criteria while meeting the SAT and HSGPA benchmarks. Such information is easily and clearly presented with the conjunctive model but not easily (if at all) communicated with the compensatory model.

It should be noted here that the SAT score used for this study represents the sum of all three test sections of the SAT. While it was possible to develop a separate index of college readiness using individual SAT test sections and grades and courses in a specific domain (e.g., math, English) this was not done because it could make interpretation more complicated.

The benchmarks for each of the three indicators (SAT, HSGPA and ARI) were based on a 65 percent probability of obtaining a B-. The 65 percent probability of success was chosen because this level has been widely used in research with the National Assessment of Educational Progress (NAEP) and other educational studies as an appropriate standard for defining success in a domain. A 65 percent probability level has been recommended by subject-area experts as an appropriate standard for knowledge or success in a domain (Beaton and Allen, 1992; Zwick, Senturk and Wang, 2001). Using a lower probability of

success (e.g., 50 percent) would certainly identify more students as college ready but would lead to more false positive classifications. Using a much higher probability level (e.g., 75 percent, 90 percent) would ensure much greater accuracy in predicting which students are ready for college, but it would also result in extremely high cut points and omit a high percentage of students who would succeed at college.

In 2008, the College Board assembled an expert panel of educators and policymakers to participate in a judgmental process to recommend both probability and criterion for defining college readiness. The panel agreed that a probability in the range of 60 to 75 percent would be the most appropriate.[5] The FYGPA criterion of 2.67 was chosen because it represents a B- at most colleges and seems appropriate and sufficiently rigorous when considering academic success of freshmen. In addition, the expert panel recommended a FYGPA of a B- as indicative of college success, and six-year graduation as indicative of ultimate college success. While this research will continue, and the proposed criteria of six-year graduation rate will also be evaluated, it will not be feasible to do until after the 2012-13 academic year.

Results

Descriptive Statistics

Table 1 compares the characteristics of the 110 colleges and universities in our sample to the population of institutions that received at least 200 SAT score reports in 2005. The institutions in the sample were fairly representative geographically, although slightly overweighted with schools from New England and the Middle Atlantic states while being underweighted with schools from the South. Additionally, schools in the sample were more selective and more likely to be privately controlled than those in the population.

Table 2 displays the demographic characteristics of all the students from the 110 participating colleges and universities (159,283) to those students from these same institutions who registered with a revised SAT Questionnaire and fully completed the course work questions (67,644). The two samples were very similar although there were a higher percentage of female students, a smaller percentage of white students, and a larger percentage of African American and Hispanic students among those students who completed the course work questions. Going forward, the 67,644 students who completed revised course work questions will be referred to as the "sample."

Table 3 compares the demographic characteristics of all the U.S. SAT takers graduating in 2009 to those SAT takers who also provided HSGPA and course work information (2009 restricted). Only students from the United States were included because the course work questions might contain nation-specific terminology and inclusion of responses from international students might confound interpretation of the results. The demographic characteristics of the 2009 U.S. total is very similar to the 2009 restricted group, although the later group is slightly more heavily weighted with female students and students whose best language is English. From this point forward in this report, this latter group will be referred to as the "population."

Table 3 also provides information on the demographic characteristics of the 2007 CRI sample. Compared to the population, the sample is more heavily weighted toward females and white students and slightly underweighted with African American and Hispanic students. The population used was from 2009 because this was the first class registering for the SAT using the revised SAT Questionnaire almost exclusively. The revised SAT Questionnaire contained the

5 A full description of the panel and the recommendations provided can be found in Kobrin, et al. (in press).

course work questions used to compute the ARI. Thus, it was felt that the 2009 population would be a more appropriate comparison group for the sample than the 2007 population because many students from the 2007 cohort had not registered with the new SAT Questionnaire.

Table 4 displays the descriptive statistics for the three components of college readiness: SAT scores (three sections combined), HSGPA, and ARI and freshman year GPA for the sample and population. The sample is comprised of students who had enrolled in a four-year college in the fall of the year they graduated from high school. Thus, it is not surprising that this sample appears to be better academically prepared than the overall population, with a mean SAT score of 1662 compared to 1523 for the population, a mean HSGPA of 3.62 compared to 3.35 for the population, and a mean ARI score of 13.50 compared to 10.90 for the population.

The difference in achievement between the cohort of high school students who took the SAT and the sample of enrolled college freshmen can be measured using an effect size index (Cohen, 1988). The effect size index is calculated using the ratio of the difference between means divided by the pooled standard deviation. All three measures showed moderate differences in achievement between the two groups, with the SAT and HSGPA effect size equal to 0.49, and the ARI effect size equal to 0.48. The fact that all three measures showed moderate differences in achievement suggests that all three measures are important in identifying college-ready students from the overall population of high school students.

