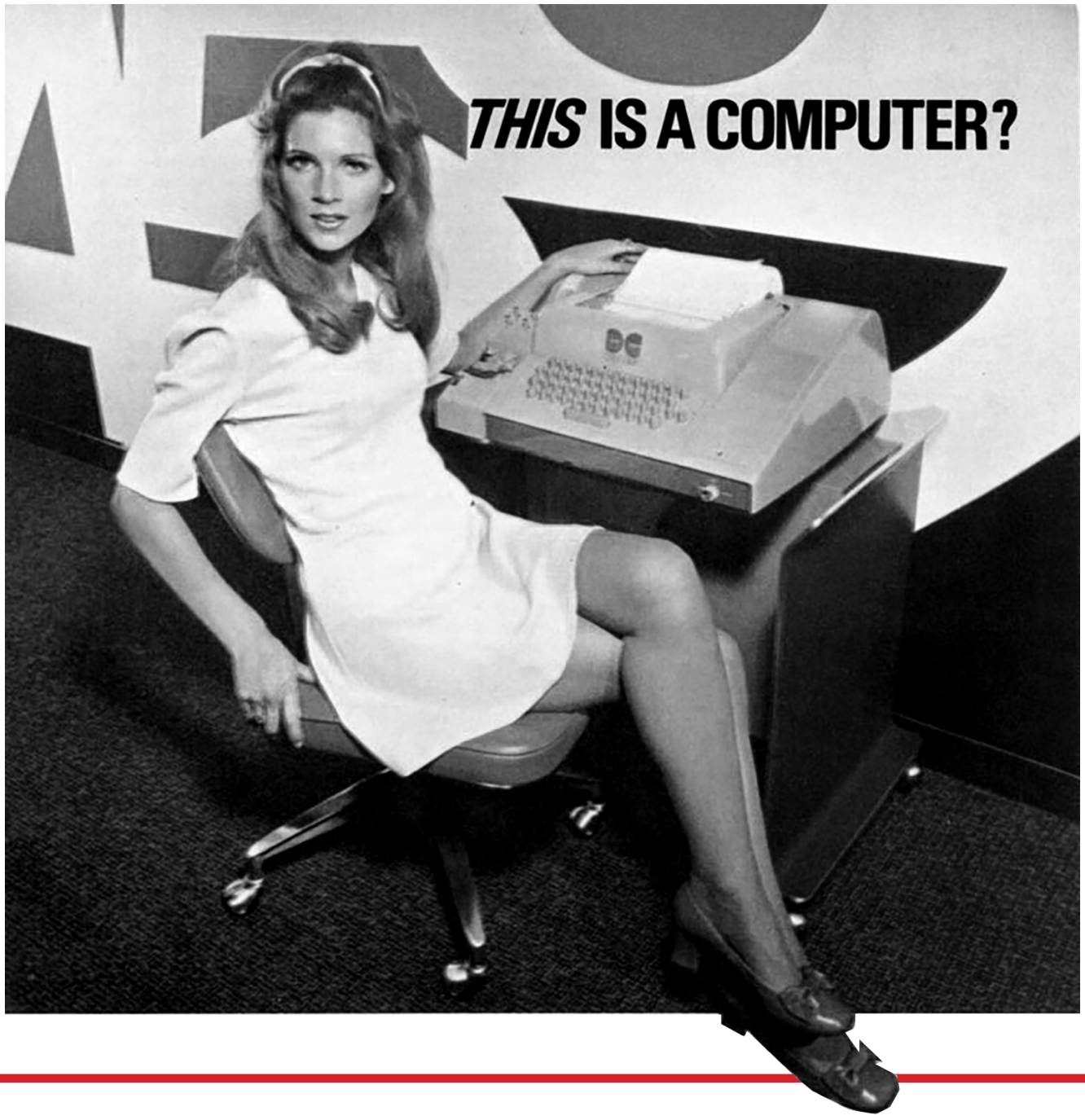
spe café

Breaking Gender Barriers in STEMM – Whose Responsability is it

03/08/18



REPORT

Preface

This report was generated from discussions among mostly female undergraduate and graduate STEMM students at an SPE Café on Dec 11, 2017, inspired by the Gender Summit that took place in Montreal on Nov 6-8, 2017. It reflects barriers that participants have experienced or observed during their studies, as well as obstacles they anticipate facing as they pursue their careers. We acknowledge that many institutions have taken steps to address some of the gender barriers identified in this report, and are encouraged by the progress. We are also pleased that gender equity was a key theme in the 2018 Federal Budget and look forward to seeing the Government of Canada advance this as a priority.

Science & Policy Exchange (SPE)

Science & Policy Exchange is a non-profit advocacy group run by graduate students and post-doctoral fellows in Montreal, whose mission is to foster the student voice in evidence-based decision making and to bring together leading experts from academia, industry, and government to engage and inform students and the public on issues at the interface of science and policy.

SPE Café

Science and Policy Exchange (SPE) Café is a monthly meeting space for all community members to gather and discuss a current topic in the field of science and policy in a casual atmosphere. The goal is to facilitate dialogue in a collaborative space, and brainstorm solutions for issues related to science and policy.

