MOTHER NATURE NEEDS HER DAUGHTERS:
A HOMeward bound global review and fact sheet
Investigating gender inequality in STEMm

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Collated from scientific literature, international and national reports, this is a fact sheet aimed at encouraging women’s empowerment at work and in leadership.

It’s not in your head. The evidence is clear. Let’s get to changing it.

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The full reference list and bibliography for the Global Review and Factsheet can be accessed publicly at https://www.mendeley.com/community/f469af2e-b221-338e-b71a-a6d110b3baa2/
Executive Summary

The world is at an important cross road. Many key indicators measuring human progress are on the ascent: better education, declining infant mortality, population growth, fewer pandemics, and reduction of infectious disease; more food for most people, extraordinary innovation and global access to technology and information. However, as a consequence of these human achievements, the physical environment and natural systems which support the survival of our species (and 9 million others) are experiencing unprecedented change. Most notably, the planet’s climate is rapidly heating, with a multitude of unpredictable consequences for biodiversity and food security. Globally we are experiencing large scale habitat destruction and deforestation, rampant biological invasions, a mass extinction, ubiquitous plastic pollution, collapse of natural food resources and critical loss of insect populations. The biological system is at tipping point, under threat of irreversible collapse; at this pivotal time, we need collaborative, global leadership that prioritises these issues. We are cognizant that the very practice of leadership that got us to where we are today - male dominated, competitive, aggressive, short term, ‘I’ over ‘we’, and often using the common assets for personal gain - is manifestly unsuited to guiding humanity to where it needs to be to survive and indeed prosper - together. Indeed, we need a radically new model of leadership; the easiest way to shift the current leadership paradigm? Include more women.

To inform this discussion, we have compiled an extensive literature review and fact sheet on the systemic challenges faced by women with a STEMM (Science, Technology, Engineering, Mathematics and Medicine) background in both the developed and developing world. Although modest, this compilation is a crucial contribution to shifting the global narrative of leadership; we must understand the mechanisms underpinning disparities if we wish to change them. ‘Homeward Bound’ is a global initiative which elevates the visibility and leadership capacity of women with a STEMM background, to collaborate, influence environmental policy and contribute to the leadership debate. Over three years a collaboration of multi-national Homeward Bound alumnae (women in STEMM) created these two documents for a global audience. Firstly, our aim is to show women across the world ‘you are not alone’. Secondly, to a world in need of more leaders who are collaborative, inclusive and legacy minded (irrespective of their sex), we demonstrate that women face unique challenges which undermine their ability to get into the leadership arena. They are significant, and will only diminish with united effort; but we - men, women, children, and the planet, upon which we survive - will benefit. These documents are for sharing widely within your sphere of influence.
What are the biases for women entering, already in, or staying in STEMM?

Key issues include: stereotypes around science and gender and biology, beliefs around intelligence, self-assessment, beliefs about spatial skills, school and University environments and processes, and implicit and workplace biases.

What prevents women from entering STEMM? Biology is not destiny

- A review of 400+ articles exploring the causes of women’s underrepresentation in STEMM concluded that research on sex differences in brain structure and hormones is inconclusive. Female and male brains are physically distinct, but how these differences translate into specific cognitive strengths and weaknesses remains unclear.¹

- Sociocultural factors and environmental factors are more likely explanations for gender gaps. For example, fewer girls think they are good at maths, but in the past few decades the gender gap has narrowed and, today, girls are doing as well as boys in maths on average.²

- Gender differences in self-confidence in STEMM subjects begin in middle school and increase in high school and college, with girls reporting less confidence than boys in their maths and science ability.³

- Boys may develop greater confidence in STEMM through experience developing relevant skills. A number of studies have shown that gender differences in self-confidence disappear when variables such as previous achievement or opportunity to learn are controlled.⁴

- The relative proportion of girls doing well on tests of advanced mathematical ability has increased exponentially over the last 30 years showing much of the difference was environmental and societal⁵. Recent studies are showing the distributions of grades for girls and boys are very similar in STEMM subjects⁶; the biggest gender gaps are in non-STEMM subjects such as English, where girls earned 7.8% higher average grades and 13.8% less variable grades than boys.

- A study using an international database on adolescent achievement in science, mathematics and reading (n=472,242) found that in 2/3 countries girls performed similarly or better than boys in science. In almost all countries, more girls appeared capable of college-level STEM

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¹ Ceci et al. 2009, The Mathematics of Sex
than were enrolling in STEM degrees in college. Even though girls match or outperform boys in STEM in school, they outperform boys to a greater extent in reading and comprehension.7

- In some fields such as biology, women and men are now equally represented in training at undergraduate, graduate and postgraduate levels. However, women disproportionately leave these disciplines at each career stage following training.8

What influences Women’s interest in STEMM?

It could be that women are just not interested... but societal constructs play a major role in what women are interested in

- Interest in an occupation is influenced by many factors, including a belief that one can succeed in that occupation9 and culturally prescribed gender roles may influence occupational interest.10

- Aptitude differentials in math among girls and boys as the source of women underrepresentation in STEM has been debunked many times over. The causes are numerous and complex, but include marginalization within educational and corporate institutions11

- Girls assess their mathematical ability as lower than boys with equivalent past mathematical achievement. Girls hold themselves to a higher standard in subjects like maths, where boys are considered to excel. Because of this, girls are less likely to believe that they will succeed in a STEMM field and, therefore, less likely to express interest in a STEMM career.12

- There are well-documented gender differences in the value that women and men place on doing work that contributes to society. Women are more likely than men to prefer work with a clear social purpose.13 People do not always view STEMM occupations as directly benefiting society or individuals (although this is inaccurate).14

- STEMM subdisciplines with a clearer social purpose, such as medicine, biomedical engineering and environmental engineering, have higher percentages of women than have other subdisciplines like mechanical or electrical engineering.15

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What is it like for Women working in STEMM?

There are fewer women in STEMM, their jobs are less secure and they earn less

- Globally in higher education, only 35% of all students enrolled in STEM-related fields are female. Today, only 28% of all of the world’s researchers are women. Gender stereotypes and biased attitudes compromise the quality of the learning experience for female students and limit their education choices.\(^{16}\)

- The share of STEM degrees is even smaller for women of color. In 2014–2015, women of color earned a small percentage of bachelor’s degrees across all STEM fields\(^{17}\):
  - Black women: 2.9%
  - Latinas: 3.6%
  - Asian women: 4.8%

- The challenge for women in information technology is implicit in this statistic: In 2015, women held 57% of all professional occupations, yet they held only 25% of all computing occupations. Research shows company culture, bias and discouragement from science and maths all work against women in this male-dominated career.\(^{18}\)

- Only one in five board members at Standard & Poor’s top 500 companies (large company Index, US Stock Exchange) are women. A study of women’s representation on the boards of 518 Forbes Global 2000 companies in 39 countries has revealed that while only 10 percent of board members overall have professional technology experience, the percentage of female board members with tech experience—at 16 percent—greatly exceeds that of male board members with tech experience, at 9 percent. This phenomenon was consistent across the United States, Japan, Germany, France, the United Kingdom, the Netherlands and Australia.\(^{19}\)

- Women earn nearly one-third less than men within a year of completing a PhD in a science, technology, engineering or mathematics (STEM) field, according to American research.\(^{20}\)

- Although women fill close to half of all jobs in the US economy, they hold less than 25% of STEMM jobs. This has been the case throughout the past decade, even as college-educated women have increased their share of the overall workforce.\(^{21}\)

- Women who do not have children tend to earn more than women who do, but both groups still earn less than men;\(^{22}\) e.g. female physician researchers earn less than male counterparts, even after adjustments are made for other factors such as part-time work.\(^{23}\)

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\(^{16}\) UNESCO Aug 2017 Report, Cracking the code: Girls’ and women’s education in science, technology, engineering and mathematics (STEM).


\(^{18}\) Scheid, L 2016, The Challenges and Rewards for Women in Information Technology, Reading Eagle (PA)


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- Controlling for differences in the academic field, women still lagged men by 11% in first-year earnings. That difference was explained entirely by the finding that married women with children earned less than men. Married men with children, on the other hand, saw no disadvantage in earnings.  