Academic Rigor and FYGPA

The relationship between the ARI and FYGPA is positive and is shown in Table 5, which displays the mean FYGPA and the percentage obtaining an FYGPA of B- or higher at every point on the index. Each successive increment in the ARI above 4 resulted in a higher average FYGPA. The positive relationship can also be observed by investigating the percentage of students obtaining an FYGPA of a B- or higher. Each incremental increase in ARI between 4 and 25 results in an increase in the percentage of students obtaining a B- or higher. The failure to obtain such results at ARI levels below 4 may be due to the small number of students at each academic rigor level. Only 881 students (1.3 percent) scored between 0 to 3 on the ARI scale. Figure 1 provides a graphical account of the distribution of students on the ARI scale, while Figure 2 illustrates the relationship between the index and freshman college grades.

Benchmark Results

As described above, benchmark scores for each of the three components were obtained by completing a logistic regression analysis and determining the score associated with a 65 percent probability of obtaining a B- in first-year college courses. In order to be considered college ready, students must obtain the benchmark score in each of the three areas — SAT, HSGPA and ARI. Failure to meet any one of the benchmarks precluded a student from being deemed college ready. The benchmark scores obtained from the logistic regressions, also included in Table 6, were:

1. SAT benchmark	1550 (rounded from 1556)
2. HSGPA benchmark	3.33 or a B+ (rounded from 3.38)
3. ARI	10 (rounded from 10.54)

College readiness data for the sample and the population are presented in Table 7. Those in the 2007 sample are, by definition, already enrolled in college and are better academically prepared than the population. Thus, a higher percentage of students in the sample meet the overall college readiness index as well as each individual benchmark (Tables B1, B2 and

B3). This difference is observed consistently across all of the groups investigated. Given the consistency of the results, moving forward, only results for the 2009 population are discussed in this report.

Overall Results

The percentage of the population meeting all three benchmarks is reported in Table 7, and 31.9 percent of students are estimated to be college ready. As expected, a much higher proportion of students met each individual benchmark than were college ready (met all 3 benchmarks). For example, 45.7 percent of the population met (or exceeded) the SAT benchmark, 63.8 percent met the HSGPA benchmark and 52.8 percent met the ARI benchmark (Tables B1, B2 and B3). The percentage of students in the sample and population meeting each individual benchmark is reported in Appendix B.

31.9 percent of the 2009 population met all three benchmarks, while 23.1 percent of students did not meet any of the three criteria, 23.6 percent met one of the criteria and 21.4 percent met two criteria.

Table 8 displays data on the percentage of students in the population meeting the overall college readiness index, as well as the percentage meeting none, one or two of the benchmarks. As mentioned before, 31.9 percent of the 2009 population met all three benchmarks, while 23.1 percent of students did not meet any of the three criteria, 23.6 percent met one of the criteria and 21.4 percent met two criteria.

Results by Gender

The differences in the percentage of students considered to be college ready by gender are slight, with 32.2 percent of female students compared to 31.6 percent of male students considered college ready. Across the individual benchmarks, a smaller percentage of female students met the SAT benchmark, but a higher percentage of female students met the HSGPA and ARI benchmark.

Table 9 contains the means and standardized differences for HSGPA, SAT and ARI by gender. The standardized differences were calculated by subtracting the mean score for the total group from the mean score of the subgroup and dividing the difference by the total group standard deviation. The table indicates that male students had a higher mean SAT score than female students (1541 versus 1508) and had a standardized difference of 0.06, whereas female students had a standardized difference of -0.05. Female students had a slightly higher HSGPA (3.41 versus 3.27) and had a standardized difference of 0.10 versus -0.13 for male students. The mean ARI score for female students was 11.0 compared to 10.7 for male students, resulting in effect sizes of 0.3 and -0.4, respectively.

Results by Ethnicity

The percentage of the 2009 college-bound seniors cohort meeting all three benchmarks, as well as each individual benchmark, is reported by ethnicity in Table 7 and in Tables B1, B2 and B3. As shown in the table, 42.7 percent of Asian American students were considered college ready, as were 38.2 percent of white students. The percentage of African American and Hispanic students considered to be college ready is 9.8 percent and 17.8 percent, respectively.

The HSGPA benchmark was achieved by the highest percentage of students across all ethnic groups, followed by the ARI benchmark, and then by the SAT benchmark. While this trend was consistent across ethnic subgroups, the magnitude of the differences between the percentage obtaining the SAT benchmark and the percentage obtaining the HSGPA benchmark varied. For example, 68.8 percent of white students met the HSGPA benchmark and 54.7 percent met the SAT benchmark, a difference of 14.1 percent. In contrast, 43.7 percent of African American students met the HSGPA benchmark and 15.9 percent met the SAT benchmark, a difference of 27.8 percent.

Table 8 displays data on the percentage of students in the population meeting the overall College Readiness Index, as well as the percentage of students meeting one, two or no benchmarks. The data in Table 8 is also disaggregated by ethnicity. As can be seen in Table 8, American Indian, African American and Hispanic students achieve each of the benchmarks less frequently than do Asian American and white students.

