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Article

The gender gap in STEM at top U.S. Universities: change over time and relationship with ranking

Nicholas Kruus[1], Idaliya Grigoryeva[2], Jennifer Kruus[3]
[1] STEM School Highlands Ranch, Highlands Ranch, Colorado
[2] Department of Economics, University of California-San Diego, San Diego, California
[3] Agilent Technologies Inc., Highlands Ranch, Colorado

SUMMARY
Addressing the gender gap in science, technology, engineering, and mathematics (STEM) fields may be an opportunity to promote equity and enhance institutional environments and their performance. We aimed to measure male-dominated undergraduate programs' change in gender diversity over time, whether it has been converging, and whether it correlates with disciplinary ranking. We considered the number of degrees conferred in 60 disciplines over 19 years at 24 universities representing the top 20 universities of two lists using data from the National Center for Education Statistics (NCES) Integrated Postsecondary Education Data System (IPEDS). We found that the nine most male-dominated disciplines fell within STEM, suggesting continued effort is needed to address the gender gap. Eight of the nine most male-dominated disciplines increased in gender diversity over time, especially between the two most recent time periods, suggesting contemporary policies are often effective. We also found that five out of eight of the most male-dominated disciplines converged over time, which may imply increasing homogeneity in these universities' gender-diversity policies in some disciplines. Of the nine most male-dominated disciplines, computer science and mechanical engineering had statistically significant results that suggested higher-ranked universities in these disciplines weakly correlated with higher disciplinary gender diversity. The weak correlation between rank and women's representation suggests that universities with increased resources are better able to create effective initiatives to increase women's representation in STEM. More broadly, our results suggest these 24 universities' initiatives have been effective in reducing the STEM gender gap from 2002 to 2021, but room for improvement remains.

INTRODUCTION
Numerous studies have identified a "gender gap" consisting of low representation of women in science, technology, engineering, and mathematics (STEM) majors and careers. For instance, women received under 30% of all engineering, mathematical sciences, and computer sciences undergraduate degrees in 2020 (1). STEM occupations offer 26% higher average salaries compared to non-STEM counterparts, and gender diversity may offer institutional advantages, such as improved workplace well-being, governance, and performance (2–4). Thus, minimizing the STEM gender gap offers an opportunity to promote equity and enhance institutional environments and performance.

Previous studies examining thousands of U.S. doctoral programs have found a positive correlation between gender diversity and departmental rank (5, 6). That is, higher-ranked universities tended to exhibit higher women's representation. We built on these findings by assessing whether a similar correlation holds true in undergraduate program rankings in top-ranked U.S. universities. We also assessed whether these universities' change in disciplinary gender diversity between 2002–2009 and 2016–2021 correlates to their disciplinary rank and measured the convergence of women's representation in these disciplines over time using coefficient of variation calculations. Our data was gathered from the National Center for Education Statistics (NCES) Integrated Postsecondary Education Data System (IPEDS) from a sample of 60 undergraduate disciplines from 24 universities (listed in the Appendix). The universities included represent the top 20 U.S. universities across two rankings (7–9). We used three time periods (2002–2009, 2010–2015, 2016–2021) to smooth out annual variation. We hope our findings will help inform STEM gender diversity advocacy and policy, especially in universities.

A substantial portion of existing literature suggests women are more averse to competition than men, especially young women, or those in male-dominated environments (10–16). One study identified no gender difference in competitiveness in a verbal task but not in a math task (17). The latter task is stereotypically perceived as a task where men perform better, suggesting the perception of tasks influences competitiveness. On the other hand, another study has found no gender gap in competitiveness overall (18). Still, the evidence in favor of women's aversion to competition, especially among young women in male-dominated and masculine-perceived environments, led us to conjecture that women may be less likely to enter STEM disciplines of top universities. This is because STEM majors at top universities are plausibly perceived as competitive and male-dominated environments in which men stereotypically perform better, perhaps making competition aversion among women more likely. Because we focused on top-ranked universities, we conjectured that academic and admissions competitiveness would be especially pertinent in applicants' perceptions of and experiences in university and, therefore, have a larger impact on gender diversity in top-ranked universities than in lower-ranked universities. Seeking to examine if top universities' STEM gender diversity policies can counteract the plausible negative effect of their competitiveness on women's

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representation in STEM, we hypothesized that, if such policies are equally well-resourced in every assessed university, then higher-ranked universities would correlate with lower women's representation in STEM fields and lower changes in disciplinary women's representation. Consequently, a non-negative correlation may suggest that higher ranked universities can reduce the effects of their competitive nature with STEM gender diversity policies, promoting women's representation in these fields. We expected the sign of the correlation between gender diversity and rank established by prior studies of thousands of universities to change when considering only top-ranked universities, considering the salience of competitiveness in these universities (5, 6).

Additionally, we hypothesized that gender diversity in STEM degrees would converge over time, meaning the variation in gender representation in STEM degrees between different universities would decrease over time. In other words, the STEM gender diversity would become more similar between universities as time passed. This is because university policies and opportunities to increase women's representation in STEM may have become more widespread as time passed because of increasing awareness of the STEM gender gap (19). These policies would plausibly be effective, as similar policies intended to increase the representation of racial minorities have been successful in achieving their aims (20).

In most disciplines, we found no statistically significant correlation between disciplinary rank and women's representation, and no disciplines had a statistically significant correlation between disciplinary rank and change in women's representation since 2002. However, in computer science and mechanical engineering, more desirably ranked universities weakly correlated with higher disciplinary gender diversity. Lastly, we found that five out of the eight most male-dominated STEM degrees analyzed converged in women's representation over time by a relatively large amount; the three that did not converge diverged slightly.

Our results suggest that these universities' rankings have no relationship with their representation of women in STEM, except for in two fields, where a statistically significant but weak relationship exists, and that the universities' rankings have no relationship with their change in women's representation in STEM between 2002–2009 and 2016–2021. Our results also suggest gender diversity in STEM is increasing, especially between 2010–2015 and 2016–2021, and is converging (decreasing in variation) over time in some disciplines.