- In academia, women outnumber men in full-time fixed-term contracts, and in part-time and casual employment categories. Improved job security has been identified as the single factor that most increases job satisfaction.

- Research suggests that women who have young children within 5–10 years after earning their PhDs are less likely to have tenure-track jobs or to hold tenured faculty positions than men or women without children.

Women’s retention and attrition in STEMM

Attrition from the STEMM workforce is impacting the overall representation of women in STEMM in the workplace

- Women’s representation among tenured faculty is lower than one would expect based on the supply of female science and engineering doctoral degree recipients in recent decades.

- For example, women earned 12% of the doctorates in engineering in 1996, but were only 7% of the tenured faculty in engineering in 2006. Even in fields like biology, where women now receive about one-half of doctorates and received 42% in 1996, women made up less than one-quarter of tenured faculty and only 34% of tenure-track faculty in 2006.

- Several studies have found a gender difference in hiring in STEMM academic disciplines. Recent research found that when women do apply for STEMM faculty positions at major research universities they are more likely than men to be hired, but smaller percentages of qualified women apply for these positions in the first place.

- Female STEMM faculty express lower job satisfaction than do their male peers. Lower satisfaction leads to higher turnover and a loss of talent in science and engineering. The climate of science and engineering departments is closely related to satisfaction of female faculty, and providing effective mentoring and work-life policies can help improve job satisfaction, hence, the retention of female STEMM faculty.

- Female scientists, engineers, and technologists in business and high-tech industry have higher attrition rates than do both their male peers and women in other occupations. Mid-career is a critical time for female scientists. Female engineers and technologists are fairly well represented at the lower rungs on corporate ladders.

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24 American Economic Review, DOI:10.1257/aer.p20161124
26 Mason MA & Goulden M 2002, Academe 88, 21–27
30 Cathy Trower and her colleagues at the Collaborative on Academic Careers in Higher Education (COACHE) at Harvard University
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- Documented attrition among STEMM faculty shows that women leave at higher rates than men, and women are more likely than men to consider changing jobs within academia. Women’s higher turnover intention in academia (which is the best predictor of actual turnover) is mainly due to dissatisfaction with departmental culture, advancement opportunities, faculty leadership and research support.32 33

- Between 2001 and 2014, women across 18 STEMM disciplines were significantly underrepresented among recipients of scholarly and research awards, and overrepresented in service and teaching awards relative to the proportion of PhDs, Full and Associate Professors.34

- Regardless of their representation in the nomination pool, men were twice as likely to win scholarly awards.35

- Minorities also remain woefully underrepresented in the sciences. For example, both the gender and racial composition of the Ecological Society of America remains skewed compared to the overall US population, and leadership and award winners have mostly been white males.36

- Overwhelmingly, the research findings demonstrate that women of color, among other underrepresented groups, do not persist in STEMM at the same rates as their white male counterparts due to social or interpersonal factors; in other words, women of color struggle and leave because they do not experience a sense of social belonging.37

- In the United Kingdom, there is also evidence that women academics in science, engineering and mathematics have more administrative duties on average than men and, hence, less time to do research.38

- Because scientists are increasingly judged by the number of their publications, citations, research grants, awards and membership of elite academies, this effectively constrains women’s career choices and progression.39

- Women cite feelings of isolation, an unsupportive work environment, extreme work schedules, and unclear rules about advancement40 and success as major factors in their

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32 Xu 2008, DOI: 10.1007/s11162-008-9097-4
https://doi.org/10.1002/tea.20937
Family responsibilities such as caring for children and/or moving to follow a partner’s job are common reasons for exiting the science and engineering sector.  

From examining women in leadership in Asia, specifically Singapore, the double bind of patriarchal construction of leadership is seen as masculine and performing Asian femininity impeded the leadership progression of women. There is a priority to balance career and familial roles over leadership roles. Women, especially the Chinese participants, voiced the cultural expectation of ideal motherhood (depicted here as the idealized “Tiger Mom”) they actively participated in. Work/life “balance” was more important than leadership progression.

One survey showed that 33.8% of women respondents in the 25 to 35 age group were intending to leave their profession within 5 years. Key reasons for people leaving the STEMM industry include a lack of career advancement, leaving for better pay and workplace conditions, and leaving for better work/life balance. Notably, this was the case for women with and without children.

Women in doctoral programs in Science, Technology, Engineering and Math (STEM) leave without finishing at higher rates than men and, as with men, turn away from academic and research careers.

It has also been refuted by evidence that the decisions to leave STEMM are influenced more by dissatisfaction with discrepant institutional and personal priorities than family factors.

Women are more likely to work part-time, and remain at the bottom of the academic hierarchy, with lower salaries, fewer senior roles, fewer opportunities for career development and training, more substantial teaching and service duties, and less research productivity than men.

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44 ibid
45 All Talk, Gap Between Policy and Practice a Key Obstacle to Gender Equity In STEM, 2018 Women in STEM Professions Survey Report Key Findings Gender segregation in Australia’s workforce, August 2016, WGEA;
46 Chilly Climates, Balancing Acts, and Shifting Pathways: What Happens to Women in STEM Doctoral Programs (Cabay et al., 2018)
49 Aldercotte A, Guyan K, Lawson J, Neave S & Altorjai S, ibid
Implicit Bias

- Bias can be explicit or implicit (unconscious). There are many unconscious biases. Implicit biases may reflect, be stronger than or, in some cases contradict, explicitly held beliefs or values. Therefore, even individuals who espouse a belief in gender equity and equality may have implicit biases about gender and, hence, negative gender stereotypes about women and girls in science and maths. Importantly, biases can change over time with societal views.

- Since modern societies explicitly and legally forbid gender inequality in job recruitment and career development, men seem to use language abstraction as an implicit means to maintain and reproduce their power. Grammatical and syntactical rules are built in a way that feminine terms usually derive from the corresponding masculine form. Similarly, masculine nouns and pronouns are often used with a generic function to refer to both men and women. Such linguistic forms have the negative effects of making women disappear in mental representations.

- People judge women to be less competent than men in ‘male’ jobs unless they are clearly successful. When a woman is clearly competent in a ‘masculine’ job, she is considered to be less likeable. Because both likability and competence are needed for success in the workplace, women in STEMM fields can find themselves in a double bind.

- Being disliked can affect career outcomes, leading to lower evaluations and less access to organisational rewards. Gender stereotypes can introduce bias in evaluative judgements of women in male-dominated environments, even when these women have proved themselves to be successful and demonstrated their competence.

- Daily slights, insults, and unconscious sexist actions are known as microaggressions. Microaggressions are subtle forms of discrimination that are often socially ingrained and unconscious. An example of a gender microaggression would be not listening to a woman’s idea but then responding to the same idea from a man, or not thinking to initiate a collaborative project with a woman.

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54 Heilman et al. 2004,
55 Ibid
Bias in hiring

- Yale researchers used different genders on two identical job applications. Regardless of selectors’ gender, most evaluated John as significantly more competent, more hireable and offered Jennifer a 12% lower salary and less mentorship.\(^{57}\)

- Both male and female faculty were equally likely to exhibit bias against Jennifer.\(^{58}\)

- Academic scientists tend to favour men’s applications over women’s for student positions.\(^{59}\)

- When scientists judged the female applicants more harshly, they did not use sexist reasoning explicitly to do so. Instead, they drew upon ostensibly sound reasons to justify why they would not want to hire her: ‘she is not competent enough’. This shows that you do not need to use anti-women language or even harbour conscious anti-women beliefs to behave in ways that are effectively anti-women. This factor contributes to making it easier for women to internalise unfair criticisms as valid.\(^{60}\)

- “If faculty express gender biases, we are not suggesting that these biases are intentional or stem from a conscious desire to impede the progress of women in science. Past studies indicate that people’s behaviour is shaped by implicit or unintended biases, stemming from repeated exposure to pervasive cultural stereotypes that portray women as less competent...”\(^{61}\)

- The inclusion of more masculine stereotype-linked words, like the ones used in the advertisements for male-dominated jobs (such as competitive, dominant, and leader, dominant, forceful, independent, confident, outspoken, intellectual, ambitious), makes a given job less appealing to female candidates\(^{62}\,\.^{63}\).