Table 9 contains the means and standardized differences for HSGPA, SAT and academic rigor (ARI) by ethnicity. Asian American and white students have positive standardized differences across each of the three measures, while African American and Hispanic students have negative standardized differences. The magnitude of these standardized differences varied within ethnicity. Asian American students were fairly consistent across SAT, HSGPA and ARI, with standardized differences of .30, .21 and .32, respectively. White students have the greatest standardized difference on the SAT (.22) compared to HSGPA (.13) or ARI (.09). As with white students, African American and Hispanic students have the greatest standardized difference on the SAT. African American students had a standardized difference of -.76 on the SAT compared to -.52 on HSGPA and -.44 on ARI. Hispanic students had a standardized difference of -.46 on the SAT compared to -.21 on HSGPA and -.19 on ARI.

Research has consistently shown significant differences between racial/ethnic subgroups on nearly all measures of educational outcomes or achievement, but these differences tend to be larger across standardized tests, followed by academic rigor or course work and high school grades (Adelman, 2006; Camara and Schmidt, 1999; Zwick, 2002). Subgroup differences in college performance tend to be most consistent with patterns on standardized tests; that is, group differences on the SAT and other standardized tests are much more representative of differences in college grades and graduation rates across these groups. This is further supported by evidence that high school grades significantly overpredict the performance of underrepresented minorities and that the difference between high school grades and college grades are approximately 30 percent greater for minority students.[6] Admission test scores also result in the overprediction of minority student performance, but the effect is smaller than when high school grades are used (Camara and Schmidt, 1999; Mattern, Patterson, Shaw, Kobrin and Barbuti, 2008).

There is no definitive answer as to why such minority group differences exist, or why the differences are slightly larger on standardized tests and college grades than nonstandardized measures such as HSGPA and academic rigor. However, Barton and Coley (2008) have identified 14 factors that correlated with educational achievement and resulted in large gaps in educational achievement. Six factors were associated with differences in school quality (e.g., teacher quality and experience, attendance, class size, school safety) and eight factors were associated with preschool experience and out-of-school experience (e.g., hunger and nutrition, parent participation, student mobility, reading to children, TV watching). Research

6 For example, Camara and Schmidt (1999) report an average difference of 1.0 –1.06 between HSGPA and FYGPA of minority students, compared to a difference of .74–.78 for white and Asian American students.

has found significant gaps favoring nonminority students on each of these factors, and has also demonstrated that these factors are highly related to educational achievement.

Hanushek and Rivkin (2006) suggested that the cause of the achievement gap between students was in large part due to differences in school quality. Hanushek and Rivkin used a quantitative approach utilizing data from the Early Childhood Longitudinal Survey (ECLS) and the Texas School Projects (TSP) and found that many school-based factors were responsible for the exacerbation of the achievement gap beyond grade three. Factors contributing to African American student underperformance included higher mobility rates, higher proportions of beginning teachers, and imbalanced racial composition of teachers and peers. Thus, there seems to be compelling evidence that African American and Hispanic students attend lower quality secondary schools. Arguably, these differences in school quality are reflected in national standardized examinations, which are consistent across schools but not in measures such as HSGPA and course work content that can differ by school.

Discussion

This report presented a methodology for the measurement and tracking of the college readiness level of high school students who are engaged in the college admission process. The proposed index would use the three distinct hurdles of SAT scores, high school GPA and a newly developed measure of academic rigor. The proposed index could provide useful information to constituents of the College Board and has many advantages to recommend it. Among the anticipated advantages are:

1. The measurement of college readiness using multiple measures
2. The enhancement of aggregate reporting capability
3. The development of early indicators of college readiness
4. The capability to assist schools and districts in tracking college readiness

A measure based upon the three indicators used here is likely to present a more comprehensive picture than a benchmark based on test scores alone.

Multiple Measures

An index of college readiness that focuses solely on the academic preparedness of students will, by definition, neglect to incorporate other important areas of college readiness, such as study skills, student motivation and other key personality factors that have been associated with a variety of important college outcomes such as persistence, graduation status and time to degree (Conley, 2007). Nonetheless, a measure based upon the three indicators used here is likely to present a more comprehensive picture than a benchmark based on test scores alone.

One of the most frequent criticisms of most No Child Left Behind (NCLB) testing systems is the sole reliance on test scores (Pinkus, 2009). The Standards for Educational and Psychological Testing (AERA, APA and NCME, 1999) recommend that educational decisions or characterizations not be made on the basis of a

single test score. "Comprehensive assessment should involve the use of multiple measures, and data should be collected from multiple sources" (p. 147). Indices based on only one metric are convenient and easily understood, yet thousands of students with poor admission test scores or poor grades succeed at college each year. Likewise, thousands of students with high test scores or grades fail to complete their first year, are placed on academic probation or do not succeed at college based on other outcomes (Mattern, Shaw and Kobrin, 2010; Milewski, Kobrin and Camara, 2002).