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Thank you to all the SPE Café participants for their thoughtful inputs and engaging discussions.

Summary

While there has been progress toward gender equity across all professional fields, there continues to be a persistent gender gap in science, technology, engineering, mathematics, and medicine (STEMM). In 2012, women made up 57.1% of STEMM graduate students but only 35.7% of full-time faculty. In physical sciences and engineering, the gap persists at the undergraduate level as well. This has been described as the "leaky pipeline", the progressive loss of women at every stage of career advancement. Since this implies a linear trajectory where women simply drop out of the career path at some point, a more comprehensive analogy is the "glass obstacle course". This refers to the invisible barriers, often unseen by the individual experiencing the barriers, that consistently arise over the course of the individual's career in formal and informal ways.

Participants were invited to engage in group discussions about the gender barriers they have experienced and/or observed in STEMM, and generate potential solutions that could be implemented at the individual and institutional levels.

A series of small group discussions were guided by the following questions:

1. What barriers do women face in obtaining leadership positions in STEMM? Share first-hand or second-hand experiences of barriers in STEMM.

2. What local solutions exist in your community? What others can you think of? What can we do as individuals?

3. What could our institutions be doing to promote women in leadership in STEMM?

Seven gender barriers emerged from our discussion:

1. Family planning:

— Women fear that being pregnant and taking maternity leave is perceived as a burden for an employer.
— Women worry, justifiably, that they will lose professional competitiveness if they take maternity leave and/or time off to take care of their health and family.
— Graduate students face the possibility of not receiving any compensation for maternity leave.
— Women continue to take on more of their families' childcare and household responsibilities.

2. Criteria for excellence:

— Conventional measures of excellence assume that everyone is on equal footing; women and minority groups encounter barriers that may make it more difficult to achieve measures of excellence.
— Measures of excellence often don't consider less quantifiable skills.

— Maternity or caretaking leave can present gaps in a CV that may decrease a woman's competitiveness in the hiring process.

3. Hiring practices:

— Women and minorities make up an increasing proportion of PhD holders yet are largely underrepresented as faculty members.
— Implicit and unconscious bias may be manifested in reference letters that are less likely to highlight a woman's most relevant professional skills.
— Women have a fear of being the "diversity candidate".
— Women are more likely to suffer from imposter syndrome.

4. Discrimination in the workplace:

— Unwanted sexual advances or comments more frequently affect women in science, and often occur in accordance with established power dynamics; women of colour have been shown to be at an additional risk of harassment and discrimination in scientific disciplines.
— Imbalance of power can affect the victim's willingness to come forward and report harassment.
— A hostile work environment can lead to psychological distress, reduced job satisfaction, and an increased likelihood of leaving a profession.
— Women often are assigned assignments related to organization or mentoring activities, which are often not reflective of criteria for hiring/promotion.

5. Role models and mentorships:

— Young girls and women lack female role models in leadership positions.
— Women who do make it to leadership positions tend to take on more mentorships roles; this is an additional time commitment and an emotional burden for women.

6. Inherent societal biases:

— Language biases - words used to describe men and women's qualities are often biased, for example "bossy" is much more likely to be used for a woman than a man who might be considered "assertive".
— Gendered pronouns used to describe professions assert gender normative roles.
— Most women will only apply for a job or position if they meet 100% of the requirements, whereas the typical man will apply if they meet at least 60% of the requirements

7. Lack of men in the conversation:

— Equity workshops are disproportionately attended by those who face barriers.
— Privileged majority lack awareness and understanding of the barriers encountered by women and other marginalized groups.

Recommendations for addressing the outlined barriers above:

1. Create awareness and transparency around rights for parental leave.
2. Create parental leave plans for students/postdocs left out of coverage by specific grants.
3. Create policies to better accommodate families - for example, childcare subsidies for students and postdoctoral fellows.
4. Brainstorm creative solutions to foster a family-friendly environment.
5. Revise the criteria used to judge merit for any type of application and nomination to reflect the reality that underrepresented groups are not on a level playing field and to value different types of merit (such as mentorship).
6. Include discussions of implicit biases against female and minority candidates among hiring committee members before the hiring process begins.
7. At the department level, implement written reports for each shortlisted candidate that should contain explanations on the final decision.
8. At the institutional level, adopt a transparency policy for the hiring and promotions by publishing statistics annually.
9. Consider the possibility of gender quota or reward system for hiring; explore different systems of implementation
10. Create clear, accessible harassment policies that are enforced.
11. Hold faculty accountable and be transparent about disciplinary actions.
12. Clearly advertise process for reporting abuse.
13. Establish sustainable positions for monitoring progress on equity, diversity,and inclusion.
14. Improve equity training policies and provide up to date training.
15. Collect and publish data about their policies and practices, based on clear targets and indicators of reduced harassment, bias, and discrimination.
16. Incorporate equity, diversity, and inclusion training/discussion within each department's core curriculum for students and faculty.
17. Re-evaluate traditional language used in reference to prestigious awards and opportunities.
18. Financially and socially support conversations, dialogue, and specialized groups that will identify and propose targeted solutions for the specific group needs.
19. Include students in discussions for equity, diversity, and inclusion.
20. All leaders need to engage, including and especially men.