- Hiring decisions about female candidates are more likely to be motivated by the use of terms referred to their sociability and morality, in addition to their competence. Selectors use language to differentiate evaluations of female and male job candidates not only on the stereotypical dimensions of warmth and competence but also on the morality dimension.\(^{64}\)

- Moreover, female candidates are asked to meet higher requirements and have to perform well on different evaluation dimensions to be selected, whereas justifications of men’s hiring and rejection are primarily based on the use of competence-related terms only.\(^{65}\)

- The use of language abstraction can be a subtle means to discriminate against female applicants\(^{66}\) — assuming equal qualifications of male and female applicants—without explicitly selecting more men than women.

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\(^{58}\) Moss-Racusin CA et al. ibid

\(^{59}\) Moss-Racusin CA et al. op cit

\(^{60}\) Yurkiewitz 2012, Blogs scientificalamerican, ‘Study shows gender bias in science is real: Here’s why it matters’


\(^{62}\) Madera et al. (2009)


\(^{65}\) Moscatelli, S., Ellemers, N., Menegatti, M. G., & Rubini, M. (2016). The Lehman sisters would not have been hired: How the introduction of morality as a personnel decision criterion puts female job applicants at a disadvantage. Paper under review.
Bias in peer review

- Female postdoctoral applicants have to be significantly more productive than a male applicant to receive the same peer review score. This meant that she either had to publish at least three more papers in a prestigious science journal or an additional 20 papers in lesser-known speciality journals to be judged as productive as a male applicant. Systematic underrating of female applicants could help explain the lower success rate of female scientists in achieving high academic rank compared with their male counterparts.67

- STEMM-talented women are similar to STEMM-talented men in age of first publication, age at which STEMM talent was first recognised and age of PhD; however, women publish less frequently than men and women’s publications are less likely to be cited by peers.68,69 Even in engineering, where women publish in higher-impact journals, they receive fewer citations and it is hypothesised that this is due to male collaboration networks.70

- Double-blind reviewing of publications, where authors are not identifiable to reviewers, and vice versa, has increased publication rates for women first author researchers, suggesting either women were given harsher treatment during review, or were less likely to submit when their gender could be identified at submission.71

- When people evaluate letters that use equivalent language to describe male and female students in a masculine domain, they translate those letters into less favourable judgments of qualifications when the applicant was female compared to male72

- Systematic differences occur in letters of recommendation for academic faculty positions for female and male applicants:
  - Recommenders (the majority of whom were men) appear to rely on accepted gender schema in which, for example, women are not expected to have significant accomplishments in a field like academic medicine.73
  - Letters written for women are more likely to refer to their compassion, teaching and effort as opposed to their achievements, research and ability, which are the characteristics highlighted for male applicants.74
  - Recommenders unknowingly used selective categorisation and perception, also known as stereotyping, in choosing what features to include in their profiles of the female applicants.75
  - Agentic and communal stereotypical characteristics are used in a way that discriminates against female applicants. Women are described by more communal adjectives, such as kind, helpful, sympathetic, warm, agreeable, than men, who are

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67 Wenners & Wold 1997, DOI: 10.1038/387341a0; Steinpreis et al. 1999, DOI: 10.1023/A:1018839203698


69 Journal of Health Organisation and Management, https://doi.org/10.1108/JHOM-12-2016-0243


described with more agentic terms, such as dominant, forceful, independent, confident, outspoken, intellectual, ambitious. Moreover, letters written for women contain more social-communal-related terms, such as husband, kids, wife, babies, family, colleagues, children, than letters for men, which are composed of more agentic orientation-related terms, such as earn, gain, insight, think, know, do.76

Bias in the workplace

• Women encounter sexism every step of the way - from being interested in the STEMM fields for the first time to the end their career. One of the studies indicated that 71% of women reported experiencing harassment in the field as compared to 41% of men. They also found that 26% of women reported assaults against them as compared to only 6% of men. These experiences primarily occurred while the participants were trainees and were arguably at the most vulnerable points in their careers.77

• In three entrepreneurial pitch competitions and two controlled experiments, Harvard and MIT researchers found that investors preferred entrepreneurial pitches presented by men to women. The effect was moderated by physical attractiveness for men, while physical attractiveness made no significant difference for women (but attractive women still scored lower than unattractive ones). Even when the content of the pitch is identical, men are more than twice as likely to have their entrepreneurial pitches funded than women.78

• Compared with white women, Asian and black women PhDs and black women MDs were significantly less likely to receive funding. Women submitted fewer grant applications, and blacks and women who were new investigators were more likely to submit only one application between 2000 and 2006.79

• A scientific abstract is judged as poorer in quality when attributed to a female (vs. male) author. Both women and men are likely to exhibit STEMM gender biases.80

• Diversity training on university faculty found that implicit associations about women in STEMM improved for men. Women’s associations around women in STEMM remained unchanged, as they already tended towards positive implicit associations.81

• Men are more likely than women to explicitly endorse stereotypes about women in STEMM and these attitudes did not change as a result of diversity training.82

• In one study of conference talks at the American Astronomical Society, women were underrepresented as question-askers. While there was likely an age effect, with senior scientists (mostly men) more likely to ask questions, women also asked disproportionately fewer questions in sessions chaired by men. Speaker gender seemed to have the greatest impact on the gender ratio of questioners.

82 ibid
Gender stereotyping and workplace culture remain as key structural barriers to women progressing in STEMM professions. One survey noted that 39.6% of women felt that in their workplace, advice or information of a technical nature was less likely to be listened to if provided by a woman than a man, 37.1% felt like they had to “become one of the boys” if they wanted to “fit into” their workplace and only 33.3% agreed or strongly agreed that clients respect the professional opinion or advice of men and women equally, whereas 40.4% disagreed. 

While the proportion of women completing doctoral degrees in STEMM fields has risen over the years, particularly in the life sciences and social sciences, these gains have been less apparent in the physical sciences where the proportion of women completing doctoral degrees in 2014 in the physical sciences reached 32% and only 23% in engineering. Women of color represent an even smaller proportion of new PhD’s, with less than 2% of doctoral degrees earned in the physical sciences and engineering. 

Women’s development and leadership promotion in STEMM

What are the biases for women in STEMM, or being promoted to leadership within STEMM?

- Women in STEMM report regularly encountering gender bias, papers by women are less likely to be cited than those by men, female junior biomedical researchers receive significantly less start-up support than do comparable men, women are less likely than men to be invited to present colloquium talks at top universities (across six academic fields), and when men introduce invited medical grand rounds speakers, they are less likely to refer to female (relative to male) colleagues by their professional title. 
- Scientific journals tend to appoint more men than women to editorial boards, and editors tend to select reviewers of the same gender as themselves.
- Expert ecologists of both genders consistently ranked men-dominated articles as higher quality before actual assessment, demonstrating subconscious bias.
- Scientists tend to rate writings authored by men higher than those authored by women.

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68 All Talk, Gap Between Policy and Practice a Key Obstacle to Gender Equity In STEM, 2018 Women in STEM Professions Survey Report Key Findings, Professionals Australia; 
The work of female scientists is often invisible. For example, women scientists are consistently underrepresented in ecology textbooks compared to baseline assumptions of no bias. 98

Female assistant professors are between 5-7% less likely to earn tenure, and publish roughly 25% fewer papers than men, counting either the “top five” or “top 55” journals. 94 They are also judged to be less competent, less deserving of mentoring, are paid less 95, and are less likely to receive valuable pre-doctoral mentoring.96

Among other issues reported by the Yale School of Medicine Ad Hoc Task Force were "inadequate mentoring" and large differences between the numbers of men and women in senior positions. "Although the ratio of men to women hires approaches 1 at the Assistant Professor level," with 148 men and 134 women hired, "more men are hired at higher ranks, especially tenured faculty positions," the report states.97

The concept of “organizing as unseeing” suggests that women are discursively constructed as invisible in the context of STEMM leadership which in turn leads women to discursively constructing leadership as unattainable.98

Although female role models may be effective in the retention of women in STEMM, female and male role models can be equally effective in recruitment efforts. Given the limited number of women in STEMM, it may be most useful to concentrate their efforts on the retention of other women while encouraging men to serve as role models for potential female recruits.99

Mentoring may overcome some of the gender disparity in STEMM and serve to increase the number of women at higher ranks.100

Between 2010 and 2014, 20 men were hired as full Professors compared with five women, while the number hired at the level of tenured Associate Professor was seven men compared with one woman, according to the taskforce.101

Mentors who are influential in women’s decisions to major in STEMM are female, enthusiastic about STEMM, encourage questions and treat their mentees with respect.102

Women that stay in STEMM seek mentors more actively and are identified more frequently by mentors as possible protégés.103

References:
102 Stannard E 2015, ‘Report details wide gender-based inequities at Yale School of Medicine’, New Haven Register (CT) .
106 op cit
107 Review of Educational Research, DOI:10.3102/00346543074002171
Encouragement from mentors in graduate school plays an important role in women’s STEMM persistence – for instance, female mathematics students who had doubts about continuing stayed when their advisors encouraged them.  

