

25 Years of GRE Scores and Graduate Enrollments by Discipline, Sex, and Ethnicity

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Background

The Graduate Record Examination (GRE) is a high-stakes test of developed cognitive abilities. Undergraduate students who aspire to graduate school are often recommended and sometimes required to take the GRE, or a test like it such as the LSAT or MCAT, for admission. Several lines of research have established these tools as valid measures of cognitive ability and strong predictors of subsequent success. For example, performance on the GRE is strongly tied to performance on other measures of cognitive abilities (Angoff & Johnson, 1988; Hsu & Schombert, 2010). Given the GRE's strong ties to other measures such as the SAT, which itself predicts obtaining a doctorate, earning tenure, and getting patents (Lubinski, Benbow, Webb, & Bleske-Rechek, 2006), the GRE is likely to predict high intellectual achievement. In fact, the GRE is a strong predictor of success in both master's and doctoral graduate programs (Kuncel, Wee, Serafin, & Hezlett, 2010), as indexed by first-year GPA, graduate GPA, faculty ratings (Kuncel & Hezlett, 2007), and even citation counts (Kuncel, Hezlett, & Ones, 2001).

Although the GRE is just one of many predictors of exceptional achievement (e.g., emotional stability and conscientiousness forecast a variety of positive life outcomes; Roberts, Kuncel, Shiner, Caspi, & Goldberg, 2007), there is substantial rationale for its use in higher education admissions decisions. Large-scale databases and meta-analytic evidence suggest that cognitively loaded tests in general do not exhibit predictive bias, are not substantially affected by motivation in high-stakes testing, and demonstrate strong predictive utility even after controlling for socioeconomic status (Sackett, Borneman, & Connelly, 2008; see also various reports released by ETS).

Graduate education itself is typically viewed as the path by which the U.S. will maintain global competitiveness and a capacity for innovation (Wendler, Bridgeman, Cline, Millett, Rock, Bell, & McAllister, 2010). Students who take the GRE represent the pool of intellectual talent aspiring to study at the graduate level. Thus, we compiled the current set of data to determine how scores on the GRE have fared over time. We compare GRE scores and graduate enrollment patterns by sex, ethnicity, and discipline to explore the flow of intellectual talent into graduate education.

Materials

We obtained GRE score data from Educational Testing Services (ETS) technical reports released for the periods of 1982 through 1996, and 2003 through 2007. We received enrollment and degree reports from reports released by the National Council of Graduate Schools (CGS) between 1986 and 2009. In November 2010, Nathan Bell, Director of Research and Policy Analysis at CGS, provided us with annual records of graduate enrollments and graduate degrees from 1986 to 2009, by ethnicity, sex, and discipline. Population statistics reported are taken from 1980, 1990, 2000, and 2010 US Census reports. Below, we list the reports from which our GRE score and graduate enrollment data are taken:

ETS/GRE Reports:

- Grandy, J. (1995). *Talent flow from undergraduate to graduate school: 1982-1993*. GRE Board Professional Report No. 92-02P; ETS RR 95-36. Princeton, NJ: Educational Testing Service.
- Grandy, J. (1999). *Trends and profiles: Statistics about GRE general test examinees by gender, age, and ethnicity* (second edition). GRE No: 96-07 RR-9916. Princeton, New Jersey: Educational Testing Service.

NSF Reports:

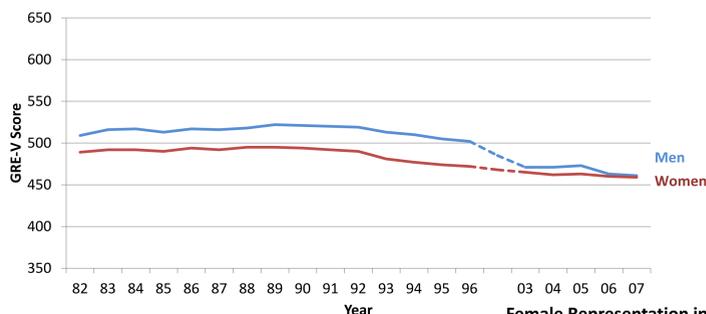
- National Science Foundation, Division of Science Resources Statistics. (2010). *Doctorate Recipients from U.S. Universities: 2009*. Special Report NSF 11-306. Arlington, VA. Available at <http://www.nsf.gov/statistics/nsf11306/>.