Enhanced Reporting

This index could greatly enhance the reporting of college readiness for educators and policymakers. The index has four key features that could make it exceptionally useful. First, the index could be reported on all students who took the SAT and completed the SAT Questionnaire. Over 1 million students in the high school graduating class of 2009 took the SAT and fully completed the SAT Questionnaire. Being able to report trends on this large a number of students could serve as a useful indicator of college readiness across the United States. A second advantage of the proposed index is that it can easily summarize the college readiness of students. A single measure or number is more easily understood and communicated across a variety of audiences. The third advantage is that while the index can be condensed into a single measure, it can also be disaggregated across the three measures. The ARI, in particular, can be deconstructed in ways that allow educators to understand why groups of students may be less academically prepared for college and to identify specific gaps by content and grade. For example, at a particular school or district, low ARI metrics may be related to less preparation in math. Upon further investigation we can determine whether this is primarily due to policies that appear to limit access to rigorous courses such as Algebra I in eighth grade or whether students are simply not taking math courses in the senior year, or both. The fourth advantage for aggregate reporting is that the index could also greatly facilitate the tracking and reporting of trends across years for schools and districts. Because there is a single measure of college readiness, schools and districts can quickly and easily see if the overall academic standing of their graduating seniors has improved over the past few years. If interested, they can also determine which of the three components their students' preparedness has improved.

Early Indicators

While the proposed index can provide useful information for schools and districts to evaluate the students graduating from their high schools, it can also be used as a benchmark in the development of a series of early indicators of college readiness. Approximately 1.5 million high school sophomores and 1.5 million high school juniors take the PSAT/NMSQT® each year. By linking the proposed index to student performance on the PSAT/NMSQT in the 10th and 11th grades, early indicators of college readiness can be developed. By having these indicators earlier in the students' academic careers, more time would be available to assist the students in need of remedial work. Research creating the link between the SAT benchmark and the PSAT/NMSQT has been completed, and benchmarks for the PSAT/NMSQT have been developed (Proctor, Wyatt and Wiley, in press). With the introduction of the ReadiStep™ program for eighth-grade students, a link between ReadiStep and PSAT/NMSQT performance may also be developed in the future. Once these links are developed, early indicators for eighth-grade students could also be calculated. Future research will look to create comprehensive links to the complete College Readiness Index.

The development of indicators for eighth-grade students could prove even more useful, as the students' entire high school careers are still available for remediation. Such projections

would ideally incorporate grades and course-taking history, as well as scores from PSAT/NMSQT and ReadiStep.

The index could present a useful summary of students' college readiness as they leave high school, and could be a valuable component of a district's overall college readiness toolbox.

Potential Uses by Schools, Districts and States

Information from these indicators may also be useful to schools, districts and states that may need assistance in developing and validating their own measures of college readiness. The index could present a useful summary of students' college readiness as they leave high school, and could be a valuable component of a district's overall college readiness toolbox. Many researchers who have focused on college readiness have encouraged the development of clear college readiness indicators for students as they progress through school (Corwin and Tierney, 2007; Dounay, 2006). In addition, through the development of the ARI, a clear set of course recommendations could be developed that would allow schools and districts to track what percentage of their students were taking an appropriate level of course work each year. The ARI could allow educators to compare the rigor or courses across groups of students and across years to determine if and where significant gaps exist and how to respond to these needs. Finally, schools can examine gaps and weaknesses (e.g., test scores, grades or courses, as well as specific course areas), and evaluate the impact that potential changes in course sequence, access to honors and AP courses, and curriculum may have on the number and percentage of students who are college ready in high school. With substantial research, similar projections could also inform projections of college readiness in the eighth and ninth grades.

Limitations

While the proposed index does have many positive features, a few limitations of the index should also be noted here. Most importantly, this index is not designed for high stakes decisions such as college admission or school accountability. The College Readiness Index and other similar metrics are convenient methods of describing aggregate data and groups of students in a school, district or state. The College Board's College Readiness Index is based on multiple measures, but it still compresses the data for each student. Admission officers have the actual high school transcript available and are able to conduct a comprehensive review of each student, evaluating his or her grades in relation to the rigor of courses completed. They can also examine student achievement and academic rigor in relation to other students at that school. The proposed index cannot consider the overall educational and social context and the way in which a student's test scores and academic performance relate to that context. Using student grades and course patterns from actual transcripts will be more effective and appropriate for individual decisions. The course work data used to calculate the ARI, as well as the high school GPA data, are collected through student self-reporting of their behavior. As it is collected now, students have very little motivation to misrepresent their behavior. If the index were to become a high stakes index, the incentive for students to

misrepresent themselves will increase and could lead to inaccurate data being reported back to schools and districts.

A second limitation of the proposed index is that student SAT participation will confound the interpretation of the index. In most states, districts and schools, there is significant self-selection among students in deciding whether to apply to college, and if so, whether to take the SAT. In instances where self-selection is high and SAT participation is low, the college readiness metrics will be less representative and valid as indicators of a school or district performance. However, in schools, districts or states where a significant majority of students have taken the SAT, the college readiness metric should be representative and accurate as an indicator of college preparedness. In essence, we are simply reiterating proper methodological procedures in reminding users to consider the representativeness and participation rates of students in a sample when drawing inferences about issues of school quality.