RESULTS

To indicate the characteristics of and changes in the STEM gender gap, we aimed to identify how women's representation in STEM disciplines at top US universities changed from 2002 to 2021, its relationship with top universities' disciplinary rank, and whether it has converged (become more similar) over time between top universities. Lastly, we considered a case study comparison of the policies and initiatives of two universities with a difference in women's representation in male-dominated disciplines of 19.5 percentage points.

Overall Trends in Representation of Women

We gathered data from the NCES IPEDS including 60 disciplines in 24 universities and summed the number of degrees conferred across three time periods, 2002–2009, 2010–2015, and 2016–2021. We defined the nine most male-dominated disciplines as those with the nine lowest percentages of degrees conferred to women in 2016–2021, and we graphed their representation of women over time (**Figure 1**). Gender diversity increased over the 19 years in every discipline, except for aerospace engineering, with the most substantial gains occurring between 2010–2015 and 2016–2021. We individually graphed the six most male-dominated degrees with the highest number of degrees conferred from 2002–2009 to 2016–2021, using the universities with the

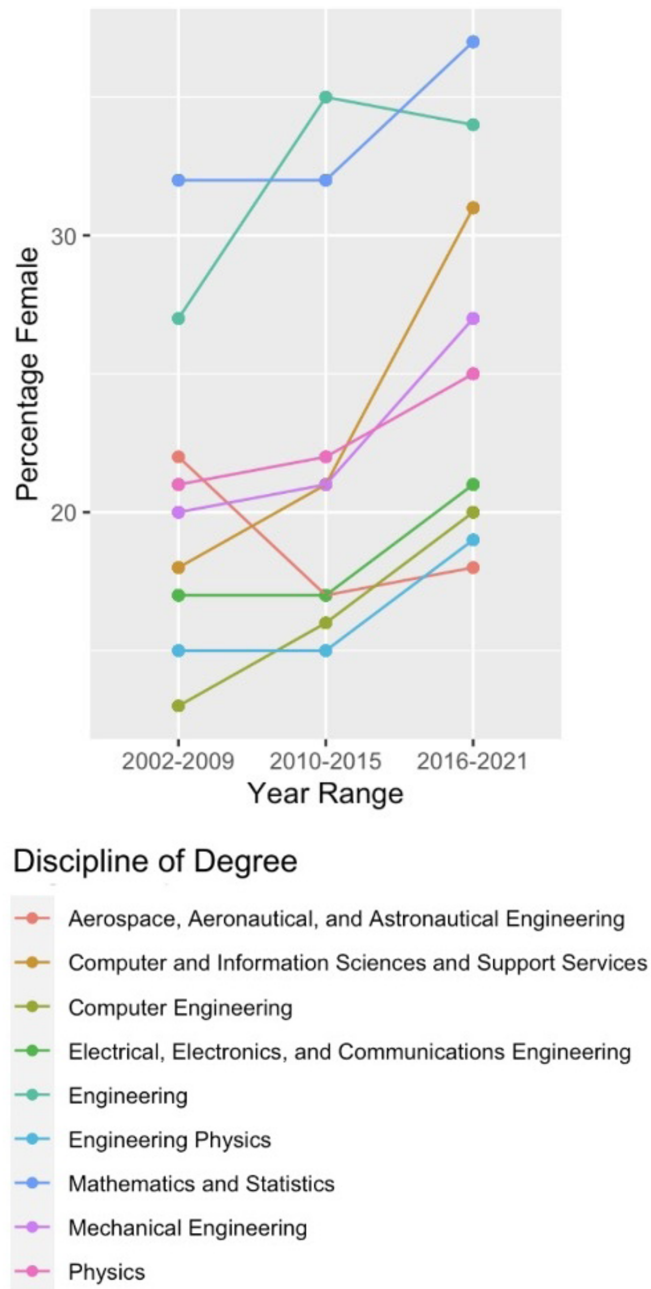

Figure 1. Female share of the most male-dominated degrees between year ranges. Line plot shows the female percentage of undergraduate degrees conferred in the nine most male-dominated disciplines over 19 years at the top 20 U.S. universities of two rankings.

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three lowest and three highest disciplinary gender diversity in 2016–2021 to illustrate the range (**Figure 2**). In most degrees, the gap is clearly visible; universities with the three highest and three lowest disciplinary gender diversity had an average difference in women's representation of 19.6 percentage points.

Convergence in Disciplinary Representation of Women

To measure convergence in women's representation over time — whether the variation between the representation of men and women has been decreasing — among the nine most male-dominated degrees, the coefficient of variation was calculated during each time period (**Table 1**). The change in the coefficient of variation from 2002–2009 to 2016–2021 was negative for five out of the nine degrees, demonstrating convergence over time. We measured coefficient of variation changes of -0.2807, -0.1838, -0.1257, -0.0707, and -0.0267 in general engineering, engineering physics, computer science, mathematics and statistics, and physics, respectively. One degree lacked sufficient data, and aerospace, electrical, and