CGS Reports:

- Brown, H. A. (2006). *Graduate enrollment and degrees: 1986 - 2005*. Washington, DC: Council of Graduate Schools.
- Redd, K. E. (2007). *Graduate Enrollment and Degrees: 1996 - 2006*. Washington, DC: Council of Graduate Schools.
- Bell, N. E. (2008). *Graduate enrollment and degrees: 1997 - 2007*. Washington, DC: Council of Graduate Schools.
- Bell, N. E. (2009). *Graduate enrollment and degrees: 1998 - 2008*. Washington, DC: Council of Graduate Schools.
- Bell, N. E. (2010). *Graduate enrollment and degrees: 1999 - 2009*. Washington, DC: Council of Graduate Schools.

The following websites hold a variety of reports from ETS and CGS: <http://www.ets.org/gre/research> <http://www.cgsnet.org/Default.aspx?tabid=177>

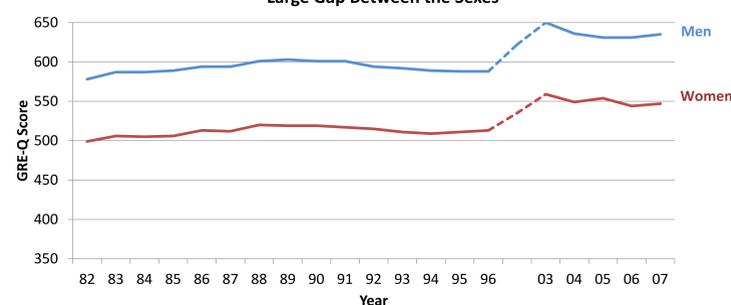
GRE Verbal Scores have Decreased for Both Sexes, with a Minimal Difference Between Sexes in Recent Years



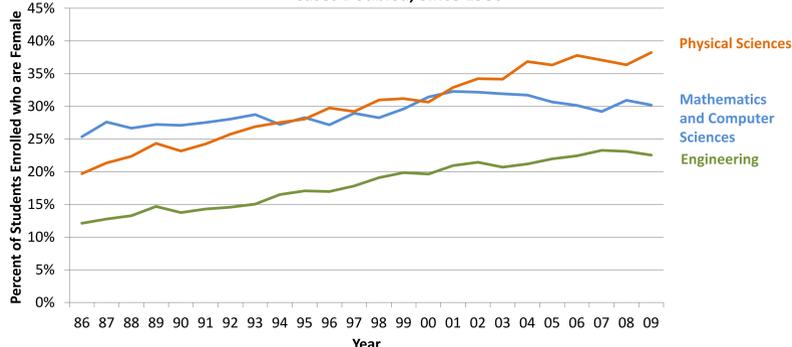
Scores on each of the Verbal and Quantitative sections of the GRE can be as high as 800 and as low as 200. As shown in the two top panels, it is more difficult to score high on the Verbal section than on the Quantitative section. Scores on the Verbal section of the GRE have decreased since the early 1980s, and a long-enduring gap between the sexes on the Quantitative section has essentially disappeared. Scores on the Quantitative section have increased at a similar rate for both sexes, such that a large gap between the sexes endures. In 1982, men outscored women by 75 points, and in 2006 by 88 points.

Results

GRE Quantative Scores have Generally Increased, with a Consistent and Large Gap Between the Sexes

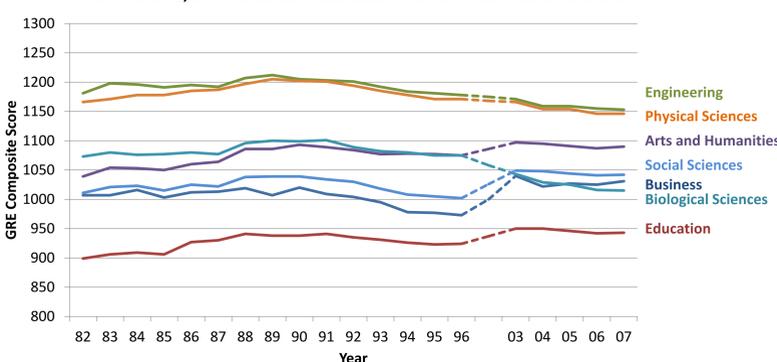


Female Representation in Graduate STEM Programs Has Increased, and in Some Cases Doubled, Since 1986