A professor’s encouragement can be the deciding factor in a woman’s choice of major; for example, a professor’s explicit recognition of women’s STEMM aptitude and encouragement to continue influenced women’s decisions to major in STEMM.  

Encouraging feedback keeps eminent female scientists focused and interested despite obstacles.

What is the relationship to women generally?

What is the relationship of biases for women in STEMM to the problems women face no matter what field?

Women need to comprise 15%–30% of a department or organisation before they start having institutional effects.  

If there is only one woman in your candidate pool, there is statistically no chance she will be hired.  

Male decision-makers exhibit a pro-male bias and female decision-makers exhibit minimal bias.  

When traditional gender roles are made salient, political ideology moderates evaluations of the female employment candidates such that conservatives evaluate her negatively and liberals evaluate her positively.

Political ideology-based bias does not occur when the non-traditional female gender roles are made salient. This study also demonstrated that the observed effects were not driven by liberals’ and conservatives’ differing perceptions regarding the female applicant’s qualifications for the job.

Without any information other than a candidate’s appearance, both men and women are twice more likely to hire a man than a woman. This remains the same when performance is self-reported, as men tend to boast about their performance, whereas women under-report it.

Institutional support for family commitments is linked with job satisfaction and sense of belonging for both men and women. Women with low institutional support for family commitments were significantly less satisfied with their jobs and felt less belonging to their workplace environment than comparable men.
Many entrenched organisational structures and work practices were designed to fit men’s lives and situations at a time when women made up only a very small portion of the workforce.\(^\text{114}\)

Women remain significantly underrepresented across the length of the corporate pipeline. Fewer women than men are hired at the entry level, despite women being 57% of recent college graduates. At every subsequent step, the representation of women further declines.\(^\text{115}\)

Universities are unfriendly environments for many women. Women fill the majority of lower-ranking academic (53.2%) and non-academic (66.3%) positions and made up the majority of casual staff at Australian universities\(^\text{116}\). Less than one-third of above senior lecturer positions (31.7%), and less than half of senior lecturer positions (44.7%) are occupied by women\(^\text{117}\).

Women are much more likely to consider ethics in decision-making and behaviour. With corporate ethics becoming more and more important to a business’s ability to thrive, these inherent differences should be even more important.\(^\text{118}\)

Gender pay gap

The gender pay gap clearly extends beyond STEM, and it is estimated that women earn 20% less than men in America in 2016. If this rate of change continues, pay equality will not be reached until 2119. That’s just over a century.\(^\text{119}\)

Non-white or non-Asian women are even more significantly marginalised. The pay gap increases with age and even more dramatically for people with a disability. When we consider equality, it needs to be cross-cultural and across all societal sectors.\(^\text{120}\)

More education is not an effective tool against the gender pay gap. At every level of academic achievement, women’s median earnings are less than men’s median earnings, and in some cases the gender pay gap is larger at higher levels of education.\(^\text{121}\)

Female managers in academia have important effects on gender disparities - they narrow gender gaps in early-career achievement for faculty, raise women’s earnings, and increase the number of women entering as graduate students, without changing the number of papers published in their departments or the characteristics correlated with ability among incoming cohorts of students. However, they do not influence the number of female faculty across disciplines.\(^\text{122}\)

All of the biases mentioned in Question 1 are contributing factors to the gender pay gap across all sectors.

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117 Ibid
120 Ibid
121 Ibid
Workplace retention

- It seems that, compared to STEMM, women and men leave their companies at similar rates. Of people leaving the workplace, only 2% or less say they’re leaving to focus on family. This percentage is also the same for men and women. The majority intend to stay in the workforce.\(^{123}\)

- Three major factors contribute to broad workplace advantage: (1) Women experience a workplace skewed in favour of men; (2) Women of color face even greater challenges; (3) Women and men see the success of gender diversity differently – men have a more positive assessment that often clashes with reality.\(^{124}\)

- Household work still falls squarely on women, regardless of the level of earning in the family. Time pressures negatively affect career aspirations.\(^{125}\)

- The women received more positive comments in workplace evaluations (excellent! stellar! terrific!) than the men, but only 6% of the women (as opposed to 15% of the men) were mentioned as potential partner material, reflecting, the researchers concluded, the application of lower standards to the women and (self-fulfilling) lower expectations. This is consistent with the bias that women need protection and special consideration, which restricts women’s advancement.\(^{126}\)

- The gender similarities hypothesis: males and females are similar on most, but not all, psychological variables. Results from a review of 46 meta-analyses support the gender similarities hypothesis. Gender differences can vary substantially in magnitude at different ages and depend on the context in which measurement occurs. Overinflated claims of gender differences carry substantial costs in areas such as the workplace and relationships.\(^{127}\)

- The comprehensive body of research around these inherent and second generation biases shows why advocating for a ‘pure meritocracy’ – rather than explicitly pursuing diversity – doesn’t help companies overcome bias. In fact, ‘meritocracy’ may actually cause greater bias against women.\(^{128}\)

- Calling for a meritocracy and denying that workplace inequality still exists captures what scientists refer to as modern sexism.\(^{129}\)

- Women are the key to solving the challenges facing humanity. Women tend to think more about the long-term than men do, and about the future needs of their children and grandchildren. They tend to seek peaceful and constructive solutions to problems rather than fighting over differences in values and beliefs, or resources.\(^{130}\)

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\(^{124}\) McKinsey and LeanIn.Org, ibid

\(^{125}\) 2013, ‘Women in the workplace: A research roundup’, ibid


\(^{128}\) Ibid

\(^{129}\) Cribb J 2016, Surviving the 21st Century: Humanity’s 10 Greatest Challenges and How to Overcome Them, Springer
Women in leadership

- Meta-analyses consistently reveal higher ratings for men than for women in occupations that confer high status, power and pay—e.g. leadership positions.  
  
- Compared to women, men are more likely to hold traditional stereotypes about women (e.g. passive, timid), have less favourable attitudes toward gender egalitarianism, endorse hostile sexism, and view leadership positions as more masculine and less feminine.  
  
- A recent study that compared current beliefs about what characterises a good manager with beliefs of the past three decades found that people continue to ascribe stereotypically masculine traits, such as dominance, intuitiveness and emotional stability to good managers. “Think manager – think man.”  
  
- Imposter syndrome—early family dynamics and later gender stereotyping contribute significantly. Men tend to own their success as a quality inherent to themselves; women project the cause of success outward as ‘luck’ or ‘effort’ that they don’t equate with inherent ability.  
  
- Job adverts for male-dominated areas employ wording that is associated with male stereotypes—leader, competitive, dominant—compared to adverts in female-dominated areas. Adverts with masculine wording as perceived occupations that are predominantly male, and are less appealing to women.  
  
- Many employees think women are well represented in leadership when they see only a few. Nearly 50% of men think women are well represented in leadership in organisations where only one in ten senior leaders is a woman; 39% of women believe the best opportunities go to the most deserving employees, compared to 47% of men. These unconscious biases mean that men are less committed to gender equality. This needs to change, as we can’t get to equality without them.  
  