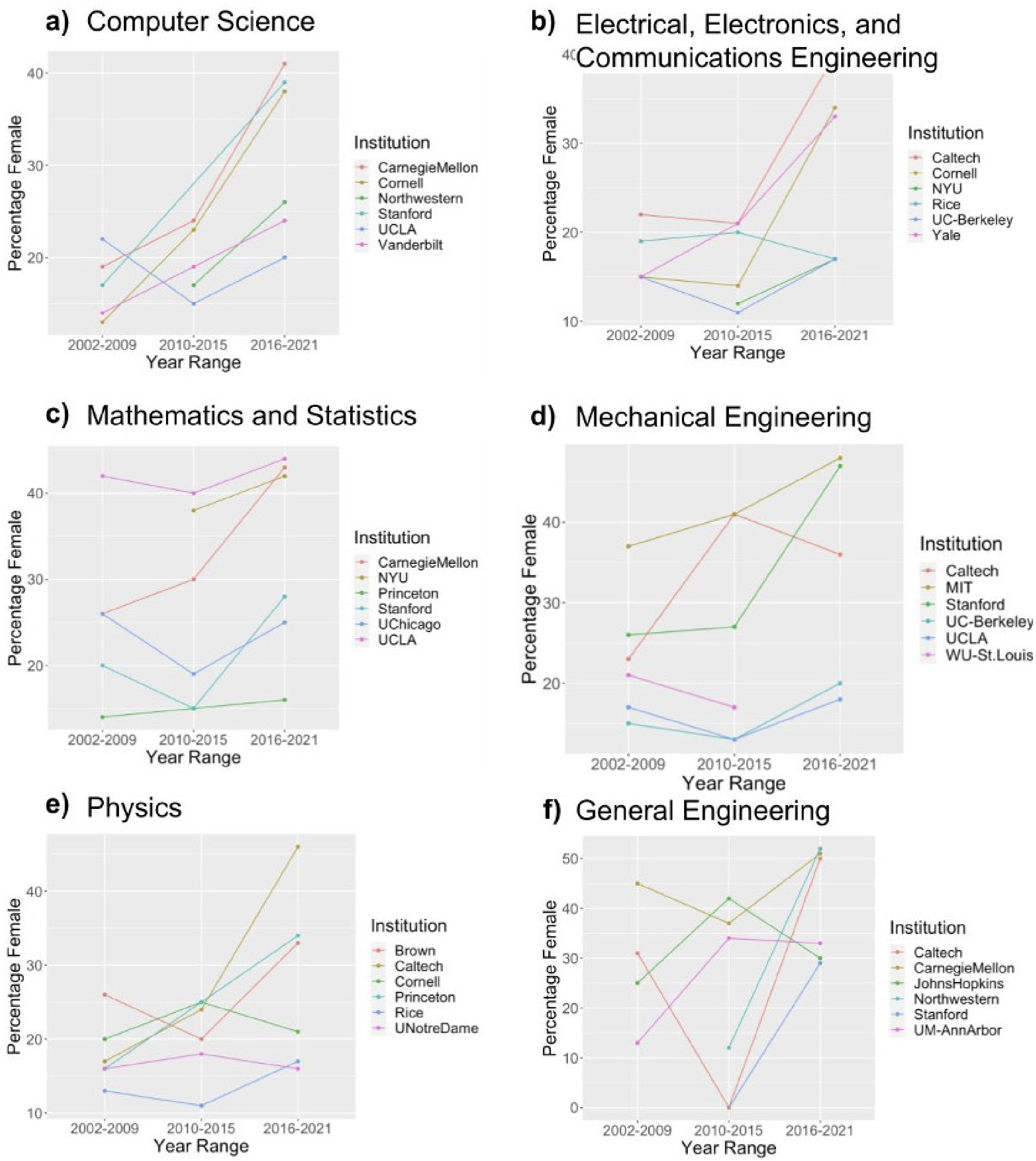

Figure 2: Female percentage of degrees conferred in selected disciplines between year ranges. Each discipline's graph shows six universities — the three universities assessed with the highest disciplinary female percentage in 2016–2021 and the three universities with the lowest 2016-2021 disciplinary female percentage.

Degree Discipline & Metric		T1 2002-2009	T2 2010-2015	T3 2016-2021	T3 - T1 Change
Computer Science	CV	0.3031	0.2132	0.1774	-0.1257
	Mean	17.32	21.04	31.00	13.68
Electrical Engineering	CV	0.2670	0.3029	0.2744	0.0074
	Mean	16.58	19.45	24.45	7.88
Mechanical Engineering	CV	0.2697	0.3715	0.2757	0.0060
	Mean	20.58	21.73	27.82	7.24
Mathematics and Statistics	CV	0.2598	0.2238	0.1892	-0.0707
	Mean	28.61	30.04	34.28	5.67
Physics	CV	0.2774	0.2361	0.2507	-0.0267
	Mean	19.30	21.12	25.44	6.14
General Engineering	CV	0.5197	0.8441	0.2390	-0.2807
	Mean	25.78	21.89	41.00	15.22
Aerospace Engineering	CV	0.3620	0.8591	0.4106	0.0486
	Mean	25.78	21.89	41.00	15.22
Computer Engineering	CV	NA	0.4932	0.2757	NA
	Mean	NA	21.89	41.00	NA
Engineering Physics	CV	0.6365	0.5722	0.4527	-0.1838
	Mean	25.78	21.89	41.00	15.22

Color Key					
Mean	1				0
Coefficient of Variation	41				0

Table 1: The Coefficient of Variation (CV) in women's representation and mean women's representation among the top 20 universities for the nine most male-dominated degrees. Data include the top 20 U.S. universities from the 2023 US News and 2021 QS U.S. university rankings. Degrees conferred data are from the NCES IPEDS. The "Change" column is the difference between the 2016–2021 value and the 2002–2009 value.

mechanical engineering diverged slightly, with coefficient of variation changes of 0.0486, 0.0074, and 0.0060, respectively. For the six most male-dominated degrees with the greatest number of degrees conferred over time, the disciplinary women's representation over time was plotted to illustrate convergence, being most substantial and visible in general engineering and computer science, the coefficient of variations of which decreased by 0.2807 and 0.1257, respectively, from 2002–2009 to 2016–2021 (**Figure 3**). Other disciplines show similar trends and were omitted for visual clarity.

Correlation Between Universities' Disciplinary Ranking and Representation of Women

Discipline-specific university rankings were collected from the QS world university subject rankings and used to identify potential correlations between universities' ranking and women's representation within specific disciplines (21). We also investigated the change in disciplinary representation of women over time. Because a lower numeric university ranking value (e.g., #1) denotes a higher (more desirable) rank, negative correlation coefficients suggest that more desirably ranked universities tend to have higher representation of women in those disciplines, while positive correlation coefficients suggest the opposite. Using the Pearson and Spearman statistical tests, two of the nine most male-dominated degrees had statistically significant correlations. Computer science had a correlation coefficient of -0.39 by the Pearson method ($p = 0.051$) and -0.46 by the Spearman method ($p = 0.021$, **Figure 4**), where the p-values perhaps suggest a slightly stronger nonlinear correlation. Mechanical engineering had a correlation coefficient of -0.42 by the Pearson method ($p = 0.05$, **Figure 5**) and -0.23 by the Spearman method ($p = 0.301$), where the p-values suggest a statistically significant weak linear correlation.

To further illustrate this relationship, the percentage of computer science degrees conferred to women at the top five and bottom five universities by computer science rank was graphed over time, contrasting with that of the top 10 universities by computer science rank (**Figure 6, 7**).