Introduction

Participants were invited to discuss gender barriers in Science, Technology, Engineering, Mathematics, and Medicine (STEMM). While we focused on women, we recognize that these barriers exist for, and are likely compounded by, other gender identities. We invited participants to keep this in mind during their discussion as well as the concept of intersectionality, which is the intersection between social categories like gender, race, class, sexual orientation, and ability, and how this affects an individual's experience of disadvantages and discrimination. The statistics reported here relate only to women because much of the existing data does not include more specific information. Hence, we focused on women to keep a more focused discussion during the allotted two hours, while encouraging participants to discuss intersectionality and the full gender spectrum.

Going into this discussion, we believed that there is an underlying sense throughout society that feminism has already happened and it is merely a matter of time before women and men are equal. To explore this, we presented participants with a brief (Appendix A) with some background on the issue that included statistics on the representation of women in STEMM. While progress has been made, there is a persistent gender gap in STEMM. In 2012, women made up 57.1% of STEM students but only 35.7% of full-time faculty. In physical sciences and engineering, the gap persists at the undergraduate level as well (1). This is a particularly concerning trend as it points to the likelihood that women will be left out of these growing fields that will lead to new and transformative technologies, such as Artificial Intelligence. This inequity not only limits the involvement of women but also deprives society of new questions and solutions that may contribute to these advancing technologies.

The lack of women in leadership positions has been attributed to the "leaky pipeline", referring to the progressive loss of women at every stage of career advancement. Because this implies a linear trajectory where women just "fall out" at some point, a more comprehensive analogy is the glass obstacle course (2). This refers to the invisible barriers, often unseen by the individual experiencing the barriers, that consistently arise over the course of the individual's career in formal and informal ways. With this in mind, we asked participants to discuss three questions:

1. What barriers do women face in obtaining leadership positions in STEMM? Share first-hand or second-hand experiences or barriers in STEMM.

2. What local solutions exist in your community? What others can you think of? What can we do as individuals?

3. What could our institutions be doing to promote women in leadership in STEMM?

These questions were discussed one at a time in small groups, with participants rotating between different groups. Here, we present the findings arising from these discussions. Although we focused on STEMM fields, many of these barriers are widespread. We discussed seven barriers, explored below: family planning, criteria for excellence, hiring practices,

discrimination in the workplace, role models and mentorship, inherent societal biases, and the lack of men in the conversation.

Participants

The event was open to everyone, however due to the background of the organizers it was mostly advertised through networks at McGill University. While participants were not surveyed, the event included mostly students in various fields of STEMM, with higher participation from graduate students. Hence, our event focused on a university and academic setting. This also allowed us to create more specific institutional solutions, targeting universities and research institutions.

1. Family Planning

Studies regularly report that women contribute more to childcare and household responsibilities (3). However, balancing work and family is not exclusively a problem for women, nor do all women want children. Like other fields that require many years of training, women in STEMM fields who do want children often find themselves having children late in their studies or early in their career. Here, we highlight the barriers related to all stages of family planning: pregnancy, maternity leave, and child care.

<u>Barriers</u>

Overall, there is a general concern of having to choose between a successful career and having children. In academia, this feeling is even more potent because the most competitive point in one's career comes after the postdoctoral stage, a time that overlaps largely with biological and social readiness for children (4).

Unfortunately, despite laws preventing discrimination against pregnant women, participants discussed a general worry about being pregnant, particularly if applying for jobs or at the early career stage. Women also worry about the lingering culture that pregnancies and maternity leaves are a burden on employers. Furthermore, if there are complications during pregnancy, sick leave might be necessary, taking even more time away from a career.

Maternity leave presents a variety of difficulties. There is significant variability in length of time and amount of pay for parental leaves. Being a student at a family-planning age requires awareness of the policies around parental leave because they are often different from those in non-academic contexts. Recently, the federal Tri-Council agencies that fund graduate students, either through trainee scholarships or through grants to their supervisors, harmonized their policies to allow graduate students to take 6 months leave. This is a necessary step in the right direction, however concerns still remain for students supported by smaller grants or working in poorly funded labs. While one might argue it is a student's responsibility to know their right to parental leave, the system could improve on

the transparency of these policies, or universities could provide a website that aggregates all the relevant information to help graduate students navigate a potentially stressful period. Importantly, women justifiably worry that taking time off will reduce their competitiveness, even if they are entitled to the time.

While both parents will typically bear childcare responsibilities, women tend to take on more of the responsibilities (3). We recognize that policies exist at most institutions to ensure that no one is penalized for parental leaves - for example, grant funding can easily be deferred. However, women still feel penalized, especially when caring for small children at home. They cannot put in the extra time on evenings and weekends, that is usually needed to make their CVs competitive (discussed below). Other barriers discussed include the lack of access to childcare and creative solutions for accommodating family responsibilities. The financial burden of paying for childcare on a graduate student stipend or postdoctoral fellowship is stressful. Furthermore, the responsibilities of caring for aging parents or other family members are rarely addressed in workplaces.

