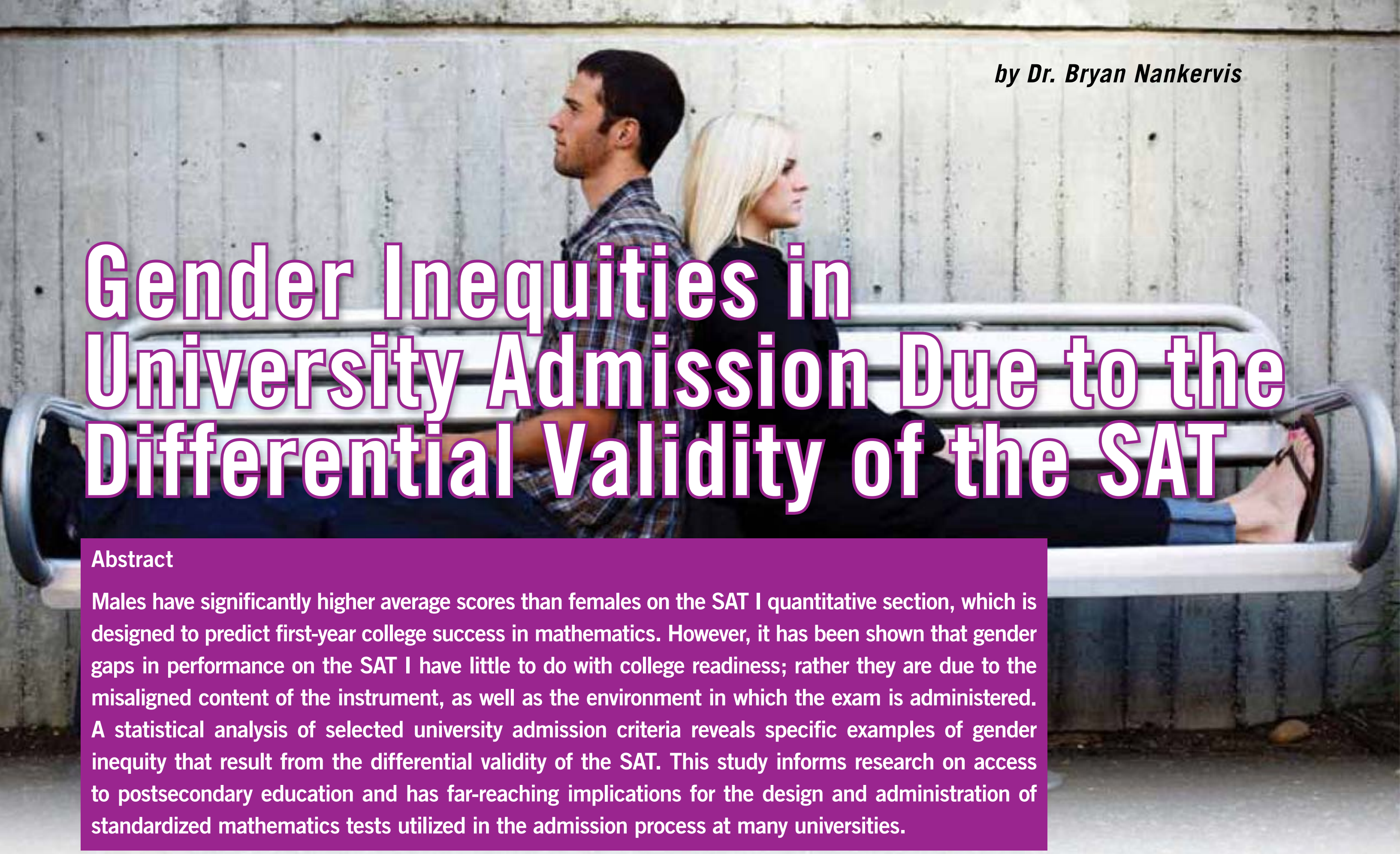


by Dr. Bryan Nankervis

Gender Inequities in University Admission Due to the Differential Validity of the SAT

Abstract

Males have significantly higher average scores than females on the SAT I quantitative section, which is designed to predict first-year college success in mathematics. However, it has been shown that gender gaps in performance on the SAT I have little to do with college readiness; rather they are due to the misaligned content of the instrument, as well as the environment in which the exam is administered. A statistical analysis of selected university admission criteria reveals specific examples of gender inequity that result from the differential validity of the SAT. This study informs research on access to postsecondary education and has far-reaching implications for the design and administration of standardized mathematics tests utilized in the admission process at many universities.