We calculated the change in women's representation for each university in each discipline by subtracting the 2002–2009 percentage of women from the 2016–2021 percentage of women. Then, using the Pearson and Spearman statistical tests, we found none of the nine most male-dominated disciplines had a statistically significant correlation between the universities' disciplinary ranking and their change in disciplinary women's representation between 2002–2009 and 2016–2021.

A Case Study Comparison

As a case study, we compared Carnegie Mellon University (CMU) to UCLA. CMU has the highest average 2016-2021 women's representation in the most male-dominated disciplines of our sample (42.3%), while UCLA has the lowest (22.8%). Exploring publicly available information on these two universities' policies and programs to promote gender diversity in STEM fields shows that CMU features women's student groups in engineering and computer science, which hold several events each semester, including career fairs and STEM outreach programs (22, 23). In addition, the university has a partnership with the ARCS Foundation Pittsburgh, which in part aims to promote women entering STEM fields, and finally, according to the *Post-Gazette* (2023), CMU created a $150 million program to increase diversity in STEM in 2023 (24, 25). In contrast, UCLA's Samueli School of Engineering held a "Women in STEM" summit in April 2021, and the university ran a 2014 event called "Empower Her: STEMDAY" for high school girls from underserved schools, suggesting that, relative to CMU, UCLA may offer fewer easily accessible ongoing programs to increase women's representation in STEM fields (26, 27).

DISCUSSION

We measured the change in women's representation among STEM disciplines at top US universities from 2002 to 2021, its relationship with disciplinary rank, and whether it converged over time between universities, as we aimed to

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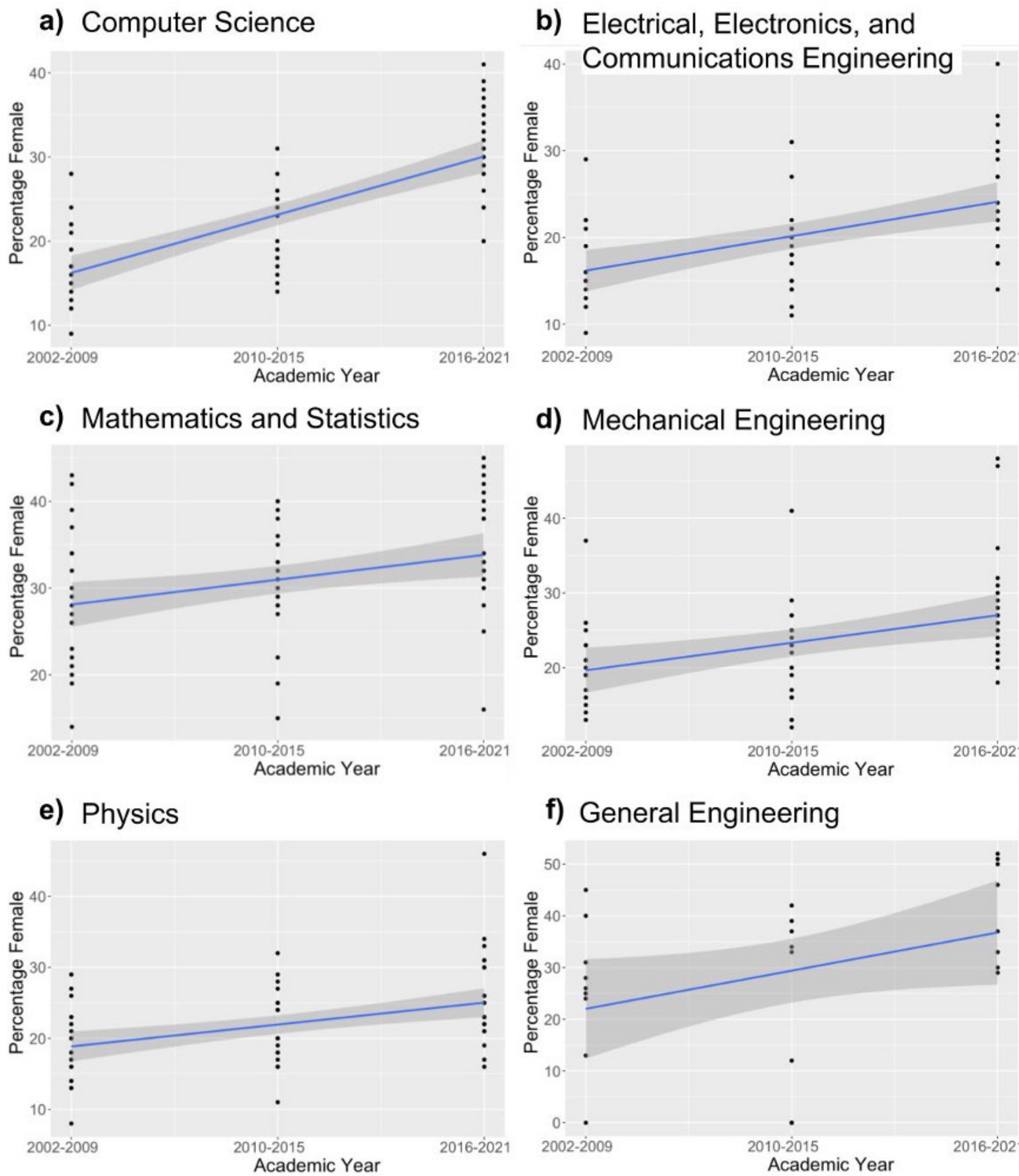

Figure 3: Distribution of female representation in the six most popular disciplines during each year period. Other Scatterplot points represent individual universities. Linear regression lines show trends, and shaded areas represent the 95% confidence interval. Other fields show similar trends and were omitted for visual purposes.

identify characteristics of and changes in the STEM gender gap. Additionally, we compared the policies and initiatives of CMU and UCLA to identify examples of efforts that appear to effectively increase women's representation in male-dominated disciplines.