Women consider all of these barriers when career and family-planning, something men rarely feel they need to do.

Individual/Local Solutions

Broader understanding of the barriers to family-planning and the advantages of removing them will help drive institutional and societal change. As individuals, we can foster discussions on these issues. We can also encourage our co-workers, men and women, to take parental leave to help create a culture where we prioritize work-family balance. We can become knowledgeable about policies for parental leave, and encourage awareness particularly in academia between supervisors and students.

Institutional Solutions

Firstly, we discussed the need for an awareness and transparency of policies related to parental leave. When a student, postdoctoral fellow, or employee signs a contract, it could be mandatory to go over the rights and options related to parental leave. Alternatively, there could be a prominent link on Department or Faculty websites that explicitly states the policies and consolidates all the different options to obtain compensation from different granting agencies. Further, this information should be clearly available in a graduate student handbook.

We also believe that more policies could be created to ease the burden of childcare. For example, some funding agencies provide funding for an additional caretaker to travel with a mother presenting at a conference who is bringing her infant. Furthermore, institutions should seek creative solutions; for example, General Electric now provides breast milk transport if a breastfeeding mother needs to travel for work and be away from her infant (5).

From a financial perspective, strategies should be discussed by universities for labs that are not well-funded (or funded by many small grants) to support students on parental leave.

Furthermore, extra financial support system for graduate students and postdoctoral fellows paying for childcare services would help ease financial burdens.

Finally, shifting the institutional culture to a family-friendly environment will help break down the barriers addressed above. This includes creating and advertising policies around accommodating families to employees and students, promoting paternity leave, providing childcare during evening meetings and events, and a general willingness to discuss and address the needs of women and families.

2. Criteria for excellence

Any job, grant, award, or promotion application process requires a set of criteria upon which to compare one candidate against another. We want to reward the most "excellent" candidates. But who sets the standards for "excellence"?

Barriers

We discussed that the current measures of success themselves can present barriers to women and any marginalized group. First, they incorrectly assume everyone is on equal footing within the system. Women and all marginalized groups encounter many other barriers that reduce their ability to meet these criteria. For example, a woman with a young child cannot put in the extra time on evenings and weekends that is usually needed to make their CVs competitive.

Secondly, the current merit system typically does not reward less quantifiable contributions, such as ongoing mentorship relationships in support of other women.

Individual/Local Solutions

We believe the best thing we can do as individuals is to continuously bring awareness to the fact that the current perceived merit-based system largely ignores the barriers encountered by women and marginalized people in meeting these criteria.

Institutional Solutions

Institutions need to revise their criteria for hiring, promotions, and scholarship/grant giving. An good start would be to require equity and diversity training for everyone on application review committees. In addition, applications should include more comment sections where applicants are encouraged to include mentorships (as discussed below) and other less quantifiable skills and contributions on their CVs. Best practices must be developed, tested, and shared to promote equity.

3. Hiring practices

The issues highlighted here are not specific to STEMM in academia, however we focused on these disciplines in the discussion below. Women and minorities are largely underrepresented as faculty members even though they make up an increasing proportion of PhD holders.

Barriers

Academia is extremely competitive; only about one in four PhD holders will occupy a faculty position (6). As discussed above, the criteria for excellence that academic institutions favour likely contribute to the lack of women and minorities in leadership positions. In addition, there are a number of biases in the hiring process that may act as barriers for to employment (7). It has been shown that implicit bias can be manifested in reference letters that are less likely to highlight the skills and excellence that are most relevant for the opportunity at hand (8). Finally, spousal hires, which apply more to women, are frequently looked down on and sometimes even considered as a problem to be solved.

There are other barriers that are internalized by female candidates themselves, namely the fear of being hired as the “diversity candidate” or the “token woman”. Due to all of the barriers women face, they can feel discouraged and lack of confidence. Women are more likely to experience “imposter syndrome”, which refers to the persistent feeling of inadequacy and the fear of being exposed as a fraud (9).

Individual/Local Solutions

Faculty members, particularly tenured professors, as well as administrators, are in a good position to act at the individual level. They can do so by recommending and promoting diverse candidates. Acknowledging the aforementioned implicit biases during the hiring process and discussing them with the hiring committee can also help address the barriers that women and minorities face when applying for faculty positions.

Institutional Solutions

At the institutional level, one contentious solution is to implement gender quotas. There are both potential benefits and harms associated with implementing quotas, as well as different forms of quotas and reward systems, which we would encourage institutions to consider exploring (10). In addition, radical transparency should be encouraged at all levels of the institution. At the department level, there should policies in place that require written reports of the hiring process that include explanations if the underrepresented candidate is not hired. At the university level, transparent policies could include public annual statistics detailing faculty hirings and tenure career advancements. These statistics would help quantify the bias against women and minority candidates, and motivate the faculties to take action to reduce these inequalities. This strategy has been used in some faculties in Canada (e.g. UBC Applied Science, 11) and has led to the creation of an action plan that succeeded in advancing gender equity and diversity.