Introduction

Nationwide, 92 percent of four-year universities require potential students to submit SAT scores and 75 percent of schools use the scores as part of the admission process (College Board 2002). However, the disparity in scores between college-bound males and females on the quantitative section of the SAT I results in inequities in terms of access to postsecondary opportunities. Research suggests that the conditions under which the high-stakes SAT I is administered are conducive to stereotype threat and account for much of the gender gap on the exam (Walton and Spencer 2009). Further, the predictive validity of the instrument is questionable, in terms of gender, since it includes a significant amount of content that not only favors males, but also is not representative of typical entry-level college mathematics (Nankervis 2009). This study presents statistically-based examples of gender inequity that result from reliance on SAT scores in admission requirements at universities, as well as recommendations for correcting these deficiencies.

Review of Literature

Universities rely on SAT scores for many reasons. Since students pay for the administration of the tests and delivery of the results, and the scores are easy to process, the exams provide an inexpensive method for capping the size of freshmen classes and presenting the appearance of academic standards. Further, if a particular college were to stop requiring test scores, it might give the impression of a lowering of academic standards and potentially reduce the institution's national ranking. As an example of the weight entrance exams carry, 7.5 percent of a college's ranking in *U.S. News* comes from SAT scores of entering freshmen (*U.S. News* 2008). Furthermore, an institution's ability to raise funds through bonds is affected by the average SAT scores of their students (West-Faulcon 2009).

The College Board, which is responsible for the SAT, warns against relying on the results of a single instrument, as well as the use of minimum scores and there are several studies that suggest the SAT is under-predictive of the future success of females (Bridgeman and Wendler 1991; College Board 2008; NACAC 2008; Wainer and Steinberg 1992). In fact, some of the earliest studies to highlight the differential validity of the SAT quantitative section, in terms of gender, were conducted by College Board researchers (Bridgeman and Wendler 1991; Wainer and Steinberg 1992). However, these guidelines and research are often ignored by institutions' admission policies, which can create a double standard due to the large performance gap between males and females on the mathematics section of the SAT. While scores are comparable on the reading and writing sections, males average 35 points (1/3 of a standard deviation) higher than females nationally on the SAT mathematics section and the gender gap is as large as 50 points in some states (College Board 2009). Further, males generally have a larger standard deviation on all sections of the SAT (most pronounced in the mathematics portion), which, in combination with a higher mean on the quantitative section, leads to even greater achievement gaps between the genders for higher ability students (Hedges and Friedman 1993).

Possible Reasons for Gender Differences in Performance on the SAT

Studies from the early 1980s showed that adolescent males not only had higher average scores on the SAT quantitative section than their female counterparts, they also displayed greater variability and researchers determined these dissimilarities were genetically based (Benbow and Stanley 1980; 1983). The differences resulted in a greater concentration of boys in the right-hand tail of the distribution of scores. More recently, however, similar studies have shown the ratio of males to females in the higher ability region of the distribution of scores has decreased dramatically (Brody, Barnett and Mills 1994, Brody and Mills 2005, Feingold 1994, Monastersky 2005, Willingham and Cole 1997) suggesting that sociocultural factors may be primarily responsible for gender gaps in mathematical achievement.