As mentioned earlier, HSGPA and the ARI are based upon self-reported data. While research has indicated that self-reported data are reliable and accurate indicators of student behavior (Freeberg, 1988; Kuncel, Credé and Thomas, 2005), the self-reported nature of the data does impose some restrictions on the interpretation of the index.

A fourth limitation is that course work data are currently not available for students who take the PSAT/NMSQT and the ReadiStep tests. As discussed previously, while PSAT/NMSQT and ReadiStep test scores can be linked to the SAT benchmarks, course work data are currently unavailable for these students. Because of this limitation, a link to the composite college readiness index is not feasible at this time.

Conclusion

Further research is needed in several areas to examine the stability of college readiness benchmarks over time, and across different types of institutions and different majors. In addition, many educators have called for studies that use other criteria such as time to graduation or cumulative grades in college. Validation studies that examine other academic outcomes such as performance in specific course grades (e.g., Western Civilization, Organic Chemistry) within and across majors and cumulative GPA should be the most immediate concern because current benchmarks are based on academic measures. Clearly, while these outcomes will be influenced by factors that lie outside the current college readiness model, they still must be examined. Conley (2007) has emphasized the importance of academic behaviors, and contextual skills and awareness that include meta-cognition, the ability to self-monitor performance, and awareness of cultural norms and behaviors that impact success in any system. In addition, graduation and persistence will be influenced by nonacademic factors such as personality traits, financial resources and coping skills (e.g., adjustment, interpersonal relationships) (Camara, 2005). We would expect that academic and cognitive predictors will be less predictive of outcomes such as persistence and graduation that are more heavily influenced by economic and social factors. However, we still expect to see an important relationship between cognitive predictors and these outcome variables.

Another focus of research should be to evaluate the efficiency and accuracy of the linkages between performance on eighth- and 10th-grade tests such as the PSAT/NMSQT and ReadiStep in projecting college readiness for cohorts in earlier grades. One way to evaluate this issue is to work with participating schools and districts that administer these tests to all students in a particular grade and obtain course grade and course-taking data from a central database. Additionally, students could be asked to complete a separate questionnaire

to collect this information prior to test administration. In this way, research could examine the effectiveness of multiple measures in providing an early indication of student college readiness and compare results to a college readiness metric based solely on a test scores.

Ultimately, the utility and validity of college readiness metrics will rest on multiple lines of evidence that must demonstrate the relationship between all measures to academic performance in college. In addition, future research should examine issues such as differential prediction based on school and student characteristics, as well as the performance of students with discrepant scores on the three measures. College readiness metrics can inform educational policy and even inform educational decisions, yet we must recognize the limitations of projections and predictions, especially as they could result in unintended negative consequences for students and schools. It is important to show modesty in our discussions and caution in our interpretations when attempting to predict how young students may behave in the future given what we know about student learning, development and cognition.

The College Readiness Index can provide rich and detailed information to initiate discussions in schools and districts, and even around the dinner table, about what it takes to be successful in college.

Nonetheless, the College Readiness Index can provide rich and detailed information to initiate discussions in schools and districts, and even around the dinner table, about what it takes to be successful in college. Accurately measuring and diagnosing college readiness is the first step to helping a greater number of students achieve college readiness.

The College Readiness Index can be used by students and families to provide realistic information on what it takes to be college ready. The index will also allow educators to illustrate that college readiness is more than a test score or good grades. The College Readiness Index can provide a clear framework to assist in the communication between educators, students and families when they discuss future college plans for students.

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Table 1

Percentage of Institutions by Key Variables: Comparison of Population to Sample

Variable	Class	Population	Sample	Sample N
Region of U.S.	Midwest	16%	16%	18
	Mid-Atlantic	18%	21%	23
	New England	13%	18%	20
	South	25%	14%	15
	Southwest	10%	13%	14
	West	18%	18%	20
Selectivity	Admits under 50%	20%	19%	21
	Admits 50 to 75%	44%	57%	63
	Admits over 75%	36%	24%	26
Size	Small	18%	22%	24
	Medium to large	43%	37%	41
	Large	20%	17%	19
	Very large	19%	24%	26
Control	Public	57%	46%	51
	Private	43%	54%	59

Table 2

Demographic Characteristics of the 2007 Validity and CRI Samples

Variable	Class	2007 Validity Sample		2007 CRI Sample[1]	
		Number	Percent	Number	Percent
Gender	Female	86,390	54%	39,189	58%
	Male	72,893	46%	28,455	42%
Race/Ethnicity	American Indian	823	1%	358	1%
	Asian American	14,555	9%	6,809	10%
	African American	10,224	6%	5,796	9%
	Hispanic	12,934	8%	6,951	10%
	White	109,150	69%	43,130	64%
	Other	4,480	3%	1,908	3%
	No Response	7,117	4%	2,692	4%
Best Language	English	147,114	92%	61,503	91%
	English and Another Language	8,521	5%	4,594	7%
	Another Language	1,556	1%	732	1%
	No Response	2,092	1%	815	1%