- The breakdown of female and male students in the business school’s undergraduate programs is about 50:50. But the percentage of female students pursuing an MBA drops significantly, falling to about 25%. Women hold only 4.6% of CEO positions at Standard & Poor’s top 500 companies—with only 23 female chief executives out of 500 companies, according to research group Catalyst.  
  
- One factor in women’s lower rate of promotion is that they are less likely to receive advice from managers and senior leaders on how to advance. This kind of support is important: employees who receive it are more likely to say they’ve been promoted in the last two years.  

131 Journal of Experimental Psychology, https://doi.org/10.1016/j.jesp.2011.08.004  
132 Journal of Applied Psychology, DOI: 10.1037/a0036734  
133 Journal of Personality and Social Psychology, DOI:10.1037/0022-3514.46.4.735  
135 Gaucher, Friesen & Kay 2011, https://doi.org/10.1037/a0022530  
136 McKinsey and LeanIn.Org., op cit  
137 Hernandez, ML 2012, ‘UTPA wants more women STEMM professors’, The Monitor, (TX)  
138 McKinsey and LeanIn.Org., op cit
In top-performing companies, women are much more likely to be promoted to manager than in lesser-performing companies (4% less likely to be promoted in higher-performing compared to 18% less likely in lower-performing companies).\textsuperscript{139}

Subtle gender bias that persists in organisations and in society disrupts the learning cycle at the heart of becoming a leader. These second-generation biases including feeling less connected to one’s male colleagues, being advised to take a staff role to accommodate family, finding oneself excluded from consideration for key positions—all put women at a disadvantage.\textsuperscript{140}

Most women are unaware of having personally been victims of gender discrimination and deny it even when it is objectively true and they see that women in general experience it.\textsuperscript{141}

Women consistently excel in leadership roles. On all levels, women are rated higher in 12 of the 16 competencies that go into outstanding leadership. This included taking initiative and driving for results, which are thought of as particularly male strengths.\textsuperscript{142}

But fewer female leaders means fewer role models and can suggest to young would-be leaders that being a woman is a liability, discouraging them from viewing senior women as credible sources of advice and support.\textsuperscript{143}

Research indicates that organisations tend to ignore or undervalue behind-the-scenes work (building a team, avoiding a crisis), which women are more likely to do while rewarding heroic work, which is most often done by men.\textsuperscript{144}

Women often have to provide more evidence of competence than men do to be seen as equally capable, a problem documented in scores of studies on double standards, attribution bias, leniency bias, recall bias\textsuperscript{145}, and polarised evaluations\textsuperscript{146}.

What holds women back?\textsuperscript{147}

Not qualifications or ability: a higher percentage of women than men hold a university degree and women consistently outperform men in terms of academic achievement.\textsuperscript{148}

Not personality differences: extraversion, conscientiousness and openness to experience (which consistently predict leadership emergence) are the same between women and men. Women show higher levels of agreeableness and neuroticism, but weak connections of these two dimensions with leadership.\textsuperscript{149}

\textsuperscript{139} McKinsey and LeanIn.Org., op cit
\textsuperscript{141} ibid
\textsuperscript{142} op cit
\textsuperscript{143} op cit
\textsuperscript{144} op cit
\textsuperscript{147} Epitropaki O, ‘What holds women back?’, American Business School of Greece
Family responsibilities: women’s domestic responsibilities exceed men’s 2:1 and they don’t seem to be able to reduce this. Employed mothers in 2000 spent as much time interacting with their children as mothers without a job in 1975! But they still perceive that they spend too little time.\textsuperscript{150}

Taking breaks from employment, including leaves of absence and sick days for family members or seeking flexible or part-time jobs; 37% of professional women voluntarily dropped out of employment at some point in their lives compared to 24% of men. Women take time out for ‘family time’, men take time out to change careers. The serious implications are: lost income, impedes career growth, depreciation of skills, difficulty in re-establishing one’s career.\textsuperscript{151}

Employment bias of 2:1 in favour of men at all levels.\textsuperscript{152}

Even in female-dominated fields, women don’t have the advantage! Token women generally suffer slow promotion in male-dominated careers, but token men advance quickly in female dominated careers – the glass escalator effect.\textsuperscript{153}

Men and women may want different types of leaders. Women have a perception of their ideal leader as more sensitive, understanding, sincere and helpful and less domineering, pushy and selfish than men.\textsuperscript{154}

Women who adopt masculine styles of leadership (directive and assertive behaviours) tend to be disliked and their ability to wield influence can be undermined. Women also risk not getting a job or a promotion when they are too direct.\textsuperscript{155}

Negotiation strategies can be an additional hurdle. Women routinely negotiate less desirable employment terms than men, and women who are assertive in negotiation still need to engage in behaviours signalling warmth and likeability (gender consistent behaviours in order to achieve positive outcomes). Before negotiating, women report believing that they might be punished if they were perceived as too ‘pushy’ or ‘demanding’.\textsuperscript{156} Further, this fear of backlash was unique to women negotiating their own salaries, as those negotiating for a friend did not anticipate social punishment for their behaviour. The fear is warranted. Women and men both penalised female job candidates who initiated salary negotiations.\textsuperscript{157}

Gender differences in negotiation performance lead to an asymmetric distribution of rewards. Male managers and professionals negotiate 60% higher starting pay than their female peers.\textsuperscript{158}

\textsuperscript{150} Bianci et al. 2000, DOI:10.1353/dem.2000.0001
\textsuperscript{154} Epitropaki & Martin 2004, 2005; DOI: 10.1037/0021-9010.89.2.293 and DOI: 10.1037/0021-9010.90.4.659
\textsuperscript{157} Hannah Riley Bowles (Harvard University), Linda Babcock (Carnegie Mellon University) and Lei Lai (Tulane University)
\textsuperscript{158} Gerhart & Rynes 1991, DOI:10.1037/0021-9010.76.2.256
A series of experimental studies suggest that a female candidate is more likely to be appointed to a leadership position when the position is risky and there is an increased risk of failure. Are women set up to fail or are they considered to function better under crisis?\textsuperscript{159}

**Competition between Women**

Why do women hurt women, or why women have a tendency to tear other women down both within STEM and generally? Historically, many negative judgements have been made on the capacity of female friendship, mostly by men.\textsuperscript{160}

Sociological findings suggest relational aggression or verbal and emotional abuse are more common in women. It is unclear if this is biologically or socially founded, there are numerous possibilities.\textsuperscript{161}

- Women held to different standards than men and competitiveness is seen as positive in men but negative in women.
- The Queen Bee effect refers to the phenomenon where successful women in male-dominated workplaces appear to impede the advancement of more junior women. Queen Bees do not strongly identify with their own gender, emphasise more masculine characteristics and act to uphold the status quo in which men have higher status in the workplace.\textsuperscript{162}
- However, numerous studies suggest that rather than contributing to gender inequality, the queen bee effect is a direct consequence of pervasive gender inequality in most workplaces.\textsuperscript{163} It is also important to note that the behaviour is NOT inherent to women and NOT a direct manifestation of female competitiveness in the workplace. For example, Queen Bees are more inclined to identify with other successful women, even though these women may be their direct competitors.\textsuperscript{164}
- The Queen Bee effect is not present when men and women are treated equally in the workplace.\textsuperscript{165} A recent study of 8.3 million organizations in Brazil found that the queen bee phenomenon was either small or non-existent.\textsuperscript{166} Women leaders in public organizations who were afforded managerial discretion were found to be more likely to employ women in top and middle-management positions.\textsuperscript{160}
- Time spent adapting to work expectations can have resource implications. To manage the competence–likeability trade-off, women may downplay femininity, or try to soften a hard-

\textsuperscript{166} Arvate, P. R.; Gailliea, G. W.; Todescat, I., The queen bee: A myth? The effect of top-level female leadership on subordinate females. Leadership Quarterly 2018, 29 (5), 533-548
charging style, or attempt to strike a perfect balance between the two. But overinvestment in one’s image diminishes the emotional and motivational resources available for larger purposes. People who focus on how others perceive them are less clear about their goals, less open to learning from failure, and less capable of self-regulation.