The 60 disciplines we analyzed was comprised mostly of disaggregated STEM disciplines (50 out of 60), but also included large numbers of degrees conferred reflected in 10 non-STEM aggregate disciplines. Thus, finding that all of the nine most male-dominated disciplines in 2016–2021 fell within STEM suggests the STEM gender gap persists, despite our finding that gender diversity has been increasing over time across most STEM disciplines. We find this increase is especially pronounced in the last decade, which may reflect the increased attention to STEM's lagging gender equity in recent years (19). It appears recent efforts to increase women's participation in STEM are bearing fruit, suggesting that current diversity-promoting policies are effective but would need to continue to address the gender gap.

We calculated the change in coefficient of variation for

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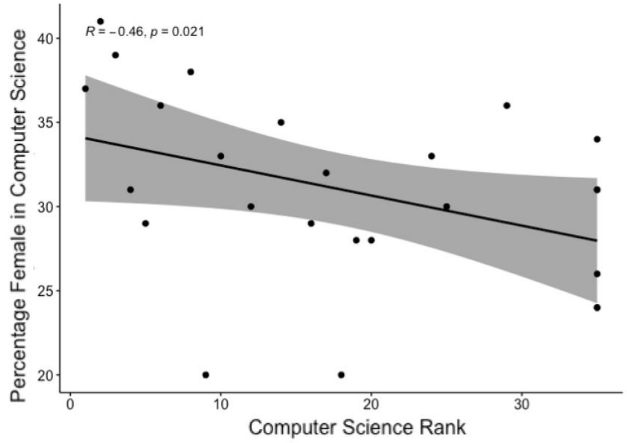

Figure 4: Correlation between universities' computer science ranking and their percentage of computer science degrees conferred to women. Scatterplot points represent individual universities. A linear regression line shows the Spearman statistical test correlation, and a shaded area represents the 95% confidence interval (p = 0.021, correlation coefficient = -0.46).

eight of the most male-dominated degrees (since one of the nine most male-dominated degrees lacked sufficient data). We recorded a 63% convergence rate (defined as the percentage of assessed degrees with a negative change in coefficient of variation), but our small sample size leaves inconclusive evidence for our hypothesis that women's representation in STEM degrees across the universities generally converged over time. Concerning specific disciplines, our results support our hypothesis for general engineering, engineering physics, computer science, mathematics and statistics, and physics. The results did not support our hypothesis for aerospace, electrical, and mechanical engineering.

Before discussing our findings regarding university rankings, it's worth mentioning that, although the usefulness of university rankings is debated, they represent university reputation, which can have real consequences for students' academic choices and careers (6, 28, 29). Perceived reputation is also relevant to our perception-based hypothesis about the correlation between universities' disciplinary ranking, women's representation, and change in representation over the 19 years. This partially motivated our focus on a smaller sample of schools where specific rankings are potentially more salient for students and employers relative to schools lower in the ranking.

For seven of the nine most male-dominated majors, we recorded no correlation between universities' disciplinary ranking and their disciplinary representation of women. This suggests that, in these universities, ranking has no significant bearing on the gender diversity observed in specific disciplines. This does not support our hypothesis and may indicate that competitiveness — to the extent that university rankings are an appropriate proxy for competitiveness — does not significantly relate to gender diversity in these disciplines. We also found that more desirably ranked universities in computer science or mechanical engineering tended to have higher representation of women in those disciplines, which did not support our hypothesis. This may be due to the higher quantity of resources that higher-ranked universities have to offer for gender diversity promoting policies and opportunities (30).

This study assessed 24 universities representing the top 20 universities of two ranking lists, some of which lacked data for certain degrees during certain time periods, likely because they did not offer degrees within the specific fields at the time (8, 9). Similarly, we calculated the coefficient of variation for the nine most male-dominated degrees, one of which lacked sufficient data. As a result, this study presents preliminary data with relatively small sample sizes. Future investigations should assess a larger number of universities to more comprehensively identify correlations between gender diversity and university ranking as well as convergence in gender diversity between universities over time. The limitations brought by our sample size suggest our hypothesis on convergence broadly occurring across STEM degrees remains neither supported nor contradicted.

Considering further limitations, our case study comparison features a small sample of two universities. Additionally, our search might have missed programs in either of the two universities. That said, there is a notable difference between these universities' gender-diversity-promoting initiatives—CMU's student groups frequently engage in outreach and the university appears to have invested a substantial amount of money into promoting gender diversity in STEM, while UCLA appears to have held two one-time events, one of which was 10 years ago. This may at least partially explain the difference in gender representation in STEM between the two universities: given CMU's relatively high representation of women in STEM, its efforts plausibly exemplify effective university initiatives to increase women's representation in STEM.

Previous literature on the causes of the gender gap in STEM identifies four main factors: stereotypes, a lack of role models, unconscious biases, and the fusion of STEM careers' demanding standards and women's familial responsibilities (31, 32, 33). We can reasonably conjecture that CMU's initiatives might affect the first three factors. First, CMU's

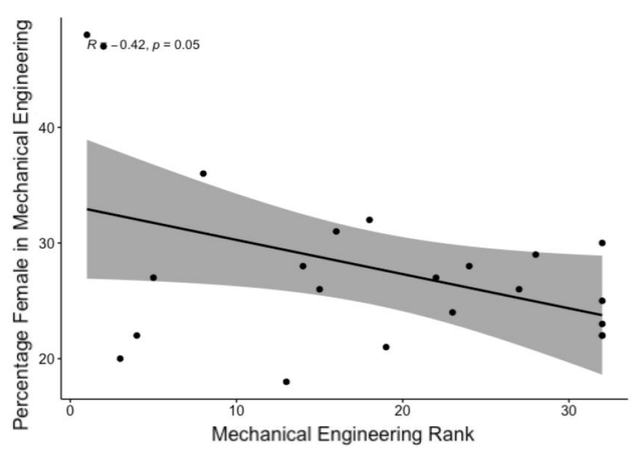

Figure 5: Correlation between universities' mechanical engineering ranking and their percentage of mechanical engineering degrees conferred to women. Scatterplot points represent individual universities. A linear regression line shows the Pearson statistical test correlation (p = 0.05, correlation coefficient = -0.42).