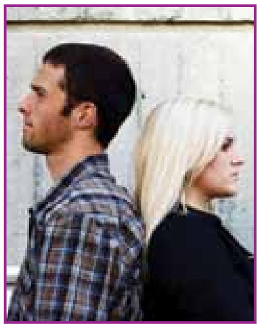
Past research proposes that differential socialization of boys and girls leads to divergent development and sex-role stereotyping (Baker and Jones, D. P. 1992, Eccles and Jacobs 1986, Fennema and Peterson 1985). For example, males tend to participate in activities related to spatial visualization more than females (Baenninger and Newcombe 1989) and this varied training leads to differences in spatial abilities (Stumpf 1993). However, it has been demonstrated that female performance improves significantly when they are given the opportunity to train with visual-spatial tasks (Vasta, Knott and Gaze 1996).

In terms of psychological reasons for gender differences on the SAT, stereotype threat has been found to account for approximately 60 percent of the performance gap on the quantitative section (Walton and Spencer 2009). Stereotype threat is defined as a feeling of "being at risk of confirming, as self-characteristic, a negative stereotype about one's group" that "may interfere with the intellectual functioning of these students [affected by stereotype threat], particularly during standardized tests" (Steele and Aronson 1995, 797). Studies have demonstrated that testing in mixed situations (males and females together) and the standard practice of asking students to identify their sex on a background information sheet prior to, rather than after a test, leads to significantly larger performance gaps between males and females (College Board 1998a, GRE Board 1999).

In addition to stereotype threat, another reason for the differential validity of the SAT quantitative section may lie with the content of the exam. Approximately 40 percent of the test is devoted to geometry, measurement and data analysis items (Achieve 2007): content strands where 12th-grade males significantly outperform their female counterparts on the National Assessment of Educational Progress (NAEP) (McGraw, Lubienski and Strutchens 2006). However, the typical core-curriculum mathematics course required for students at universities is college algebra or its equivalent, a mathematical strand where women perform on par with men (McGraw, Lubienski and Strutchens 2006). Further, a recent national curriculum survey (ACT 2007) of postsecondary mathematics instructors revealed that algebra skills were considered the most crucial, while measurement, geometry and probability/statistics skills were regarded as least important for success in college. Also, in a study on college readiness (AAU and Pew Charitable Trust 2003), the content strands of geometry and measurement accounted for only seven out of 81 mathematics standards for success in college (the rest covered by algebra) and probability/statistics was not considered a necessary prerequisite for entry-level mathematics courses.

In Hyde, Fennema and Lamon's (1990) meta-analysis of gender differences in mathematics performance, the overall effect size favoring males in all studies of standardized tests (100 studies total)—except the SAT I quantitative section—was d = 0.15. However, the SAT I had an effect size favoring males of d = 0.40. Also, other studies have shown that on the SAT I quantitative section, males consistently scored a third of a standard deviation (or more) higher than females who had like GPAs in high school and who later took the same college mathematics courses as the males and earned the same grades (Bridgeman and Wendler 1991, Wainer and Steinberg 1992). Recent studies have concluded that the gender gap in mathematics for high school students on state-administered exams has virtually disappeared (CEP 2010; Hyde, et al. 2008) but boys continue to outscore girls on the SAT quantitative section by more than one third of a standard deviation.

Since the SAT mathematics section contains a large percentage of items that are for the most part considered irrelevant to college freshman success and tend to favor males over females, it is not difficult to see why the SAT quantitative section over-predicts the future success of males while under-predicting the same for females. In particular, a recent study by the College Board reveals that among the three sections of the SAT I (reading, writing and mathematics: all of which separately and combined do a poorer job of predicting future success than students' high school GPA) the quantitative section had the greatest levels of over-prediction for males and under-prediction for females in terms of freshman year grade point average (College Board 2008).



This lack of predictive validity associated with the SAT I quantitative section creates a double standard and leads to the exclusion of otherwise qualified females when admission policies utilize minimum SAT cutoff scores.

This lack of predictive validity associated with the SAT I quantitative section creates a double standard and leads to the exclusion of otherwise qualified females when admission policies utilize minimum SAT cutoff scores. Moreover, as a result of competition between colleges for higher national rankings, the proportion of students with SAT I quantitative scores greater than 700 (scores range from 200 to 800) at more selective schools has risen 25 percent on average in the last two decades (*Chronicle* 2008). Since gender gaps in mathematical performance tend to be larger at the high end of score distributions due to males' greater means and variability (the percentage of males scoring above 700 on the SAT-M is twice that of females (College Board 2009)), this trend to court higher scoring students may be leading to greater levels of gender inequity at more 'prestigious' schools.

