

The STEM Gender Gap and SAT Scores

STAT 5810 Final Report

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Abstract

Despite progress in gender equity, the representation of women in STEM (science, technology, engineering, and mathematics) fields has only marginally increased, rising from 32% to 35% between 2011 and 2021. Using national SAT score data from 2018 to 2024, this study investigates the relationship between gender, math, and evidence-based reading and writing (ERW) performance to understand the persistent gender gap in STEM. Male test-takers consistently outperform females in math, while females excel in ERW, with the disparity more pronounced at higher percentiles. These findings align with theories linking "relative cognitive ability" to career choices, suggesting that differences in comparative verbal and math skills may influence STEM participation. Future research should explore how these cognitive patterns impact career trajectories, particularly among top-performing students.

Keywords

STEM gender gap, relative cognitive ability, SAT scores, math and verbal performance, gender disparities, STEM participation

Introduction

The gender gap in science, technology, engineering, and mathematics (STEM) fields has stayed largely the same in recent years, women's representation in these fields increasing by 3% between 2011 and 2021 (from 32% to 35%). This gap is large compared to non-STEM fields, in which women represent roughly 51% of the workforce (NCSES). Literature on the topic points to an individual's "relative cognitive ability" to predict their likelihood to pursue a STEM career. "Relative cognitive ability," is defined as verbal ability compared to math ability. Research has shown that relative cognitive ability is more indicative than overall cognitive strength in mathematics in predicting whether an individual will pursue a STEM career over a non-STEM career (Wang & Degol, 2017). For example, an individual who excels in both math and english is more likely to choose a non-STEM career than an individual with the same excellent ability in math, but whose abilities in english are average. This report pulls from national SAT Score Report data to compare differences in Math and Evidence-Based Reading and Writing scores between male and female test-takers.

Methods

The data that was used for this report was sourced from the National College Board's SAT Suite of Assessments Annual Reports from 2018-2024. These were the only years from which this particular data could be reported, because College Board adjusted the SAT sections for the 2017 test, resulting in a lack of ability to compare scores from prior years to the current test. The annual reports include various figures and data, and the table of interest for this report is displayed on page 4 of the report. This example is page 8 of the 2023 SAT Suite Annual Report.

From this page, we needed to read in the first three tables, including information on the total number of students in each demographic, the score range for the total test, the score range for the ERW section, and the score range for the Math section. The *read_pdf* function from the Camelot library was used scrape these tables from the PDF pages. This function read in two tables: the total score table as one, and the remaining four tables as the second. The remaining cleaning included removing the parenthesized test scores for the math section, removing the Reading and Writing sections (given that the ERW section includes both reading and writing), and adding a column specifying year. Once the tables were read in and initially cleaned, the *concat* function from the Pandas library was used to combine these tables into one. Table 1 displays an example of what the data looked like at this point.

	Score Range	Total	Female	Male	American Indian	Asian	African American	Hispanic	Native Hawaiian	White	More Races	Section	Year
0	Test Takers	1,973,891	990,760	971,405	14,792	200,385	228,688	483,640	3,498	725,962	70,800	Total	2024
1	1400–1600	7%	6%	9%	1%	27%	1%	2%	2%	7%	10%	Total	2024
2	1200–1390	17%	16%	17%	4%	31%	7%	9%	7%	23%	23%	Total	2024
3	1000–1190	28%	29%	26%	19%	25%	21%	25%	24%	36%	32%	Total	2024
4	800–990	30%	33%	28%	42%	13%	41%	39%	40%	26%	26%	Total	2024
5	600–790	17%	16%	18%	33%	3%	29%	24%	26%	8%	9%	Total	2024
6	400–590	1%	1%	1%	1%	0%	2%	1%	1%	0%	0%	Total	2024
7	700–800	8%	7%	8%	1%	23%	2%	3%	2%	9%	12%	ERW	2024
8	600–690	19%	19%	19%	6%	32%	9%	12%	11%	26%	26%	ERW	2024
9	500–590	29%	30%	27%	21%	26%	25%	27%	26%	35%	32%	ERW	2024

Table 1: First 10 Rows of Original SAT Dataset

Once combined into a larger table, the rows containing the number of test takers were removed and placed in a separate table that was used to convert the percentages in Table 1 to raw numbers of students that fell into each score range.

After cleaning the imported data, the Seaborn and Matplotlib libraries were used to plot various groupings of these data, including the distribution of test scores by year and gender, the difference in Math and ERW section scores by gender, and the average SAT section scores by gender over time. The difference in Math and ERW section scores was computed for the 80th-99th percentiles, using the score ranges above 600. The average section score was determined by computing the weighted average by gender by section based on the average value in the score range. Analytical emphasis was placed on high-performing test-takers, defined as those scoring above the 79th percentile in ERW and the 81st percentile in Math, to assess trends at the upper performance extremes.