4. Discrimination

Equitable hiring policies can remedy discriminatory practices that prevent women and other underrepresented groups from entering academic careers. However, discrimination does not end once hiring targets are reached, particularly for women, people of colour, and lesbian, gay, bisexual, transgender, queer, or two-spirit (LGBTQ2) individuals. We discussed how discrimination and harassment can continue to occur towards marginalized groups once hired, and how these experiences can affect an individual's academic career path.

Barriers

Discrimination can create a hostile and unwelcoming work environment, which negatively impacts an individual's career. There are many forms of discrimination, the most overt being those of explicit sexism, sexual harassment, and abuse. Consistent with our discussion, numerous studies indicate that there is a substantial problem of sexual harassment and assault within STEMM (12-14). It has been shown that unwanted sexual advances or comments more frequently affect women in science, and often occur in accordance with established power dynamics, such between a supervisor and a trainee (12). Moreover, an intersectional approach recognizes that individuals of multiple marginality, such as women of colour, are at an additional risk of harassment and discrimination in scientific disciplines (13).

We discussed how the vulnerability associated with imbalance of power can affect the victim's willingness to report harassment, especially if the abuser is a well-known and respected researcher in the field. Moreover, early career researchers rely on their supervisor's recommendations and fear the professional repercussions of speaking out, including possible lasting negative effects on their career. Young researchers are also hesitant to come forward with allegations due to fear of inaction by the institution. There was a general recognition among participants that 'star researchers' were often protected by institutions. The lack of transparency for the rights of victims of harassment, as well as a lack of accountability by institutions, establishes a culture where victims do not feel they can report workplace harassment.

A hostile work environment, resulting from harassment and abuse, can lead to psychological distress, reduced job satisfaction, and an increased likelihood of leaving academia. Even when they stay in academia, women may end up switching workplaces, supervisor, or project, to get away from their abuser, which can leave them at a disadvantage at the most competitive stage of their careers.

Discrimination can also occur in more subtle ways. Seemingly innocuous jokes, comments, and remarks that are gender-, sexual-, or racially-based can contribute to an uncomfortable and discouraging work environment. These behaviours can be defined as microaggressions: persistent verbal and nonverbal insults or slights that target individuals of a marginalized group. Microaggressions can also occur at conferences, when work environments exist in more relaxed, social situations.

Subtle discrimination can be perceived as harmless, or not 'worth it' to vocalize or report. In response, women and other marginalized groups employ different coping mechanisms and strategies to continue working in these conditions, using both time and energy that could be put towards more productive work. We also discussed that victims may choose to avoid conferences and other important work-related events altogether to escape harassment, allowing the bad behaviours by others to compromise their own professional competitiveness.
Lastly, discriminatory behaviour can take the form of exclusion from particular opportunities which would benefit an individual's career, such as all-male panels at conferences. Speaking opportunities are crucial for early career researchers, as they bolster the CV and can lead to important networking opportunities. Gender-based expectations and discrimination can also result in particular work assignments, such as women taking on more organization or mentoring, activities which are not reflective of criteria for hiring/promotion. These acts of discrimination can have a cumulative effect, ultimately affecting decisions for promotion/leadership positions when candidates' CVs are compared.

Individual/Local Solutions

Increased dialogue about workplace discrimination can raise awareness and create change. At the individual level, we can speak out against harassment and discrimination by calling out inappropriate comments, jokes, or behaviour from colleagues. By doing so, we can clearly establish how inappropriate behaviour creates an uncomfortable and harmful work environment, and that it will not be tolerated. We can also personally examine our own biases and practices, and to lead by example in the move towards a discrimination-free workplace.

Individuals need to make the effort to educate themselves on their rights, the mechanisms for reporting harassment, and the resources that are available to them. We can support victims of harassment by listening to them and providing them with available resources and support. Grassroot support networks can be organized to discuss experiences related to discrimination or harassment in a safe space, and to address feelings of powerlessness or isolation.

In addition to identifying and condemning discrimination in the workplace, we can also actively embrace diversity and promote practices that do so. We can demonstrate our support for diversity and inclusion by only attending conferences with diverse panels, and being vocal about why we have chosen to do so. Additionally, individuals in a position of power (eg. keynote speakers, panelists) can also assist by only agreeing to participate in diverse panels.

Institutional Solutions

Institutions need to address specific issues related to discrimination, beyond simply setting equity guidelines at the time of hiring. Institutions need to have clear policies on harassment which are actively enforced. Faculty need to be held accountable, and institutions need to be transparent with the actions that are taken. Moreover, information related to the process of reporting abuse and available resources need to be readily accessible and well-advertised by institutions (again, present in the graduate student handbook). These steps can help promote

a culture that supports victims, and makes it easier for individuals to come forward to report abuse and harassment.

Institutions also need to have effective and up-to-date policies on equity, diversity, and inclusion. However, it cannot end at a list of plans and guidelines; policies need to be acted upon and enforced. One method to ensure action is to establish sustainable positions for monitoring inclusion and diversity. These positions can also oversee improved equity training policies, to allow for relevant and ongoing harassment, discrimination, and diversity training for staff.