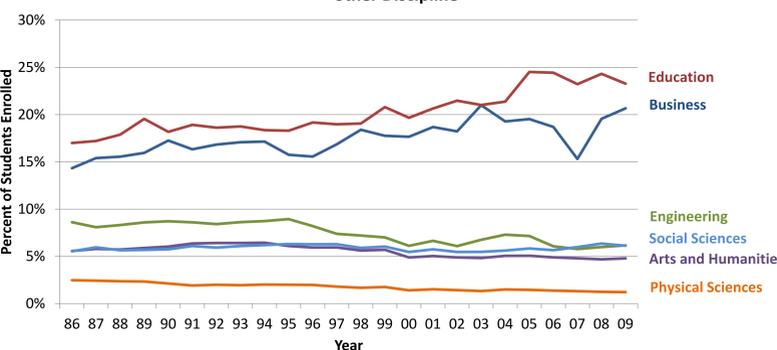


As displayed at left, women comprise an ever-increasing proportion of graduate students (masters and doctoral combined) in STEM disciplines. Other records on *doctoral* training in particular indicate that the number of women earning doctorates in physical sciences increased 70% from 1999 to 2009, and the number of female engineering doctoral recipients more than doubled over the decade (National Science Foundation, 2010). These growth rates are three times larger than the growth in male doctorate recipients during the same period.

Across Years, Students in Engineering and the Physical Sciences Score the Highest on the GRE, and Students in Education Score the Lowest on the GRE

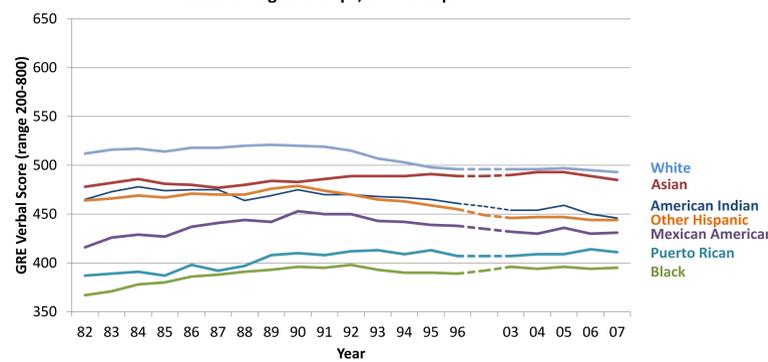


More Master's Level Students are Enrolled in Education and Business than in any other Discipline

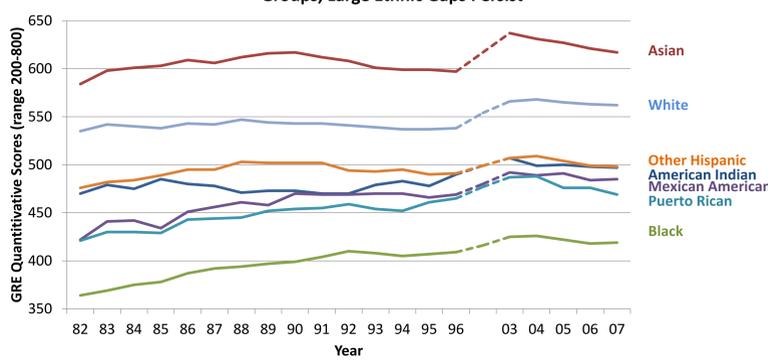


GRE scores differ substantially by undergraduate major and expected discipline of graduate study. Test takers from the Arts and Humanities consistently display the highest GRE-Verbal scores, and those from Engineering and the Physical Sciences display the highest average GRE-Quantitative scores. Students in Education and Business, two domains that make up the largest proportion of graduate students and award the most graduate degrees in the country, have consistently scored the lowest on both tests, with GRE-Verbal and GRE-Quantitative scores for Education students averaging 454 and 476 respectively.

Despite Small Increases in Performance on the GRE-Verbal for Some Disadvantaged Groups, Ethnic Gaps Persist

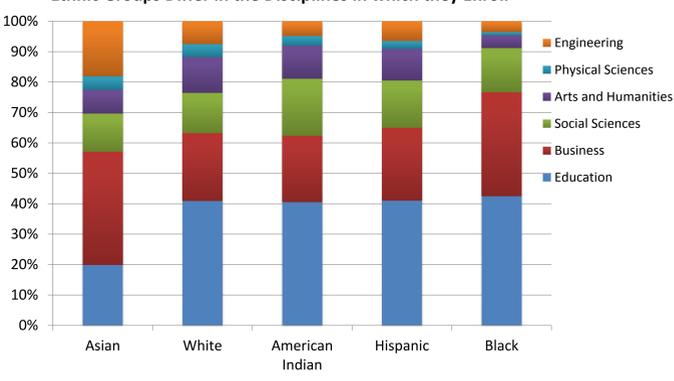


Despite Small Increases in Performance on the GRE-Quantitative Section Across Groups, Large Ethnic Gaps Persist



Over the past 25 years, test takers who self-identify as Asian have consistently earned higher GRE-Quantitative scores than any other ethnic group. White test takers have shown the highest average GRE-Verbal scores, while Black test takers have shown the lowest scores on both sections. The gap between Black and White test takers on the GRE-Verbal has diminished in recent years, but the discrepancy between these groups on the quantitative section has not. Although GRE-Quantitative scores have increased slightly over the past 25 years for all ethnic groups, and greater increases have occurred among historically disadvantaged groups, ethnic gaps continue to be large.