1. 2007 CRI Sample students are those with valid SAT scores, self-reported HSGPA and course work data, and FYGPA data

Table 3

Demographic Characteristics of the 2007 CRI Sample and the 2009 SAT College-Bound Seniors Cohort

Variable	Class	2009 U.S. Total[1]		2009 Restricted[2]		Sample[3]	
Gender	Female	773,125	54%	620,580	56%	39,189	58%
	Male	662,116	46%	496,048	44%	28,455	42%
Race/Ethnicity	American Indian	8,597	1%	6,657	1%	358	1%
	Asian American	127,190	9%	98,798	9%	6,809	10%
	African American	181,872	13%	140,442	13%	5,796	9%
	Hispanic	199,480	14%	152,968	14%	6,951	10%
	White	826,382	58%	662,683	59%	43,130	64%
	Other	42,211	3%	32,441	3%	1,908	3%
	No Response	49,509	3%	22,639	2%	2,692	4%
Best Language	English	1,237,591	86%	986,714	88%	61,503	91%
	English and Another Language	133,938	9%	103,776	9%	4,594	7%
	Another Language	30,552	2%	18,891	2%	732	1%
	No Response	33,160	2%	7,247	1%	815	1%

1. All SAT takers within the 50 states and the District of Columbia who graduated in 2009.

2. Same as above, but further restricted to those who provided HSGPA and course work information on the SAT Questionnaire.

3. Same as 2007 CRI Sample students in Table 2.

Table 4

Descriptive Statistics on the CRI Sample and Population[1]

Predictor/Outcome	Sample (67,644)		Population (1,116,628)	
	Mean	SD	Mean	SD
HSGPA	3.62	.50	3.35	.61
SAT	1662	263	1523	301
Academic Rigor	13.5	5.4	10.9	5.5
FYGPA	2.93	.73	N/A	N/A

1. Same as 2009 Restricted SAT Takers in Table 3

Table 5

Relationship Between Academic Rigor and FYGPA in the Sample

Scale Points	Number	Percent	Mean FYGPA	Percent with FYGPA 2.67+
0	31	0.0%	2.35	41.9 %
1	100	0.1%	2.35	42.0%
2	220	0.3%	2.43	43.2%
3	530	0.8%	2.51	46.4%
4	1,231	1.8%	2.43	43.9%
5	2,304	3.4%	2.48	46.0%
6	3,084	4.6%	2.53	48.8%
7	3,676	5.4%	2.61	52.8%
8	3,769	5.6%	2.66	55.2%
9	3,704	5.5%	2.74	60.1%
10	3,599	5.3%	2.80	62.2%
11	3,762	5.6%	2.86	66.6%
12	3,720	5.5%	2.91	69.6%
13	3,878	5.7%	2.95	71.0%
14	3,875	5.7%	2.97	71.9%
15	3,919	5.8%	3.02	73.8%
16	4,036	6.0%	3.06	75.8%
17	3,968	5.9%	3.10	78.9%
18	3,871	5.7%	3.12	79.9%
19	3,607	5.3%	3.19	82.1%
20	3,340	4.9%	3.22	84.1%
21	2,765	4.1%	3.25	85.1%
22	2,093	3.1%	3.26	84.9%
23	1,420	2.1%	3.32	88.8%
24	818	1.2%	3.37	90.5%
25	324	0.5%	3.42	92.3%

Table 6

Benchmark Scores Associated with a 65 Percent Probability of Obtaining a B- (2.67) FYGPA: SAT Scores, HSGPA and Academic Rigor

Criteria	SAT Score	HSGPA	Academic Rigor
65% Probability of a B-	1550	B+	10 (0–25 scale)

Table 7

Percentage of the Population and the Sample Who Are College Ready

		Population College Ready*	Sample College Ready*
Overall		31.9	52.8
Gender	Female	32.2	52.4
	Male	31.6	53.4
Ethnicity	American Indian	23.2	45.8
	Asian American	42.7	62.8
	African American	9.8	26.0
	Hispanic	17.8	37.8
	White	38.2	56.9
	Other	31.5	53.4
	No Response	37.5	59.0

*Meet all three benchmarks: SAT, HSGPA and ARI

Table 8

Percentage of the Population Attaining One, Two or Three by College-Ready Benchmarks

		None	Any One	Any Two	College Ready*
Overall		23.1	23.6	21.4	31.9
Gender	Female	21.2	24.5	22.1	32.2
	Male	25.4	22.4	20.6	31.6
Ethnicity	American Indian	27.7	27.8	21.3	23.2
	Asian American	14.0	19.9	23.3	42.7
	African American	43.0	30.3	16.9	9.8
	Hispanic	30.7	29.8	21.6	17.8
	White	18.4	21.3	22.1	38.2
	Other	23.6	23.9	21.1	31.5
	No Response	21.5	20.7	20.2	37.5