SAT Participation and Performance: Score Distributions by Subgroup

Data reflect SAT test activity for students who graduated high school in 2023. If a student took the SAT more than once, the most recent score is summarized. Cross-test scores, test scores, and subscores metrics only summarize students whose most recent SAT was the paper and pencil version.

	Total Students	Female	Male	American Indian	Asian	African American	Hispanic	Native Hawaiian	White	Two or More Races
Test Takers	1,913,742	966,726	936,481	15,384	194,108	225,954	462,186	3,791	752,632	69,410

Total Score

1400–1600	7%	5%	8%	1%	25%	1%	2%	2%	6%	9%
1200–1390	17%	16%	18%	5%	31%	6%	9%	7%	23%	22%
1000–1190	29%	30%	27%	20%	27%	21%	25%	23%	37%	33%
800–990	31%	33%	29%	42%	14%	42%	41%	41%	26%	27%
600–790	16%	15%	17%	31%	3%	29%	23%	27%	8%	8%
400–590	0%	0%	1%	1%	0%	1%	1%	0%	0%	0%

Section Scores - ERW

700–800	7%	7%	7%	1%	20%	2%	2%	2%	8%	11%
600–690	19%	20%	19%	7%	32%	9%	12%	9%	26%	26%
500–590	29%	31%	28%	22%	28%	24%	27%	25%	35%	32%
400–490	31%	31%	30%	43%	16%	42%	39%	42%	24%	24%
300–390	13%	11%	15%	26%	4%	22%	19%	20%	6%	7%
200–290	1%	1%	1%	1%	0%	1%	1%	1%	0%	0%

Section (Test) Scores - Math¹

700–800 (35–40)	9%	6%	11%	1%	34%	2%	2%	2%	8%	10%
600–690 (30–34.5)	15%	14%	16%	5%	27%	6%	8%	7%	20%	19%
500–590 (25–29.5)	28%	30%	27%	21%	24%	20%	25%	23%	36%	33%
400–490 (20–24.5)	28%	30%	25%	37%	11%	36%	36%	35%	25%	25%
300–390 (15–19.5)	19%	19%	19%	34%	4%	34%	27%	32%	11%	12%
200–290 (10–14.5)										

Test Scores - Reading

35–40	8%	7%	8%	2%	20%	2%	3%	2%	10%	12%
30–34	20%	20%	20%	8%	31%	10%	13%	11%	27%	27%
25–29	32%	33%	30%	26%	29%	28%	31%	29%	36%	34%
20–24	30%	30%	29%	42%	16%	42%	38%	41%	22%	22%
15–19	10%	9%	11%	20%	3%	17%	14%	16%	5%	5%
10–14	1%	1%	1%	1%	0%	2%	1%	1%	0%	0%

Test Scores - Writing and Language

35–40	9%	9%	9%	2%	25%	2%	3%	3%	10%	13%
30–34	20%	21%	19%	7%	31%	9%	12%	10%	26%	26%
25–29	27%	28%	25%	21%	23%	23%	25%	24%	31%	29%
20–24	29%	29%	29%	40%	15%	39%	36%	38%	23%	23%
15–19	15%	13%	17%	28%	5%	24%	21%	24%	8%	8%
10–14	1%	1%	2%	2%	0%	3%	2%	2%	1%	1%

¹ The Math test score is found by dividing the Math section score by 20.

Results

The analysis revealed consistent patterns in average section scores across all years between 2018 and 2024, with male test-takers outperforming females in Math and females excelling in ERW. Notably, the performance gap in Math was more pronounced than that in ERW. Average scores for both sections exhibited a gradual decline from 2021 onward, with Math scores decreasing at a steeper rate than ERW scores.