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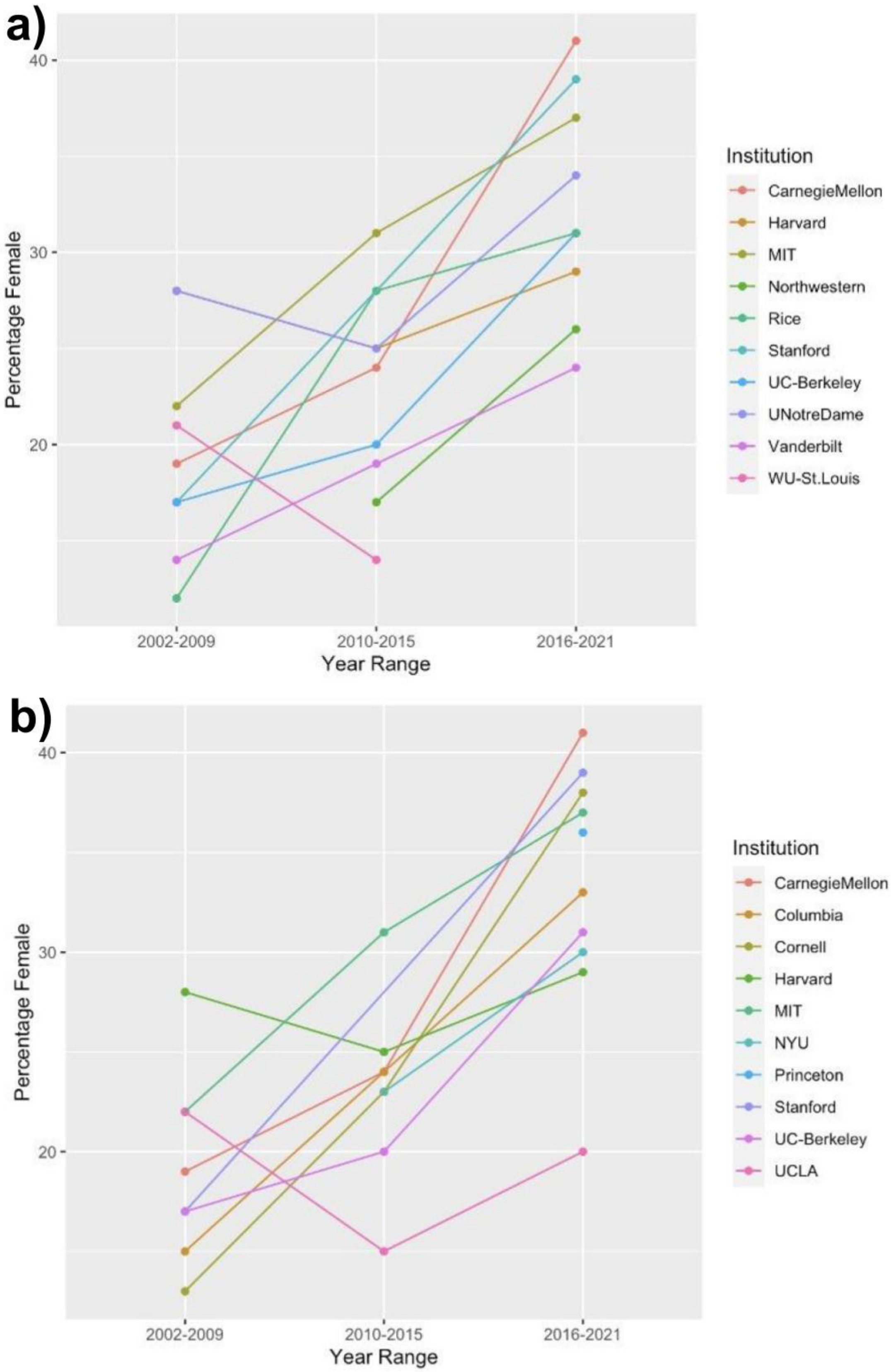

Figure 6: The percentage of computer science degrees conferred to women over 19 years. Line plot a) shows the top five and bottom five ranked assessed universities for computer science. In contrast, plot b) shows the top 10 ranked assessed universities for computer science.

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student groups and their events may heighten students' and faculty's awareness of women in STEM. This may decrease stereotypical associations that STEM programs are more appropriate for men. Second, CMU's events that prominently feature women with successful STEM careers may increase women's access to role models and mentors, increasing their interest and confidence in STEM fields. Third, the campus's frequent events may serve to increase awareness of women's success in STEM and may reduce unconscious biases in faculty and staff.

For disciplines where a subject-specific QS ranking was unavailable (i.e., aerospace engineering, computer engineering, engineering, and engineering physics), the QS aggregate subject ranking called "Engineering and Technology" was used as a proxy to assess the correlation between these subjects' percentages of women and the aggregate ranking. Thus, the ranking was less closely tailored to the women's representation for these disciplines, which may have prevented correlations from being identified. Additionally, before the process was automated in R for the earlier time periods, the NCES IPEDS raw data for 2016–2021 was compiled in Excel, leaving the potential for human error to have occurred.

MATERIALS AND METHODS

University Selection and Data Collection

24 universities (found in the Appendix) were selected to represent the top 20 universities in the United States based on the US News 2022–2023 rankings and the QS 2021 United States rankings (8, 9). The number of schools in the final sample exceeds 20 to create a complete set of the top 20 universities across both lists. During university selection, the most recent QS ranking for a U.S.-specific list was 2021. We chose these rankings as they emphasize different factors. US News rankings are determined primarily by universities' success at graduating students with minimal debt, whereas 2021 QS rankings emphasized reputation and research, determined by academic reputation, employer reputation, citations per faculty, student-faculty ratio, and international student and faculty ratios (34, 35).

Data were collected from the NCES Integrated Postsecondary Education Data System (IPEDS) through the compare institutions lookup under the completions category. We included first and second majors from 60 disciplines (found in the appendix) receiving undergraduate degrees only. We gathered the "grand total" degrees conferred and "grand total women" degrees conferred (6). This was repeated for each university and each year from 2002–2021. 2021 was the most recent year available in the NCES IPEDS during data collection. Undergraduate degrees were isolated to measure STEM participation because admissions offices reviewing applicants to highly ranked postgraduate STEM programs plausibly have higher expectations for prior involvement in STEM than they have for undergraduate applicants. Hence, as we wished to measure the change in women's engagement in STEM over time, we sought to minimize the influence of STEM engagement (or lack thereof) from before our assessed time period on our findings.