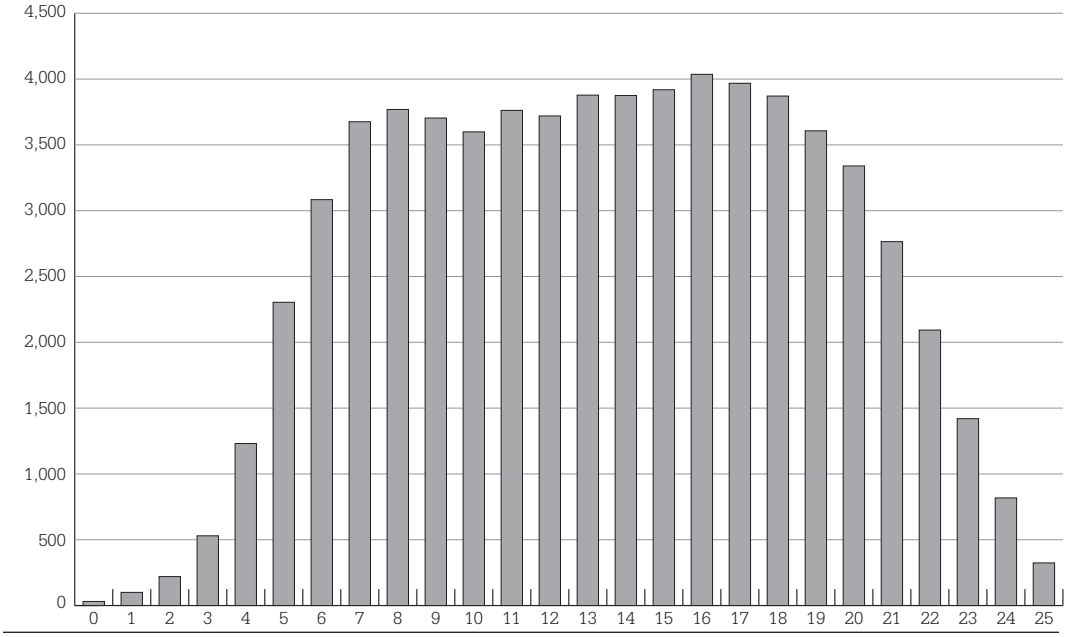
*Meet all three benchmarks

Table 9

Mean Scores and Standardized Differences for SAT, HSGPA Academic Rigor (ARI) Scores by Gender and Ethnicity for the Population

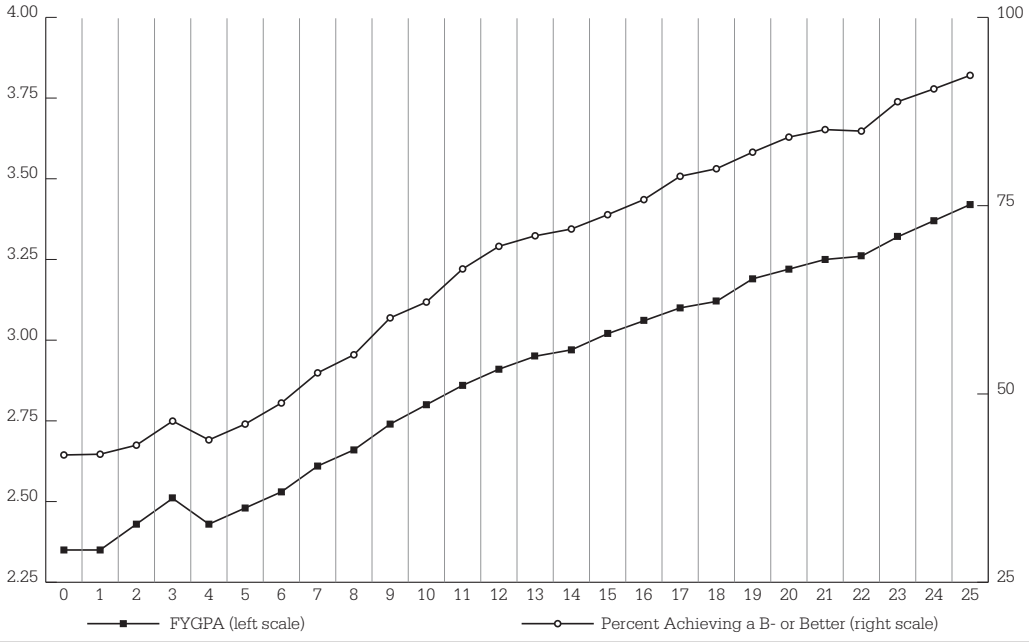
		Mean Scores			Standardized Differences		
		SAT	HSGPA	ARI	SAT	HSGPA	ARI
Overall		1523	3.35	10.9	N/A	N/A	N/A
Gender	Female	1508	3.41	11.0	-.05	.10	.03
	Male	1541	3.27	10.7	.06	-.13	-.04
Ethnicity	American Indian	1460	3.27	9.7	-.21	-.13	-.22
	Asian American	1614	3.48	12.6	.30	.21	.31
	African American	1294	3.03	8.5	-.76	-.52	-.44
	Hispanic	1383	3.22	9.9	-.47	-.21	-.18
	White	1588	3.43	11.4	.22	.13	.09
	Other	1519	3.32	11.0	-.01	-.05	.02
	No Response	1581	3.36	11.2	.19	.02	.05

Figure 1
Distribution of scores by academic rigor score for the sample.