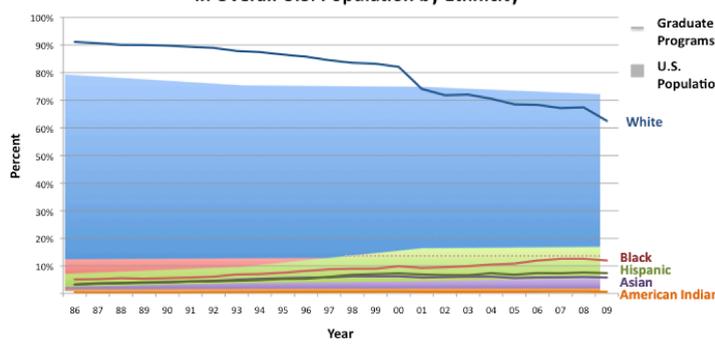
Ethnic Groups Differ in the Disciplines in which they Enroll



The figure at left displays the percent of individuals within each group enrolled in various broad disciplines in the year 2009. With the exception of Asian students, over 40% of students in each ethnic group are enrolled in Education programs. Over 20% of Asian students are enrolled in Engineering or the Physical Sciences, a pattern not replicated in the other ethnic groups.

The figure at right shows the representation of different ethnic groups in graduate training (line), set against their representation in the population (shaded area). In 1986, Whites comprised 91% of graduate students but approximately 80% of the population. In 2009, they comprised 63% of graduate students and approximately 72% of the U.S. population. As of 2009, Hispanics are the only significantly under-represented minority group.

Representation in Graduate Programs Compared to Representation in Overall U.S. Population by Ethnicity



Discussion

Overall, the data compiled here suggest slowly decreasing GRE-V scores and increasing (although recently stagnant) GRE-Q scores. The fact that all groups have shown increases in GRE-Q scores since the 1980s, and that some historically disadvantaged groups have shown *increases* in GRE-V scores as well, suggests that an increased number of test-takers has not resulted in lower scores overall.

Women's GRE-Q scores lag behind men's, and the gap is persistent from year to year. At the same time, however, women's representation in math-heavy disciplines has grown at a stronger rate than has men's. Some people might argue that women still do not comprise 50% of students (or faculty or CEOs) in STEM (Science, Technology, Engineering, and Math) careers. However, sex differences in cognitive abilities relevant for STEM disciplines are only part of a complex picture: Women with strong quantitative abilities tend to have competing intellectual interests, are less likely than men to be committed to a work-centered life, are more interested than men in working with people, and more likely to want to stay home at least part-time with their children (see Ceci, Williams, & Barnett, 2009, and Lubinski & Benbow, 2006, for lengthy reviews). Moreover, success in STEM disciplines does not appear to be a product of discrimination against women in interviewing, reviewing, or hiring (Ceci & Williams, 2010).

The data show flow of strong intellectual talent into some disciplines over others. GRE scores among students in Education are particularly low. An additional concerning factor is that higher-scoring Education majors advancing beyond undergraduate training are more likely than lower-scoring majors to move *out* of Education for their graduate studies (Grandy, 1995). In the current national climate, people question whether the U.S. really values education and our nation's teachers. By attracting individuals of high intellectual caliber to Education as a profession, we will not only be promoting the value of our nation's teachers but also improving the efficacy of our nation's education system.

Conclusion

A recent report on the future of graduate education, prepared jointly by the Educational Testing Service and the Council of Graduate Schools, offered these introductory words (p. 4): "Our competitiveness in the global economy hinges on our ability to produce sufficient numbers of graduate-degree holders — people with the advanced knowledge and critical-thinking abilities to devise solutions to grand challenges such as energy independence, affordable health care, climate change and others. One of our greatest resources is our human talent, and as a nation we must invest in educating more of our population at the graduate level to ensure our capacity to innovate and to secure our intellectual leadership into the future."

Research suggests that the GRE does just what it was designed to do — it forecasts success in graduate training, as well as completion of training and subsequent impact (via citation counts). In essence, then, GRE scores provide a measure of intellectual leadership potential, and we suggest that any interventions put forward must not ignore but rather acknowledge and include prescriptions for the persistent discipline differences, sex differences, and ethnic differences in GRE scores, so that those who enroll in graduate training have the potential to secure from that training all of which it hopes to provide.

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Acknowledgements

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