To hold institutions accountable to their commitment to equity, we suggest that they collect and publish data about their policies and practices, based on clear targets and indicators of reduced harassment, bias, and discrimination. Such data collection can inform necessary policy change by assessing whether reporting mechanisms are working, and if current policies are effective at serving the groups they are designed to protect. Additionally, evidence can further improve equity training programs by presenting information to academics in a familiar way.

5. Role models

Barriers

Participants consistently identified barriers relating to role models and mentorship. Most obvious to young girls and women is the lack of female role models in leadership positions. Not being able to see yourself in a specific position makes it more difficult to imagine attaining that position. Furthermore, female role models who have had a difficult journey have sometimes had to adapt in ways to succeed in the biased system, making them difficult to relate to.

Furthermore, women who do make it to leadership positions tend to take on more mentees or feel pressured to do so, adding time commitments and pressure while navigating their own careers.

Individual/Local Solutions

As with many other barriers discussed above and below, individuals can create awareness to these barriers by discussing them among peers and co-workers. Creating a general understanding of the effects of a lack of role models and the burden of providing mentorship will help lead to the recognition of their importance.

Institutional Solutions

Mentorship should be more formally recognized as a component of the criteria for excellence in hiring and promoting process. Furthermore, any solution discussed in other sections of this report that lead to more women in leadership positions will help provide role models.

6. Societal Biases

We believe that the major source of many of the barriers for women in STEMM discussed so far is deeply rooted within our society as a whole. Here we present some broad social biases against women that can impact their success in STEMM, as discussed at the SPE Café, with the acknowledgement that many more exist which we cannot address within the scope of this report.

Barriers

To start, gender-based biases are pervasive in our language. Most obviously, conventionalized titles for various jobs and careers reflect these biases (e.g. manager, policeman, lunch lady, etc). Masculine is the default pronoun in many of the world's languages. The words we use to describe men and women's qualities are biased, for example "bossy" is much more likely to be used for a woman than a man who might be considered "assertive". This can be particularly obvious in online ratings and evaluations of professors.

Furthermore, bias in language has negative implications in new technologies like artificial intelligence. For example, translating from a language without grammatical gender (such as Turkish) to a language with grammatical gender (such as English), Google Translate utilizes machine learning algorithms to assign a gender to the output. The algorithm draws on shared contexts between the words to determine the most likely gender output of the word. Thus, equivalent Turkish phrases would be translated to "she is a cook", "he is an engineer", or "he is a doctor" (15). This is an example of today's deeply rooted sexism being coded into tomorrow's innovation.

We explored the negative impact of implicit social biases on society's concept of brilliance. Participants reflected that male-dominant in fields like technology and engineering are more associated with brilliance. A survey of academics in the U.S.A. suggested that women are underrepresented in fields historically affiliated with genius (e.g. natural sciences). This disparity is further exacerbated for African American women, providing evidence that not all women face the same barriers in STEMM and highlighting the necessity of addressing these barriers with an intersectional lens (16).

Extending the discussion of how outdated gender expectations serve as barriers to women in STEMM, we discussed the androcentric nature of the academic establishment and what most people imagine when they think of a scientist. Typing "scientist" into Google Images will provide a glimpse of the problem - most of the results are white males in white lab coats looking into a microscope. Not only is this imagery not representative of the work of most scientists, but it grossly underrepresents women and women of color.

The academy also continues to foster a culture that is mutually exclusive from femininity. Women with more conventionally feminine appearances are deemed less likely to be a scientist. As recently as 2015, Nobel Prize-winning scientist Tim Hunt publicly made disparaging and racist comments about women in science, remarking that "… three things

happen when they are in my lab….you fall in love with them, they fall in love with you, and when you criticise them, they cry."

Individual/Local Solutions

We encourage women to form collectives and share their experiences, and concurrently, for men to engage in these conversations and listen to the lived experiences of women and minorities (discussed further below). Not only do these conversations around equity, diversity, and inclusion enable community-building, solidarity, and social support, but research suggests that explicitly addressing these issues is sometimes more effective than representation and mentorship in promoting the active engagement of young females in male-dominated fields (17, 18). While not always easy, we advocate for individuals to embark on brave and difficult conversations and to continue sharing their lived experiences should they feel comfortable and protected to do so.

Institutional Solutions

Institutions should strive to foster the open and safe dialogues that were discussed as local solutions. To achieve this in a sustainable manner, universities should work with department to integrate topics of equity, diversity, inclusion, and social justice into their core curriculum, at the undergraduate and graduate level, as either stand-alone mandatory courses or as an integral part of a mandatory introductory-level course. To match this commitment on the student side, all faculty and staff should be required to complete thorough implicit bias and equity training. In concert with these trainings, departments and universities should establish incentives or set aside funds to facilitate follow-up discussions, panels, and conversations surrounding social bias.

To begin addressing the language component of the social barriers facing women in STEMM, institutions can start by being more mindful of the nomenclature behind their prestigious awards. Many universities and many disciplines offer awards named after relevant historical figures. Most of these icons are white males, which is another point of disconnect for aspiring young females in many fields. By updating the names of these awards to reflect the increasing participation of females would be a step in the right direction of widening our definitions of success and leadership.