Method

This study began by looking at all state-supported four-year institutions in the US. If the school's admission process included SAT cutoff scores that were made available on their Web site, they made the initial list. While most schools still require the submission of test scores, many today do not utilize a cutoff score (or at least they don't advertise it) opting instead to use the scores as part of a holistic process that includes a variety of criteria. Thus, those types of institutions are not included. Also, not included are any schools whose cutoff scores were so low that they essentially were equivalent to open admission. The final analysis included 48 schools from 13 states.

Data for this analysis on student populations is from the College Board Web site. Numbers of participants, means and standard deviations are provided in the summary reports for college-bound seniors for each state. The analysis conducted here is based on the assumption that male and female test score distributions are normally distributed. The College Board provides a breakdown of scores for each section of the SAT for the whole group and by sex and there is little evidence of marked departure from normality in the distribution of scores (College Board 2009). P-values are calculated for males and females based upon their respective means, standard deviations and a common SAT cutoff score set by each institution for admission. A p-value is the probability a member of a group will score greater than or equal to a particular minimum score.

Tables 1–5 are categorized based on the variety of ways that SAT scores are utilized in the admission process and provide SAT admission cutoff scores for various four-year institutions. Cutoff scores are made available by the institutions on their respective Web sites. The percentage of eligible college-bound males and females is calculated based on these minimum scores and data from the College Board. A male-to-female ratio (male p-value divided by female p-value) for students scoring at or above cutoff scores is calculated based upon equal numbers of college-bound males and females to fairly judge any inequity in the process for admission. This method for calculating the male-to-female ratio (MFR) is that suggested by Hedges and Friedman (1993) in order to determine the combined effect of gender differences in means and standard deviations.

Results

Test Score Minimum Only

Under this type of admission policy, students must score at or above a minimum SAT score to be eligible (see Table 1). Most institutions utilize a total score from both the Math and Reading sections (M/R), but the University of Texas Engineering Program specifies a minimum score for just the mathematics section of 600, which means that approximately one in every four college-bound males in Texas qualify as opposed to only one in seven females. The University of Missouri Honors Program has a cutoff score 200 points higher than the cutoff score required for regular admission, which results in a higher male-to-female ratio (1.27 vs. 1.06) due to males' higher mean and larger standard deviation on the SAT I quantitative section at Missouri.

Table 1. Institutions with Minimum Test Score Requirement

Institution	Minimum SAT Score	Percent of College Bound Males Eligible	Percent of College Bound Females Eligible	MFR
University of Georgia	830 (M/R)	78.1	74.1	1.05
University of Nebraska-Lincoln	950 (M/R)	88.7	82.9	1.07
University of Missouri	1090 (M/R)	70.2	66.0	1.06
University of Missouri/ Honors	1290 (M/R)	37.0	29.2	1.27
University of Texas Engi-neering	600 (M)	24.3	14.7	1.65

Test Score Minimum and GPA/Class-Rank Minimum

This category of admission policy requires a minimum SAT score and minimum high school GPA or class standing (see Table 2). Oklahoma University's first level of automatic admission is a minimum GPA of 3.00 and class ranking in the top 25 percent. Students not meeting both of these requirements are eligible if they meet the minimum SAT score and have a minimum GPA of 3.00 or class standing in the top 50 percent. Accordingly, 55 percent of college-bound females from Oklahoma are eligible at this second level for admission compared to 65.6 percent of the state's males.