Note: N= 67,644

Figure 2
Relationship between academic rigor and freshman college grades for the 2007 sample.



Appendix A

English Scale (0 to 5 points)

Course work (1 point)

- A student is awarded 1 point for having taken four years (excluding courses taken concurrently) of English in grades 9–12 (0/1)
- Honors/AP/Dual Enrollment (4 points)
- No honors, no AP = 0
- 1 honors or dual enrollment course, no AP = 1
- 2 or more honors or dual enrollment courses, no AP = 2
- 1 honors or dual enrollment course, and 1 AP = 3
- 2 or more honors or dual enrollment courses, and 1 AP = 4
- 2 AP = 4

Mathematics Scale (0 to 5 points)

Course work (5 points)

- A student is awarded 1 point for having taken three years (excluding courses taken concurrently) of mathematics in grades 9–12 (0/1).
- Each class is reviewed and the student is assigned a value of 1 if he or she has taken the class in the grade for which a point is awarded (see chart below) — a maximum of 1 point is awarded for each grade.
- The points earned for grades 9–12 are summed for a total of between 0 and 4 points, and then added to the points awarded for having taken three years of mathematics for a possible subscale range of 0–5.

	9th	10th	11th	12th
None	0	0	0	0
Pre-Algebra	0	0	0	0
Algebra 1	0	0	0	0
Algebra 2	1	1	0	0
Geometry	1	0	0	0
Trigonometry	1	1	1	0
Precalculus	1	1	1	0
Calculus	1	1	1	1
Stats	1	1	1	1
Integrated Math	1	1	0	0
Other Math	0	0	0	0

Honors/AP/Dual Enrollment

- If a student has taken an AP Calculus Exam, he or she is automatically awarded 5 points.

Science (0 to 5 points)

Course work (3 points)

- A student is awarded 1 point for having taken biology, chemistry and physics (0/1).
- A student is awarded 1 point for having taken three years of science in grades 9–12 (0/1).
- A student is awarded 1 point for having taken four years of science in grades 9–12 (0/1).

Honors/AP/Dual Enrollment (2 points)

- 1 point for having taken any science honors or dual enrollment course
- 2 points for having taken an AP course (0/2)

The Social Sciences and History (0 to 5 points)

Course work (1 point)

- A student is awarded 1 point for three or more years of Social Sciences (0/1).

Honors/AP/Dual Enrollment (4 points)

- 0 points if no honors, dual enrollment or AP
- 1 point for having one honors/dual enrollment class but no AP classes
- 2 points for having two or more honors/dual enrollment classes and no AP or no honors/dual enrollment and one AP class
- 3 points for having one honors/dual enrollment and one AP or no honors/dual enrollment and two or more AP classes
- 4 points for having at least three combined honors/dual enrollment and AP courses with at least one honors/dual enrollment course and one AP class

Foreign and Classical Language (0 to 5 points)

Course work (3 points)

- 1 point for having taken two years of language (grades 9–12)
- 2 points (0/1) for having taken three years of language
- 3 points for having taken four or more years of language

Honors/AP/Dual Enrollment (2 points)

- 1 point for each class taken within language honors, dual enrollment course or AP course

Appendix B

Percentage of Students Who Are College Ready by Individual Components

Table B1

Percentage of the Population and the Sample Who Are College Ready, by SAT Scores

		Population SAT	Sample SAT
Overall		45.7	66.0
Gender	Female	43.5	63.5
	Male	48.5	69.5
Ethnicity	American Indian	37.3	62.8
	Asian American	56.6	74.3
	African American	15.9	35.0
	Hispanic	26.3	48.0
	White	54.7	71.4
	Other	44.9	66.4
	No Response	54.6	73.1

Table B2

Percentage of the Population and the Sample Who Are College Ready, by HSGPA

		Population HSGPA	Sample HSGPA
Overall		63.8	81.2
Gender	Female	67.8	83.4
	Male	58.7	78.1
Ethnicity	American Indian	58.6	73.7
	Asian American	72.8	87.3
	African American	43.7	87.3
	Hispanic	55.2	67.9
	White	68.8	82.4
	Other	61.7	81.7
	No Response	64.5	82.1

Table B3

Percentage of the Population and the Sample Who Are College Ready, by Academic Rigor (ARI)

		Population ARI	Sample ARI
Overall		52.8	72.4
Gender	Female	54.1	72.7
	Male	51.1	72.1
Ethnicity	American Indian	44.2	64.0
	Asian American	65.4	82.1
	African American	33.8	57.0
	Hispanic	45.0	70.9
	White	56.6	73.1
	Other	53.9	73.6
	No Response	54.7	75.1

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