In general, institutions can consult more students and early career researchers who are more diverse than the top leadership positions. This will have the advantage of bringing in different voices who may have experienced barriers or be more aware of them.

Lastly, universities and departments should financially and socially support the formation and maintenance of specific groups like "Women in Science" or "Women of Colour in Biology" that meet to discuss the specific barriers bound to them to establish targeted, group-specific solutions to meet their needs. We urge institution leaders to acknowledge that not all women face the same social barriers and thus differences among individuals, regions, disciplines, and other intersecting identities should always be taken into account when proposing solutions.

7. Lack of men

Barriers

Finally, the lack of men in conversations about the gender gap is a barrier that needs to be overcome in order for us to effectively address all the barriers discussed above. Most events or workshops on equity tend to be attended by those who face the barriers. Many of those who are part of the privileged majority do not even recognize their privilege or the extent of it; as a result, they lack awareness and understanding of the barriers encountered by women and other marginalized groups.

Individual solutions

Most of all, we need to engage the men around us and encourage them to participate in women in STEMM events/discussions. For those men who are already engaged in the discussion, they need to in turn engage their male colleagues and friends.

Institutional solutions

All leaders need to show commitment to equity and diversity policies, and encourage attendance at equity trainings. Considering leadership positions are more likely to be held by men, this will require allyship from men to actively help reduce barriers for women and the underrepresented. Furthermore, commitment to equity and diversity should be an important quality when considering candidates for promotion to leadership positions,rewarding those who participate in the conversation.

Conclusion

While not an exhaustive list, participants of the SPE Café explored seven gender barriers in STEMM and proposed potential solutions to address them: family planning, criteria for excellence, hiring practices, discrimination in the workplace, role models and mentorships, inherent societal biases, and lack of men in the conversation.

We believe there are two levels at which we can advocate for change - at the individual/local level and the larger institutional/policy level. We described individual solutions for each specific barrier but a common theme arose: create awareness and dialogues around these issues. This involves both creating local support groups for those affected and educating those around us. We can harness our strength and collective experience to dissect these barriers and advocate for solutions. Men need to be part of these conversations as active and supportive allies.

At the institutional level, we identified many concrete steps to promote equity and diversity.

These are formatted into a list of 20 recommendations. Most of all, it is important our institutions commit resources to equity and diversity, and advertise it. Creating best practices, and testing and reporting on them between institutions will be important to optimize solutions. We believe that active participation by institutional leaders is ultimately needed to create the culture shift needed to close the gender gap.

In addition to creating a fairer society, new research is proving that diversity leads to better ideas, better research, new technologies, and a better economy (19,20). Currently, we see universities are starting to create equity working groups and implementing required equity training for academic hiring units. We hope these are signs that the voices of the underrepresented are being heard and that institutions are open to change. We hope this report adds to those voices and will help drive change.

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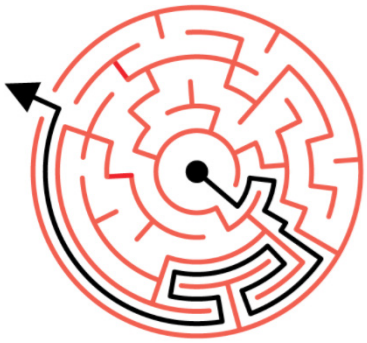
Appendix A — Brief

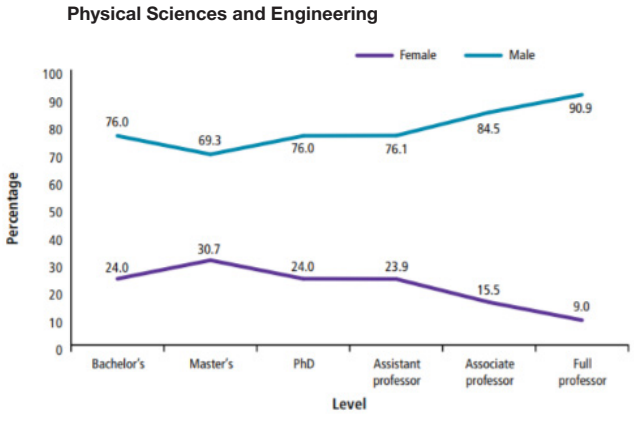
Breaking Gender Barriers in STEM - Whose responsibility is it?

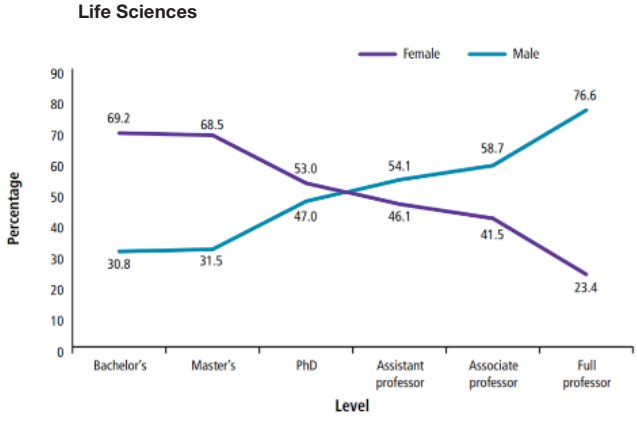
What are the problems?