Family responsibilities

- "... Pregnancy is... a wonderful thing for the woman, it's a wonderful thing for the husband... it's certainly an inconvenience for a business.” – Donald Trump (2004)

- Today, 42% of mothers with children under the age of 18 are their families’ primary or sole breadwinners. Inequality in pay contributes directly to poverty affecting women, and the family more broadly.

- Many people think that women leave STEMM academic careers because they cannot balance work and family responsibilities. However, there is evidence for a more nuanced relationship between family responsibilities and academic STEMM careers.

- Being single is a good predictor that a woman will be hired for a tenure-track job and promoted. Research also shows that marriage is a good predictor for both women and men of being hired as an Assistant Professor. However, children change the equation. Married women with children in STEMM have fewer tenure and promotion opportunities compared to married men with children.

- Other data from academic environments suggest that, over time, children affect women’s careers and women may recognise this. Among tenured faculty in the sciences, 12 to 14 years after earning a doctorate 70% of men but only 50% of the women had children living in their home. In this cohort, 77% of male science professors who had babies within the first 5 years of receiving a doctorate, achieved tenure, while only 53% of women had achieved this.

- More than twice as many female academics (38%) as male academics (18%) indicated that they had fewer children than they had wanted.

- Male and female postdocs without children are equally likely to decide against research careers. But female postdocs who become parents or plan to have children abandon research careers up to twice as often as men in similar circumstances.

- Having young children may affect women’s productivity since child-care responsibilities fall disproportionately on women. This is not unique to STEMM. In business and industry, both women and men identify family responsibilities as a possible barrier to advancement, but women are affected differently by this ‘family penalty’. Although both feel that having a
family hinders their success at work, women are more likely than men to report foregoing marriage or children and delaying having children. Among women and men with families, women are more likely to report that they are the primary caregiver and have a partner who also works full-time.\textsuperscript{177}

- A recent retention study found that most women and men who left engineering said that interest in another career was a reason, but women were far more likely than men to also cite time and family-related issues.\textsuperscript{178}

- Additionally, women in STEMM are more likely to have a partner who is also in STEMM and faces a similarly demanding work schedule. In a situation where a ‘two body problem’ exists, the man’s career is often given priority.\textsuperscript{179}

- Early-career working women face an additional family-related barrier to career advancement as they may be viewed likely to have an (eventual) pregnancy (‘maybe baby’ effect). This possible life event is construed as an organisational inconvenience.\textsuperscript{180}

- Women who become faculty members in Astronomy, Physics and Biology tend to have fewer children than their male colleagues – 1.2 versus 1.5 on average. They also have fewer children than they desire.\textsuperscript{181}

- There are many biases held by women and men about the role of motherhood. Female professionals report the need to ‘go the extra mile’ and ‘prove they are the same’ to calm co-workers’ and supervisors’ fears about pregnancy-related losses in terms of their dependability.\textsuperscript{182} Experimental studies show biases against mothers in competence expectations and screening recommendations.\textsuperscript{183} Working mothers are seen as more self-oriented and as less dedicated to their children than stay-at-home mums, especially when they are believed to work because of personal choice.\textsuperscript{184} Working mothers are also seen as less dedicated to work.\textsuperscript{185}

\textsuperscript{178} Xu 2008, DOI: 10.1007/s11162-008-9097-4
\textsuperscript{181} Journal of Vocational Behavior, https://doi.org/10.1016/j.jvb.2017.10.001
\textsuperscript{182} Ecklund & Lincoln 2011, https://doi.org/10.1371/journal.pone.0022590
\textsuperscript{183} Academy of Management Journal, https://doi.org/10.5465/amj.2013.0599
\textsuperscript{184} Heilman & Okimoto 2008, DOI: 10.1037/0021-9010.93.1.189
\textsuperscript{185} Ettaugh & Nekolny 1990, DOI: 10.1007/BF00289004
\textsuperscript{186} https://www.economist.com/blogs/democracyinamerica/2015/01/women-and-work
Intersectionality

- Theorists usually speak of three waves of feminism, which commonly refer to the development of feminism in English-speaking countries. The first wave was about achieving basic legal rights, while the second wave focused on the control of the human body. The current third-wave feminism stresses the heterogeneity of female identity, by giving voices to bisexual, lesbian and transgender women and by discussing racial and postcolonial issues.

- People belong to multiple social categories, which can each affect their interactions in society and in the workplace. An intersectional perspective in psychology focuses on the multitude of identities individuals hold, which are each associated with social positions and power dynamics (such as race, gender, sexual identity, and class; Rosenthal, 2016). Because of these intersections, people have a variety of experiences with privilege and oppression across different contexts. It is important to recognize this when studying gender because these other components and identities have a significant effect on women’s reality.

- Not only do women of color confront race and ethnic discrimination that white women do not face, they also experience gender bias differently than white women do—and they experience racial bias differently than the men in their racial or ethnic group.

- Intersectionality theory posits that minority women’s experiences can amount to “greater than the sum of racism and sexism”.

- In the United States, fewer women are earning degrees in STEMM, except in the life sciences. The share of STEMM degrees is even smaller for women of color. In 2014–2015, women of color earned a small percentage of bachelor’s degrees across all STEMM fields:
  - Black women: 2.9%
  - Latinas: 3.6%
  - Asian women: 4.8%  

- Women remain a minority of STEMM workers in the United States. Women made up less than one-quarter (24%) of those employed in STEMM occupations in 2015. A substantial gender gap in engineering and computer occupations contributes to women’s overall underrepresentation in STEMM. For women of color, this gap is even wider. Asian and black women and Latinas made up slightly less than 10% of working scientists and engineers in the United States in 2015.

- The experience of gender bias differs for women of different racial groups:

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186 cf. Krokolke and Sorensen 2006
187 Gender Ideologies in English and Slovene: A Contrastive View, Plemenitaš, 2014
188 Rosenthal, 2016
https://www.cambridge.org/core/services/aop-cambridge-core/content/view/02441755f5e1575602080783f1f849475/s1754942618000172a.pdf/pdf/spotlight_on_women_of_color_in_stem.pdf
190 Published Online: 23 January 2013, Narratives of the double bind: Intersectionality in life stories of women of color in physics, astrophysics and astronomy, AIP Conference Proceedings; 1513, 222 (2013); https://doi.org/10.1063/1.4789692
STRONGER TOGETHER·

- Prove-It-Again is more common for Black women than for the other three groups of women.
- The stereotype that Asians are good at science appears to help Asian-American women with students—but not colleagues.
- Asian-American scientists were more likely than other women to report workplace pressures to fulfill traditionally feminine roles—and/or pushback.
- Latinas who behave assertively risk being seen as “angry” or “emotional”—and they shoulder large loads of office housework for colleagues & students.
- Black women are allowed more leeway than other groups of women to behave in dominant ways—so long as they aren’t seen as “angry Black women.”
- The Maternal Wall affects mothers of all races.
- Tug of War: When asked whether women support each other, most respondents (75.5%) said yes, but Black women were far less likely to agree: only 56.0% did so. Latinas (35.5%) were far more likely to report finding it difficult to get administrative support personnel to support them.
- Attributions differ. Black women tended to attribute Prove-It-Again bias to race rather than gender. All groups of women tended to attribute Tightrope and Maternal Wall bias to gender, although race remained more salient for Black women.193

- While anyone can be on the receiving end of disrespectful behaviour, microaggressions are directed at people with less power, such as women, people of color, and lesbian, gay, bisexual, transgender, and queer people.194

- It is likely that women of color have more frequent experience with microaggressions, which have been linked to a range of negative outcomes including stress and depressive symptoms 195.

- STEMM women of color report being socially excluded more frequently at work, and having less social support than their peers, leading to feelings of isolation and inadequacy196. Working within a favourable diversity climate is unlikely for women of color who face double jeopardy in hostile work experiences—reporting more frequent experiences of inappropriate remarks, harassment, and assault based on race and gender than any other group197.

- Fifty-five percent of women in senior leadership, 48 percent of lesbian women, and 45 percent of women in technical fields report they’ve been sexually harassed. A common thread connects these groups: research has found that women who do not conform to traditional feminine expectations—in this case, by holding authority, not being heterosexual, and working in fields dominated by men—are more often the targets of sexual harassment198.