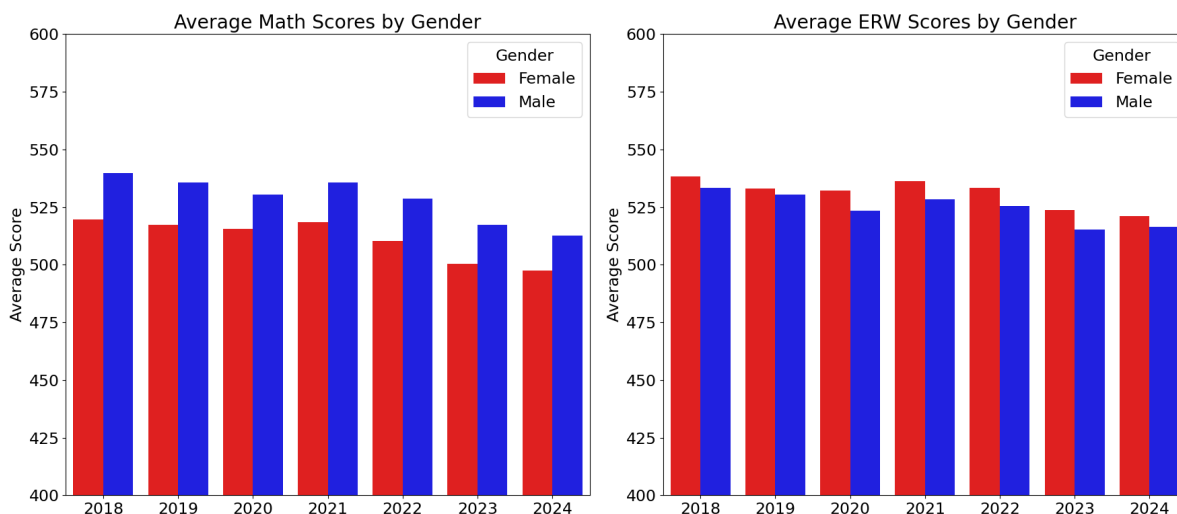


Figure 1: Average SAT Section Scores Over Time by Section and Gender

Taking a closer look at the differences in section scores over time, Figure 2 displays the score distributions of male and female test-takers from 2018-2024. Each of these distributions is relatively normal, which is to be expected, but we are particularly interested in the highest scoring students. Across every year, students with average scores of both genders tend to score higher on the ERW section, sometimes scoring roughly equally on the two sections. However, this trend is different at the right extreme, in which the highest male performers in ERW and Math sections tend to be better at Math than ERW. In comparison, females continue to perform better in ERW than in Math, and in recent years this comparative difference is even greater.