Table 2. Institutions with Minimum Test Score Requirement and Minimum GPA or Class Standing

Institution	Minimum SAT Score	Percent of College Bound Males Eligible	Percent of College Bound Females Eligible	MFR
University of Oklahoma	1090 (M/R)	65.6	55.0	1.19
Ohio U. Business	1100 (M/R)	51.9	42.2	1.23
Ohio U. Journalism	1140 (M/R)	44.3	34.7	1.28
Ohio U. Honors	1300 (M/R)	18.3	11.9	1.54

Minimum Test Score or GPA or Class Standing

Under this type of admission policy (see Table 3) students are eligible by meeting any one of three criteria. Students can enter Arizona State University with a minimum GPA of 3.00 or class standing in the top 25 percent. Students are eligible at the University of Kansas with a minimum GPA of 2.00 or class standing in the top 33 percent. Students not meeting either of these requirements at the respective schools must have the minimum SAT scores. In particular, the requirements at Arizona State University have a differential effect on 'average' students in the state (students at the 50th percentile). They would generally not be eligible for automatic admission (not in the top 25 percent) and would thus have to rely on their SAT scores. However, average males in Arizona (based on SAT scores) score above the cutoff for admission while average females do not.

Specifically what is in doubt is the predictive validity of the test in terms of its appropriateness for measuring first-year college success. Thus, regardless of the SAT's psychometric quality, its overall validity, based upon its capacity to measure what it purports to measure (college readiness), is suspect.

At Ohio University, in addition to minimum SAT scores, students must graduate high school in the top 20 percent of their class for entry to the business college, top 15 percent for the school of journalism, and top 10 percent for the honors program. There is a corresponding increase in the male-to-female ratio at Ohio University schools with higher cutoff scores. The highest minimum score required, for admission to the Ohio University Honors Program, results in a male-to-female ratio of 1.54 for college-bound students from Ohio.

Table 3. Institutions with Minimum Test Score Requirement or Minimum GPA/ Class Standing

Institution	Minimum SAT Score	Percent of College Bound Males Eligible	Percent of College Bound Females Eligible	MFR
Arizona State University	1040 (M/R)	53.7	45.9	1.17
University of Kansas	980 (M/R)	84.0	79.8	1.05

Minimum GPA or Sliding Scale (GPA/SAT)

Students gain automatic entry with a minimum GPA under this type of admission policy. Otherwise, they must meet a minimum GPA/SAT score provided in a two-way matrix. The California State University System automatically admits students with a GPA of 3.00 or above. For all other students, since males outscore females on average by 50 points on the SAT (41 points on the mathematics section), otherwise equally qualified females need a larger high school GPA than males. For example, an average male (based on SAT scores) needs a GPA of 2.32 whereas an average female must have a GPA of 2.38. Students gain automatic admission to the University of Oregon as well with a GPA of 3.00 or above. However, since males outscore females on average on the SAT by 43 points (38 points on the mathematics section), females need a higher GPA. As an example, average males require a GPA of 2.56 while females need a GPA of 2.63.

Class Standing or Sliding Scale (SAT/GPA)

Under this policy, students finishing in the top of their high school class gain automatic admission. Others must meet a minimum SAT score and class standing. In Texas, all public universities currently provide automatic admission to students graduating in the top 10 percent of their high school class (some institutions allow more than the top 10 percent). Students not meeting the automatic admission criteria must satisfy alternative criteria that generally include minimum SAT/ACT scores (see Table 4).

Most alternative admission criteria at Texas universities utilize a minimum SAT total score, a combination of critical reading and mathematics scores. Due to males' higher overall mean and standard deviation, larger minimum scores result in a greater male-to-female ratio (MFR). For example, the lowest minimum total score required (SAT total 920) at Texas State University and UTEP results in an MFR of 1.09, while the highest cutoff score (SAT total 1300) at Texas A&M University leads to an MFR of 1.62.

One consequence of the Texas State-San Marcos admission requirements directly affects the "average" student in Texas in terms of gender. If one assumes that the average college-bound student (based on SAT scores) falls in the second quartile (26–50 percent), then the average male with a combined SAT mathematics and reading score of 1010 would be automatically admitted. However, the average female with a combined score of 975 would not gain automatic admission.