— The gender gap: women 57.1% of students but 35.7% at the full-time faculty level (2012).
— Gender gap in physical science persists at the undergraduate level.
— A more comprehensive alternative to the "**leaky pipeline**" analogy, describing the progressive loss of women at every stage of career advancement, is the "**glass obstacle course**". This refers to the invisible barriers, often unseen by the individual experiencing the barriers, that consistently arise over the course of the individual's career in formal and informal ways.
— Pay equity discrimination persists: in 2013, women professors earned 88% of men professor salaries (CAUT, 2012).

"The glass obstacle course"







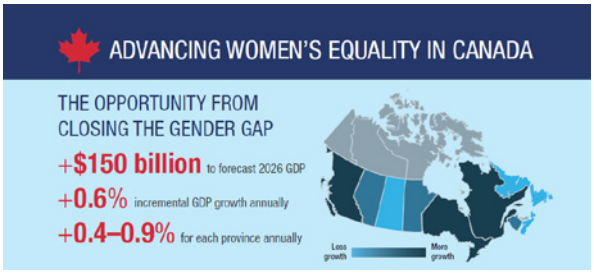
Council of Canadian Academies, 2012

What are these barriers?

— Outright sexism and harassment.
— **Implicit bias**: the attitudes or stereotypes that affect our understanding, actions, and decisions in an unconscious manner.
    - eg.: reference letters written for men more likely to include “brilliant”, “assertive” whereas women more likely to include relationship building characteristics like “nurturing”, “caring”.
— Difficult work-life choices, women more likely to do most of household chores.
— **Imposter syndrome**: the experience of feeling like a fraud, like you are not good enough despite accomplishments that prove otherwise, and the fear you will be exposed.
    - Affects everyone but disproportionately affects women.
— **Intersectionality:** Intersectionality is a term that describes the intersection between social categories like gender, race, class, sexual orientation, ability, etc. and how this affects an individual’s experience of disadvantages and discrimination.
    - eg.: women of colour least likely to see their futures in academia compared to white women and men of colour.
— Lack of effective role models/mentors.
— Exclusion from “Old Boys Club” resulting in lack of network: the connections that get made outside of the workplace are important for advancement, but women can feel left out.
— Pay equity discrimination persists: in 2013, women professors earned 88% of men professor salaries (CAUT, 2012).

Why this is important for everyone?

— Diverse groups outperform homogenous groups productively and creatively.
— A matter of social justice.
— Since women are still the main caregivers for a family, practices that include women will lead to better work environments for all, especially in terms of work-life balance.



McKinsey & Company, 2017

What are the solutions?

— **EDI** policies: need to promote Equity, Diversity, and Inclusion in our workspaces.
— **Allies:** people who recognize the unearned privilege they receive from society’s patterns of injustice and take responsibility for changing these patterns.
— Promoting STEMM to girls to break science gender stereotypes.
— Local initiatives: groups or seminar series to provide spaces to talk about these issues.
— Quotas/targets for women/minorities in hiring processes.

Current practices

— From the Government of Canada research institutions:

- NSERC: adopted EDI statement in September 2017 and promotes women specific research chairs and scholarships
- CIHR released a Gender Equity Framework, including measures to address gender bias in grant reviews.
- CRC: Tier 1 limited to 2 terms to bring in new researchers, gender targets, government will withhold funding if targets not met

— Athena SWAN Charter in the UK: to encourage and recognize institutions that commit to advancing the careers of women in STEMM
— Local universities (McGill, Concordia, UdeM, UQAM): employment equity policy - commitment to EDI, applicants option to declare as underrepresented group
— Academic hiring at McGill: search committee must undergo equity training and short-list must include at least one member from any underrepresented group
— Action Plan for Inclusive Excellence: a plan agreed to by all Canadian universities to collect and make public demographic data of students, staff, and faculty

Discussions questions

— What barriers do women face in obtaining leadership positions in STEMM? Share first-hand or second-hand experiences or barriers in STEMM.

— What local solutions exist in your community? What others can you think of? What can we do as individuals?

— What could our institutions be doing to promote women in leadership in STEMM?

Useful resources

Statistics on academia from Canadian Association of University Teachers (CAUT)
https://www.caut.ca/latest/publications/almanac

Report on the status of gender in research in Canada by the Council of Canadian Academies: Strengthening Canada's Research Capacity - The Gender Dimension (2012) http://www.scienceadvice.ca/en/assessments/completed/women-researchers.aspx

McKinsey & Company and LeanIn comprehensive studies on women in the private sector:
https://womenintheworkplace.com/

Summary of reference letter bias research:
http://www.sciencemag.org/careers/2016/10/recommendation-letters-reflect-gender-bias

The Glass Obstacle Course
http://genderandset.open.ac.uk/index.php/genderandset/article/view/205

Why diversity matters
https://www.mckinsey.com/business-functions/organization/our-insights/why-diversity-matters