- The tightrope: The tightrope reflects the experience that women feel they need to carefully monitor their behaviour to meet stringent expectations or prescribed

194 She's Price(d)less - The economics of the gender pay gap, October 2016, KPMG
198 Gender segregation in Australia’s workforce, August 2016, WGEA; McKinsey & Company, January 2018, Delivering through Diversity
Women in STEMM struggle with the fact that their field is seen as masculine, but they are expected to demonstrate feminine qualities, and acting in line with masculine work norms can lead to backlash. Recent studies focusing on women of color reveal additional challenges with navigating expectations based on both race and gender.

- Double consciousness: the concept of double consciousness has been used to describe how women of color grapple with their identity. Women of color function at work within a social-structural context in which they are aware of others’ perceptions of them, accordingly adjust their behaviour, and modify their self-view as a way of coping. The distinction of different aspects of the self can cause stress and feelings of estrangement from both identities; feeling detached from one’s work self may be more common for women in STEMM and could be a factor in retention.

- In terms of climate change and intersectionality, women and girls constitute 70% of global poor. Combine the intersectionality of poverty and prescribed gender roles means that they are increasingly being affected by climate risks.

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**STRONGER TOGETHER**

**HB GENDER FACT SHEET: TOP 20**

Below is the original text of the top 20 fact from the original *Gender Fact Sheet*. First column: number 1-20. Second column: Fact theme. Third column: original fact wording. In bold after each statement is the number corresponding to the reference in the original *Gender Fact Sheet*.

<table>
<thead>
<tr>
<th></th>
<th>Influences on interest</th>
<th>WOMEN HAVE A TOUGH INTERNAL CRITIC. NOT SURPRISING AFTER GENERATION OF CONDITIONING</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>Girls assess their mathematical ability as lower than boys with equivalent past mathematical achievement. Girls hold themselves to a higher standard in subjects like maths, where boys are considered to excel. Because of this, girls are less likely to believe that they will succeed in a STEMM field and, therefore, less likely to express interest in a STEMM career.</td>
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<td></td>
<td></td>
<td><strong>12</strong></td>
</tr>
<tr>
<td></td>
<td>Influences on interest</td>
<td>NO, MEN ARE NOT MORE ABLE</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>A review of 400+ articles exploring the causes of women’s underrepresentation in STEMM concluded that research on sex differences in brain structure and hormones is inconclusive. Female and male brains are physically distinct, but how these differences translate into specific cognitive strengths and weaknesses remains unclear.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>1</strong></td>
</tr>
<tr>
<td>3</td>
<td>Competition: between women</td>
<td>NO, WOMEN ARE NOT NATURALLY UNKIND TO EACH OTHER WHEN THEY AREN’T COMPETING</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The Queen Bee effect is not present when men and women are treated equally in the workplace. A recent study of 8.3 million organizations in Brazil found that the queen bee phenomenon was either small or non-existent. Women leaders in public organizations who were afforded managerial discretion were found to be more likely to employ women in top and middle-management positions.</td>
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<td></td>
<td><strong>165, 166</strong></td>
</tr>
<tr>
<td>4</td>
<td>Leaky pipeline</td>
<td>WHY, WHEN WOMEN ARE EQUALLY REPRESENTED, DO WE LEAVE DISCIPLINES? READ THE FACT SHEET!</td>
</tr>
<tr>
<td></td>
<td></td>
<td>In some fields such as biology, women and men are now equally represented in training at undergraduate, graduate and postgraduate levels. However, women disproportionately leave these disciplines at each career stage following training.</td>
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<td></td>
<td><strong>16</strong></td>
</tr>
<tr>
<td>5</td>
<td>Leaky pipeline</td>
<td>YOU GET TOLD OFTEN ENOUGH, WOMEN CAN’T DO THIS, OR IT’S NOT FEMININE, YOU BEGIN TO BELIEVE.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Globally in higher education, only 35% of all students enrolled in STEM-related fields are female. Today, only 28% of all of the world’s researchers are women. Gender stereotypes and biased attitudes compromise the quality of the learning experience for female students and limit their education choices.</td>
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<td></td>
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<td><strong>16</strong></td>
</tr>
<tr>
<td>6</td>
<td>Leaky pipeline</td>
<td>ENGINEERING PROJECTS BENEFIT FROM GENDER BALANCE. WE ALL HAVE TO BELIEVE.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>While the proportion of women completing doctoral degrees in STEMM fields has risen over the years, particularly in the life sciences and social sciences, these gains have been less apparent in the physical sciences where the proportion of women completing doctoral degrees in 2014 in the physical sciences reached 32% and only 23% in engineering. Women of colour represent an even smaller proportion of new PhD’s, with less than 2% of doctoral degrees earned in the physical sciences and engineering.</td>
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<td></td>
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<td><strong>84</strong></td>
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<tr>
<td>7</td>
<td>Poverty</td>
<td>WOMEN AND GIRLS CONSTITUTE 70% OF GLOBAL POOR. COMBINE POVERTY WITH GENDER DISCRIMINATION AND HEIGHTENED RISK OF CLIMATE CHANGE AND OUR BEST ASSET IS STRUGGLING</td>
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<td>&quot;Women and girls constitute 70% of the global poor. The combination of poverty and prescribed gender roles means that they are increasingly being affected by climate risks&quot;</td>
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<td></td>
<td></td>
<td><strong>202</strong></td>
</tr>
<tr>
<td>8</td>
<td>Intersectionality</td>
<td>THE RIGHT TO EQUAL TREATMENT IS EVIDENT IN MOST COUNTRY’S POLICIES. IT JUST ISN’T EVIDENT IN HOW WE BEHAVE, ESPECIALLY TO WOMEN</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Non-white or non-Asian women are even more significantly marginalised. The pay gap increases with age and even more dramatically for people with a disability. When we consider equality, it needs to be cross-cultural and across all societal sectors.</td>
</tr>
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<td></td>
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<td><strong>120</strong></td>
</tr>
<tr>
<td>9</td>
<td>Intersectionality</td>
<td>COLOUR, BEING FEMININE, DOMESTIC RESPONSIBILITY, BEING TOO TOUGH – ITS ALL HERE. MANY WOMEN CARRY THIS LOAD</td>
</tr>
</tbody>
</table>

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### Intersectionality

**WILLINGLY BUT THEY DON'T CARRY THE BLIND AND PERNICIOUS PREJUDICE THAT GOES WITH IT THAT LIMITS WHAT THEY DO, HOW THEY DO IT AND HOW THEY ARE VALUED**

The experience of gender bias differs for women of different racial groups:
- Prove-It-Again is more common for Black women than for the other three groups of women.
- The stereotype that Asians are good at science appears to help Asian-American women with students—but not colleagues.
- Asian-American scientists were more likely than other groups of women to report workplace pressures to fulfil traditionally feminine roles—and/or pushback.
- Latinas who behave assertively risk being seen as “angry” or “emotional”—and they shoulder large loads of office housework for colleagues & students.
- Black women are allowed more leeway than other groups of women to behave in dominant ways—so long as they aren’t seen as “angry Black women.”
- The Maternal Wall affects mothers of all races.