In Colorado, students in the top 10 percent of their graduating class are guaranteed admission to any of the state's public schools. Otherwise, an index score particular to each institution is required from a matrix based on SAT scores and GPA/Class standing. Table 5 summarizes required GPAs for average males and females (based on SAT scores) for different schools. In general, equally qualified females need a better high school GPA than do males.

Table 4. Eligibility for Admission by Gender at Texas Colleges

Institution	Automatic Admission	Alternative Admission Criteria	Percentage of Eligible College-Bound Males	Percentage of Eligible College-Bound Females	MFR
Texas A&M	Top 10%	1300 SAT Total	9.7	6.0	1.62
UT Dallas	Top 15%	1200 SAT Total	19.7	14.1	1.40
UTEP	Top 50%	920 SAT Total	65.7	60.4	1.09
Texas State-San Marcos	Top 10%	1st Quarter & 920 SAT Total	65.7	60.4	1.09
		2nd Quarter & 1010 SAT Total	50.0	43.4	1.15
Texas Tech	Top 10%	1st Quarter & 1140 SAT Total	28.0	21.5	1.30
		2nd Quarter & 1230 SAT Total	16.2	11.1	1.46
Univ. North Texas	Top 10%	1st Quarter & 950 SAT Total	60.6	54.8	1.11
		2nd Quarter & 1050 SAT Total	42.9	36.0	1.19
Univ. Houston	Top 20%	1st Half & 1000 SAT Total	51.8	45.2	1.15

Table 5. GPAs Required of Average Students* at Colorado Institutions

Institution	University of Northern Colorado	Colorado State University	Percent of College Bound Females Eligible	MFR
Male	2.4	2.8	2.9	3.3
Female	2.5	2.9	3.0	3.4

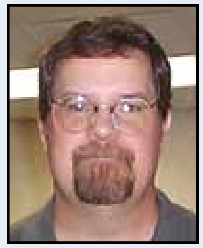
Discussion

Evidence from previous research suggests that the performance gap on the SAT I quantitative section is likely due to how the test is administered (mixed testing and identification of sex prior to the test combine to induce stereotype threat) and constructed (a significant amount of content favors males and is not representative of entry-level college mathematics skills or abilities). While the College Board suggests that females are simply not as well prepared as males (College Board 1998b), their claims of SAT validity are questionable as the exam regularly under-predicts the postsecondary mathematical success of females while over-predicting the same for males (Bridgeman and Wendler 1991, College Board 2008, Wainer and Steinberg 1992). The internal validity of the SAT, in that it accurately measures students' performance in specific content areas, is not in question here. Specifically what is in doubt is the predictive validity of the test in terms of its appropriateness for measuring first-year college success. Thus, regardless of the SAT's psychometric quality, its overall validity, based upon its capacity to measure what it purports to measure (college readiness), is suspect.

Conclusion

This analysis demonstrates that the differential validity of the SAT quantitative section leads to a double standard, in terms of gender, for institutions that utilize cutoff scores as part of their admission policy. Also, at more selective schools (those that employ higher SAT cutoff scores) the levels of gender inequity increase. For example, Texas A&M University and the Ohio University Honors Program each require a score of 1300 combined on the math and reading sections of the SAT which correspondingly result in some of the highest eligibility male-to-female ratios (1.62 and 1.54 respectively) for college-bound students from the home states of those institutions. Further, Texas A&M and the University of Texas Engineering School require a minimum score of 600 on the SAT I quantitative section, which means that while one in every four college-bound males in Texas is eligible, only one in every seven females qualifies (MFR of 1.65).

While using a score from a single test may be convenient and economical for colleges, it is ill-conceived and plainly at odds with best practices in the use of standardized tests and is a clear violation of the College Board's own recommended policy: that minimum test scores should not be used for determining admission. Nevertheless, the levels of inequity demonstrated by this study highlight the need for universities to find more inclusive and equitable ways of determining access to higher education for its students. In particular, every student's class rank, whether they have completed a required high school curriculum, their community service, and any awards or honors should be part of a more holistic set of criteria used to determine admission. If used, SAT scores should be adjusted accordingly on a state-by-state basis to compensate for the differential validity of the quantitative exam.



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