Data Compilation

Raw data from the NCES IPEDS were processed in R with replication code and data files publicly available on GitHub (36). The raw data for 2016–2021 was compiled in Excel. The number of degrees conferred during each time period (2002–2009, 2010–2015, and 2016–2021) was summed to smooth out natural fluctuations between years. These time periods were chosen to best match the data structure of the IPEDS, and these data were aggregated into time periods of five or more years to reduce large fluctuations in disciplines with a small number of degrees conferred. The most distant time period is longer to include all available data. Every university's disciplinary representation of women in each time period was calculated by dividing the number of degrees conferred to women by the total number of degrees conferred. Because the NCES IPEDS aggregated only the degrees conferred to men and women into the total degrees conferred (i.e., a non-binary category was not provided), non-binary individuals were not able to be considered. The changes in women's representation for each discipline at each university were calculated by subtracting the 2002–2009 percentage of women from the 2016–2021 percentage of women.

Line Plots

Line plots were created in R. The most male-dominated disciplines were defined as those with the lowest percentage of degrees conferred to women during the 2016–2021 range, omitting those with less than 1,000 total degrees conferred in 2016–2021 and composites of residual degrees (i.e., engineering other).

Convergence and Variation in Gender Representativeness

Convergence of women's representation over time was measured in popular disciplines among the most male-dominated disciplines by finding the coefficient of variation of each discipline's representation of women at each of the three time periods (**Table 1**). For each year range, the standard deviation (σ) in disciplinary women's representation among the universities was divided by the universities' mean disciplinary women's representation (μ) to yield the Coefficient of Variation (*CV*, Equation 1), where σ is calculated by Equation 2, in which x_i is each value from the population, and *N* is the population size.

$$CV = \frac{\sigma}{\mu} \qquad \text{Equation 1.}$$

$$\sigma = \sqrt{\frac{\Sigma(x_1 - \mu)^2}{N}} \qquad \text{Equation 2.}$$

Distribution graphs were created in R with a linear regression line to illustrate trends and a standard error shadow representing the 95% confidence interval (**Figure 3**).

Correlation Between Representation of Women and Rank

Disciplinary rankings were gathered from the QS 2023 subject rankings (21). Non-U.S. universities were omitted to create US-specific rankings, with lesser values (e.g., #1) representing a higher or more desirable rank. Correlation coefficients and p-values were calculated in R. First, since we were uncertain about the linearity of the relationship, we used both the Pearson and Spearman methods to assess correlations between the universities' disciplinary ranking and their disciplinary representation of women in the most recent period of 2016–2021. Second, we evaluated how it changed between 2002–2009 and 2016–2021. For disciplines where a subject-specific QS ranking was unavailable (i.e., aerospace engineering, computer engineering, engineering, and engineering physics), the QS aggregate subject ranking called "Engineering and Technology" was used as a proxy to assess the correlation between these subjects' percentages of women and the aggregate ranking.