**APPARENTLY YOUR SKIN COLOUR MAKES YOU LESS ABLE TO PURSUE A STEM DEGREE. FOR WOMEN OF COLOUR ONLY**

The share of STEM degrees is even smaller for women of colour. In 2014–2015, women of colour earned a small percentage of bachelor’s degrees across all STEM fields:
- Black women: 2.9%
- Latinas: 3.6%
- Asian women: 4.8%

**Bias in peer review**

**DOUBLE BLIND REVIEWING OF PUBLICATIONS WORKS TO ELIMINATE UNCONSCIOUS BIAS**

Double-blind reviewing of publications, where authors are not identifiable to reviewers, and vice versa, has increased publication rates for women first author researchers, suggesting either women were given harsher treatment during review, or were less likely to submit when their gender could be identified at submission.71

**Bias in workplace**

**MEN DON’T KNOW HOW CULTURE SHAPES THEIR BEHAVIOUR TO WOMEN AND WOMEN DON’T FULLY UNDERSTAND THAT WHAT THEY INDIVIDUALLY FEEL IS SHARED BY MANY WOMEN**

Gender stereotyping and workplace culture remain as key structural barriers to women progressing in STEMM professions. One survey noted that 39.6% of women felt that in their workplace, advice or information of a technical nature was less likely to be listened to if provided by a woman than a man, 37.1% felt like they had to “become one of the boys” if they wanted to “fit into” their workplace and only 33.3% agreed or strongly agreed that clients respect the professional opinion or advice of men and women equally, whereas 40.4% disagreed.83

**Glass cliff**

**GLASS CLIFF – WOMEN GET RISKY APPOINTMENTS TO SENIOR ROLES – ARE WE EXPENDABLE OR MORE CAPABLE**

A series of experimental studies suggest that a female candidate is more likely to be appointed to a leadership position when the position is risky and there is an increased risk of failure. Are women set up to fail or are they considered to function better under crisis?159

**Implicit Bias**

**LIKE ABILITY AND COMPETENCY ARE NEEDED FOR SUCCESS IN THE WORKPLACE. WHAT HAPPENS WHEN BEING COMPETENT AS A WOMAN MAKES YOU LESS LIKEABLE TO MEN**

People judge women to be less competent than men in ‘male’ jobs unless they are clearly successful. When a woman is clearly competent in a ‘masculine’ job, she is considered to be less likeable. Because both likability and competence are needed for success in the workplace, women in STEMM fields can find themselves in a double bind.54

**Weights**

**TOKEN WOMEN ADVANCE SLOWLY TOKEN ME QUICKLY**

Even in female-dominated fields, women don’t have the advantage! Token women generally suffer slow promotion in male-dominated careers, but token men advance quickly in female dominated careers – the glass escalator effect.153

**Bias relationships**

**STRUCTURES AND WORKPLACE PRACTICE BIAS IN FAVOUR OF MEN**

Many entrenched organisational structures and work practices were designed to fit men’s lives and situations at a time when women made up only a very small portion of the workforce.114
<table>
<thead>
<tr>
<th>Action</th>
<th>DON’T EXPECT BIG CHANGE IN DYNAMICS TIL YOU HIT 30% WOMEN IN ANY TEAM, BUSINESS, DEPARTMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Women need to comprise 15%–30% of a department or organisation before they start having institutional effects. 107</td>
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<tr>
<td>Bias in hiring</td>
<td>MEN AND WOMEN BIAS TO THE SELECTION OF MEN A MORE COMPETENT</td>
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<td></td>
<td>Yale researchers used different genders on two identical job applications. Regardless of selectors’ gender, most evaluated John as significantly more competent, more hireable and offered Jennifer a 12% lower salary and less mentorship.57</td>
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<tr>
<td>Family</td>
<td>WOMEN HANDLE TWICE AS MUCH OF THE DOMESTIC LOAD AS MEN</td>
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<td>Family responsibilities: women’s domestic responsibilities exceed men’s 2:1 and they don’t seem to be able to reduce this. Employed mothers in 2000 spent as much time interacting with their children as mothers without a job in 1975! But they still perceive that they spend too little time.150</td>
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<tr>
<td>Awards</td>
<td>WOMEN DO MORE WORK AND GET LESS RECOGNITION: AMBITION TRUMPS TALENT</td>
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<td>Between 2001 and 2014, women across 18 STEMM disciplines were significantly underrepresented among recipients of scholarly and research awards, and overrepresented in service and teaching awards relative to the proportion of PhDs, Full and Associate Professors.34</td>
</tr>
<tr>
<td>Harassment</td>
<td>MOST WOMEN STRUGGLE WITH SEXUAL HARRASSMENT – IT’S A SHARED REALITY</td>
</tr>
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<td></td>
<td>Fifty-five percent of women in senior leadership, 48 percent of lesbian women, and 45 percent of women in technical fields report they’ve been sexually harassed. A common thread connects these groups: research has found that women who do not conform to traditional feminine expectations—in this case, by holding authority, not being heterosexual, and working in fields dominated by men—are more often the targets of sexual harassment 198</td>
</tr>
<tr>
<td>Leadership / unconscious bias</td>
<td>IDENTIFYING A COUPLE OF WOMEN LEADING AS A MEASURE OF EQUALITY IS DEEPY MISLEADING</td>
</tr>
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<td></td>
<td>Many employees think women are well represented in leadership when they see only a few. Nearly 50% of men think women are well represented in leadership in organisations where only one in ten senior leaders is a woman; 39% of women believe the best opportunities go to the most deserving employees, compared to 47% of men. These unconscious biases mean that men are less committed to gender equality. This needs to change, as we can’t get to equality without them.136</td>
</tr>
<tr>
<td>Family/pay gap</td>
<td>HAVING KIDS AFFECTS YOUR INCOME AS A WOMAN BUT SO DOES SIMPLY BEING A WOMAN</td>
</tr>
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<td></td>
<td>Women who do not have children tend to earn more than women who do, but both groups still earn less than men;22 e.g. female physician researchers earn less than male counterparts, even after adjustments are made for other factors such as part-time work.23</td>
</tr>
<tr>
<td>Pay gap</td>
<td>PERNICIOUS PROBLEMS - SAME WORK LESS PAY</td>
</tr>
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<td></td>
<td>Women earn nearly one-third less than men within a year of completing a PhD in a science, technology, engineering or mathematics (STEM) field, according to American research. 20</td>
</tr>
<tr>
<td>Micro-aggressions</td>
<td>SHE SAYS IT – SILENCE. HE SAYS IT LATER – PEOPLE LISTEN. DAILY SLIGHTS COMMON.</td>
</tr>
<tr>
<td></td>
<td>Daily slights, insults, and unconscious sexist actions are known as micro-aggressions. Micro-aggressions are subtle forms of discrimination that are often socially ingrained and unconscious. An example of a gender micro-aggression would be not listening to a woman’s idea but then responding to the same idea from a man, or not thinking to initiate a collaborative project with a woman.56</td>
</tr>
<tr>
<td>Unconscious bias</td>
<td>CULTURE IS ALL ABOUT WHAT WE GET USED TO, IT’S JUST THE WAY THINGS ARE – WOMEN ARE LESS COMPETENT</td>
</tr>
</tbody>
</table>
|          | “If faculty express gender biases, we are not suggesting that these biases are intentional or stem from a conscious desire to impede the progress of
### Unconscious Bias

**WHEN WE RECOMMEND WOMEN FOR A ROLE, COMPASSION OR TEACHING ABILITY TRUMPS ACHIEVEMENTS**

Systematic differences occur in letters of recommendation for academic faculty positions for female and male applicants:

- **Recommenders (the majority of whom were men)** appear to rely on accepted gender schema in which, for example, women are not expected to have significant accomplishments in a field like academic medicine.
- **Letters written for women** are more likely to refer to their compassion, teaching and effort as opposed to their achievements, research and ability, which are the characteristics highlighted for male applicants.
- **Unknowingly used selective categorisation and perception**, also known as stereotyping, in choosing what features to include in their profiles of the female applicants.
- **Letters written for women** contain more social-communal-related terms, such as husband, kids, wife, babies, family, colleagues, children, than letters for men, which are composed of more agentic orientation-related terms, such as earn, gain, insight, think, know, do.

### Invisible Labour

**LEADERSHIP SKILLS THAT BUILD COLLABORATIVE EFFORT UNDEVALUED**

Research indicates that organisations tend to ignore or undervalue behind-the-scenes work (building a team, avoiding a crisis), which women are more likely to do while rewarding heroic work, which is most often done by men.

### Mentoring

**MENTORING HELPS OVERCOME CHALLENGES FOR WOMEN**

Mentoring may overcome some of the gender disparity in STEMM and serve to increase the number of women at higher ranks.

- **Mentors who are influential in women’s decisions to major in STEMM** are female, enthusiastic about STEMM, encourage questions and treat their mentees with respect.
- **Female STEMM faculty** express lower job satisfaction than do their male peers. Lower satisfaction leads to higher turnover and a loss of talent in science and engineering. The climate of science and engineering departments is closely related to satisfaction of female faculty, and providing effective mentoring and work-life policies can help improve job satisfaction, hence, the retention of female STEMM faculty.