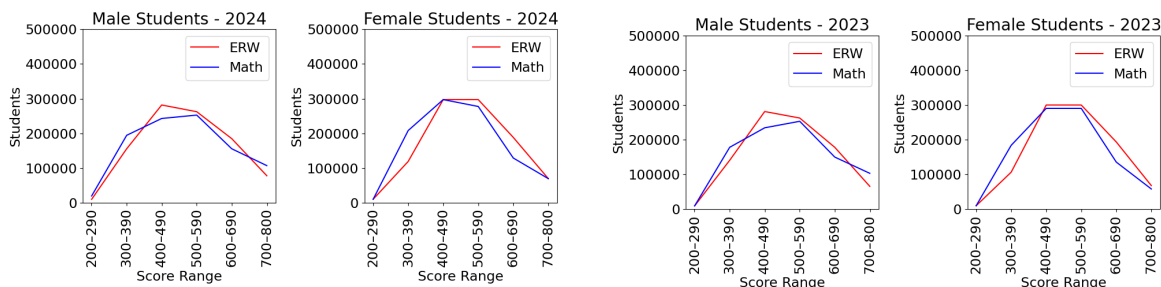


Figure 2: Distribution of Student Scores by Section, Gender, and Year

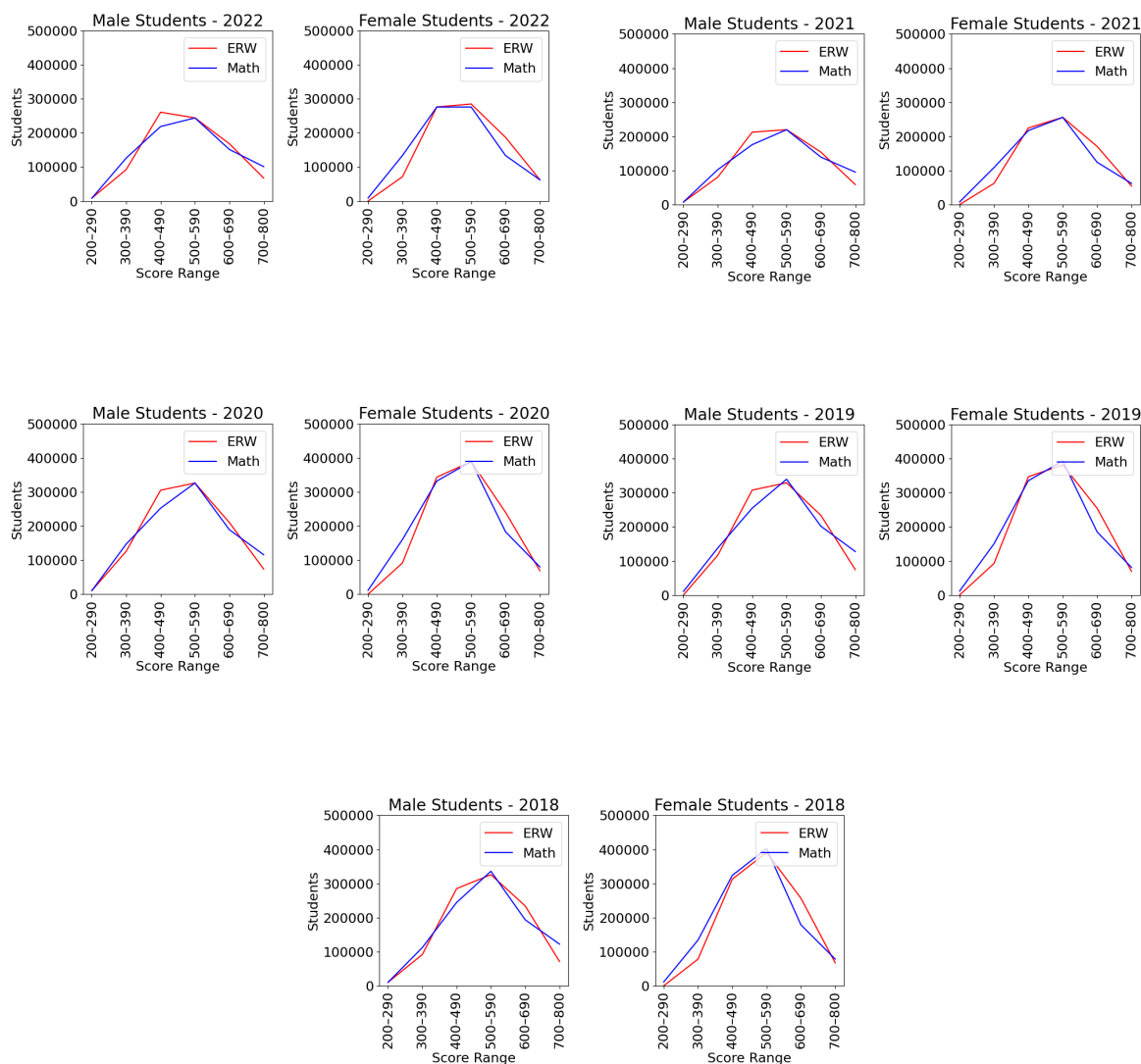


Figure 2 (cont.): Distribution of Student Scores by Section, Gender, and Year

Focusing in on the highest performing students, Figure 3 displays the average difference in ERW and Math section scores for scores above 600 in both sections. According to College Board, this represents the 79th percentile in Reading and Writing, and the 81st percentile in Math (College Board, SAT Percentiles). As inferred from Figure 2, the comparative difference between males and females by section is more pronounced in the highest percentiles of test takers. High-scoring female test-takers tend to score 2% to 4% better in Reading and Writing than in math, while high-scoring male test-takers tend to score up to 2% better in Math than in Reading and Writing.

While the score differences have fluctuated over time since 2018, the comparative difference between male and female scores has stayed stable, which is consistent with the stable gap in STEM fields overall.

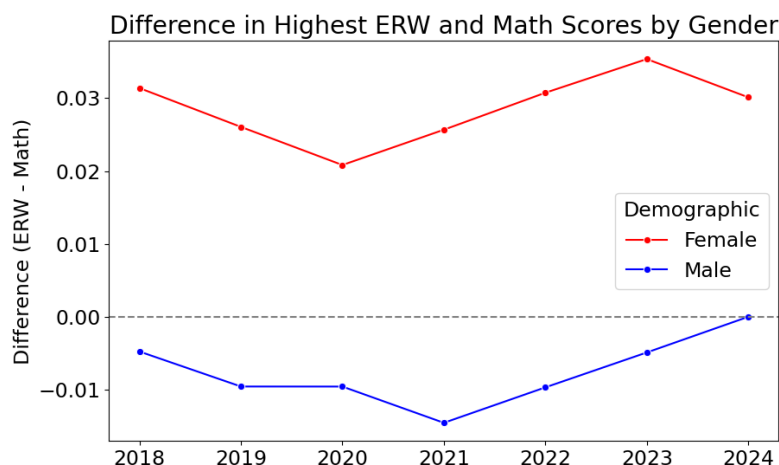


Figure 3: Average Differences in ERW and Math Scores by Gender and Year

Conclusions

This study underscores the role of relative cognitive ability in shaping gendered career paths. Male test-takers' stronger performance in Math compared to ERW aligns with their higher representation in STEM fields. Conversely, females' superior ERW performance may draw them toward non-STEM careers. While these trends have remained consistent since 2018, they emphasize the need for interventions addressing not just overall cognitive abilities but also their relative strengths.

Future research should investigate how high-performing students' comparative math and verbal abilities influence their career choices. A long-term study could track students who excel in math, comparing their job trajectories to peers with similar math abilities but stronger verbal skills. Such research could illuminate how cognitive strengths translate into professional pathways and inform strategies to close the STEM gender gap.

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