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REFERENCES

1. "Diversity and STEM: Women, Minorities, and Persons with Disabilities." *National Center for Science and Engineering Statistics Special Report NSF 23-315*, 2023, pp. 1-76. ncses.nsf.gov/pubs/nsf23315/. Accessed 30 Oct. 2023.
2. Langdon, David, et al. "STEM: Good jobs now and for the future." *Economics and Statistics Administration Issue Brief No. 03-11*, July 2011, pp. 01-10, eric.ed.gov/?id=ED522129. Accessed Oct. 2023.
3. Fine, Cordelia, et al. "Why Does Workplace Gender Diversity Matter? *Justice, Organizational Benefits, and Policy*." *Social Issues and Policy Review*, vol. 14, no. 1, 12 Dec. 2020, pp. 36-72. https://doi.org/10.1111/sipr.12064.
4. Zhang, Letian. "An Institutional Approach to Gender Diversity and Firm Performance." *Organization Science*, vol. 31, no. 2, 25 Feb. 2020, pp. 439-457. https://doi.org/10.1287/orsc.2019.1297.
5. Henderson, Loren and Cedric Herring. "Does critical diversity pay in higher education? Race, gender, and departmental rankings in research universities." *Politics, Groups, and Identities*, vol. 1, no. 3, 23 July 2013, pp. 299-310. https://doi.org/10.1080/21565503.2013.818565 .
6. Henderson, Loren, et al. "Gender Diversity and The Rankings of Stem Departments in Research Universities: Does Gender Composition Matter?" *Journal of Women and Minorities in Science and Engineering*, vol. 23, no. 4, Jan. 2017, pp. 323-337. https://doi.org/10.1615/JWomenMinorScienEng.2017019873.
7. "IPEDS: Integrated Postsecondary Education Data System." *National Center for Education Statistics*. nces.ed.gov/ipeds/datacenter/InstitutionList.aspx. Accessed 10 June 2023.
8. "Best National University Rankings." *US News*, 2022. www.usnews.com/best-colleges/rankings/national-universities?scrlybrkr. Accessed 7 June 2023.
9. "QS World University Rankings: USA." *Quacquarelli Symonds*, 2021. www.topuniversities.com/university-rankings/usa-rankings/2021. Accessed 7 June 2023.
10. Eriksson, Kimmo and Pontus Strimling. "Gender differences in competitiveness and fear of failure help explain why girls have lower life satisfaction than boys in gender equal countries." *Frontiers in Psychology*, vol. 14, 9 Mar. 2023. https://doi.org/10.3389/fpsyg.2023.1131837.
11. Flory, Jeffrey, et al. "Do Competitive Workplaces Deter Female Workers? A Large-Scale Natural Field Experiment on Job Entry Decisions." *The Review of Economic Studies*, vol. 82, no. 1, Jan. 2015, pp. 122-155. https://doi.org/10.1093/restud/rdu030.
12. Niederle, Muriel and Lise Vesterlund. "Do Women Shy Away From Competition? Do Men Compete Too Much?" *The Quarterly Journal of Economics*, vol. 122, no. 3, 1 Aug. 2007, pp. 1067-1101. https://doi.org/10.1162/qjec.122.3.1067.
13. Niederle, Muriel and Lise Vesterlund. "Gender and Competition." *The Annual Review of Economics*, vol. 3, Sept. 2011, pp. 601-630. https://doi.org/10.1146/annurev-economics-111809-125122.
14. Buser, Thomas, et al. "Gender, Competitiveness, and Career Choices." *The Quarterly Journal of Economics*, vol. 129, no. 3, Aug. 2014, pp. 1409-1447. https://doi.org/10.1093/qje/qju009.
15. Flory, Jeffrey, et al. "Gender, age, and competition: A disappearing gap?" *Journal of Economic Behavior and Organization*, vol. 150, June 2018, pp. 256-276. https://doi.org/10.1016/j.jebo.2018.03.027.
16. Carlana, Michela and Lucia Corno. "Parents and Peers: Gender Stereotypes in the Field of Study." *CEPR Discussion Papers*, 16582, Sept. 2021, pp. 1-62. ssrn.com/abstract=3960154. Accessed 20 Jan. 2024.
17. Kamas, Linda and Anne Preston. "Are Women Really Less Willing to Compete Than Men? Gender Stereotypes, Confidence, and Social Preferences." *ResearchGate*, Mar. 2012, pp. 1-32. www.researchgate.net/publication/228427441_Are_Women_Really_Less_Willing_to_Compete_Than_Men_Gender_Stereotypes_Confidence_and_Social_Preferences. Accessed 20 Jan. 2024.
18. Fornwagner, Helena, et al. "On the robustness of gender differences in economic behavior." *Scientific Reports*, vol. 12, no. 21549, Dec. 2022, pp. 1-11. https://doi.org/10.1038/s41598-022-25141-1.
19. Li, Yeping, et al. "Research and trends in STEM education: a systematic review of journal publications." *International Journal of STEM Education*, vol. 7, no. 11, 10 Mar. 2020, pp. 1-16. https://doi.org/10.1186/s40594-020-00207-6.
20. Arcidiacono, Peter, et al. "Affirmative Action in Undergraduate Education." *Annual Review of Economics*, vol. 7, no. 1, Aug. 2015, pp. 487-518. https://doi.org/10.1146/annurev-economics-080614-115445.
21. "QS World University Rankings by Subject 2023." *Quacquarelli Symonds*, 2023. www.topuniversities.com/subject-rankings/2023. Accessed 1 Nov. 2023.
22. "TechNights." *Carnegie Mellon University School of Computer Science*, 2024. www.cmu.edu/scs/technights/. Accessed 20 Jan. 2024.
23. "SWE: Society of Women Engineers." *Carnegie Mellon University*, 2024. cmuswe.org/. Accessed 20 Jan. 2024.
24. DeFrancesco, Joyce. "Women of Science." *Carnegie Mellon University*, 2024. makepossible.cmu.edu/women-of-science/. Accessed 20 Jan. 2024.
25. Tomasic, Megan. "Carnegie Mellon creates $150 million program to increase diversity in STEM fields." *The Post-Gazette*, 23 Feb. 2023. www.post-gazette.com/news/education/2023/02/22/carnegie-mellon-creates-150-million-program-stem-students-diversity/stories/202302220091. Accessed 20 Jan. 2024.
26. "Women in STEM: Breaking Barriers." *UCLA Samueli School of Engineering*, 2021. samueli.ucla.edu/women-in-stem-breaking-barriers/. Accessed 20 Jan. 2024.
27. "UCLA Hosts Event To Highlight Career Opportunities For Women In Science, Technology." *CBS News*, 27 May 2014. www.cbsnews.com/losangeles/news/ucla-hosts-

https://doi.org/10.59720/23-310

event-to-highlight-career-opportunities-for-women-in-science-technology/. Accessed 20 Jan. 2024
28. Di Gegorio, Dante, and Scott Shane. "Why do some universities generate more start-ups than others?" *Research Policy*, vol. 32, no. 2, Feb. 2003, pp. 209-227. https://doi.org/10.1016/S0048-7333(02)00097-5.
29. MacLeod, W. Bentley, et al. "The Big Sort: College Reputation and Labor Market Outcomes." *American Economic Journal: Applied Economics*, vol. 9, no. 3, July 2017, pp. 223-261. https://doi.org/10.1257/app.20160126.
30. Bulman, George. "The Effect of College and University Endowments on Financial Aid, Admissions, and Student Composition." *National Bureau of Economic Research*, Aug. 2022. https://doi.org/10.3386/w30404.
31. Makarova, Elena, et al. "The Gender Gap in STEM Fields; The Impact of the Gender Stereotype of Math and Science on Secondary Students' Career Aspirations." *Frontiers in Education*, vol. 4, no. 60, July 2019, pp. 1-11. https://doi.org/10.3389/feduc.2019.00060.
32. Charlesworth, Tessa, and Mahzarin Banaji. "Gender in Science, Technology, Engineering, and Mathematics: Issues, Causes, Solutions." *The Journal of Neuroscience*, vol. 39, no. 37, Sept. 2019, pp. 7228-7243. https://doi.org/10.1523%2FJNEUROSCI.0475-18.2019.
33. Ganley, Colleen, et al. "Gender Equity in College Majors: Looking Beyond the STEM/Non-STEM Dichotomy for Answers Regarding Female Participation." *American Educational Research Journal*, vol. 55, no. 3., June 2019, pp. 453-487. https://doi.org/10.3102/0002831217740221.
34. Morse, Robert, and Eric Brooks. "How U.S. News Calculated the 2024 Best Colleges Rankings." *US News*, 17 Sept. 2023. www.usnews.com/education/best-colleges/articles/how-us-news-calculated-the-rankings. Accessed 11 Nov. 2023.
35. "Understanding the Methodology: QS World University Rankings." *Quacquarelli Symonds,* 8 June, 2021. www.topuniversities.com/university-rankings-articles/world-university-rankings/understanding-methodology-qs-world-university-rankings. Accessed 11 Nov. 2023.
36. Kruus, Nicholas. "STEMGenderGap" *GitHub*, 11 Nov. 2023. github.com/NicholasKruus/STEMGenderGap.