Be a Catalyst for Change: Breaking Down Barriers to Maximise Australian Female Talent in Chemistry

Anitha Kopinathan,[A,B] *Lucy Weaver,*[C,E] *and Katherine Locock* [iD][A,D,E]

[A]CSIRO Manufacturing, Research Way, Clayton, Vic. 3168, Australia.

[B]Current address: Medicinal Chemistry, Monash Institute of Pharmaceutical Sciences, Monash University, Parkville, Vic. 3052, Australia.

[C]Swinburne Research, Swinburne University of Technology, 24 Wakefield Street, Hawthorn, Vic. 3122, Australia.

[D]School of Chemical and Biomedical Engineering, Melbourne School of Engineering, The University of Melbourne, Parkville, Vic. 3010, Australia.

[E]Corresponding authors. Email: lweaver@swin.edu.au; Katherine.Locock@csiro.au

Catalysts were invented to speed up chemical reactions, helping to maximise yields from available resources. If the same logic is applied to chemists themselves, what impact would this have on helping us maximise Australian female talent in the chemistry sector? This article aims to provide information on the current problems faced by female chemists across categories of workplace culture, work–life balance, measures of merit, and mentorship. It also serves as a call to action for all of us who work in the chemistry sector to be that catalyst (#catalystforchangeinchemistry) – to help speed up change towards gender equality that will, in turn, maximise our collective and diverse talents.

Introduction

The under-representation of women in science, technology, engineering, and mathematics (STEM) is a well documented issue worldwide.[1] In Australia, the Women in Science, Engineering and Technology Advisory Group (WISET) recognised in 1995 that this under-representation would ultimately be detrimental to Australia's capacity to develop internationally competitive STEM research sectors and associated industries.[2] Despite this indictment, the rate of change to address this deficit has been slow and inefficient. Fast forward 25 years and Australian females have become the least likely in the Asia Pacific region to pursue STEM subjects at school (27 % compared with 69 % and 76 % in India and China, respectively),[3] represent only 16 % of the STEM workforce,[4] and despite various gender equality initiatives, are on average, paid 23.7 % less than their male counterparts.[5,6]

Although these statistics paint a grim picture of the Australian STEM sector, certain pockets of STEM have had some success in addressing female under-representation. The chemistry sector, for example, has dealt with some of these issues through the engagement of female talent during their schooling and tertiary studies. Consequently, females represent 49 % of students enrolled in Year 12 chemistry,[7] they outnumber their male counterparts in completing a Bachelor's degree or vocational education and training (VET) course in chemistry (56 and 65 % respectively),[5] and are evenly matched in their completions of chemistry based Honours degrees (50 %) or PhDs (51 %).[8] Beyond graduate and doctorate completions, however, retention of such talent wanes significantly with only

36 % of the entire chemistry workforce comprising women.[4] Traditionally this attrition was mostly attributed to women leaving the sector in order to raise and care for a family, but further investigation has highlighted that career interruptions occur for a variety of reasons at various points in a woman's career and that there are significant barriers to re-establishing themselves upon returning to work.[5,9] In the decade between 2001 and 2011, female staff at higher levels of academic employment increased 1 % per annum or less (Level C: 18 to 32.5 %, Level D: 12 to 20 %, Level E: 7 to 14 %) in the natural and physical sciences (including chemistry).[8] Outside academia, the proportion of female representation at higher levels of employment in the private sector is not well documented, despite these roles constituting 72 % of the chemistry employment opportunities in Australia.[4] As such, there is a significant need for these figures to be collected and reported in order to improve conditions for women across the chemistry sector.[4] Nonetheless, the disadvantage of women employed in the chemical sciences is starkly apparent. Women employed with a bachelor qualification in the chemical sciences are twice as likely to be engaged in part-time work (35 %) compared with their male colleagues (17 %), and at least twice as unlikely to earn in the top income bracket (i.e. > $104000 p.a.) than men above the age of 30.[4] At the global level, and for the chemical sciences in particular, many of these challenges and barriers are mirrored in the recent Royal Society of Chemistry report on women's retention and progression in the chemical sciences.[10]

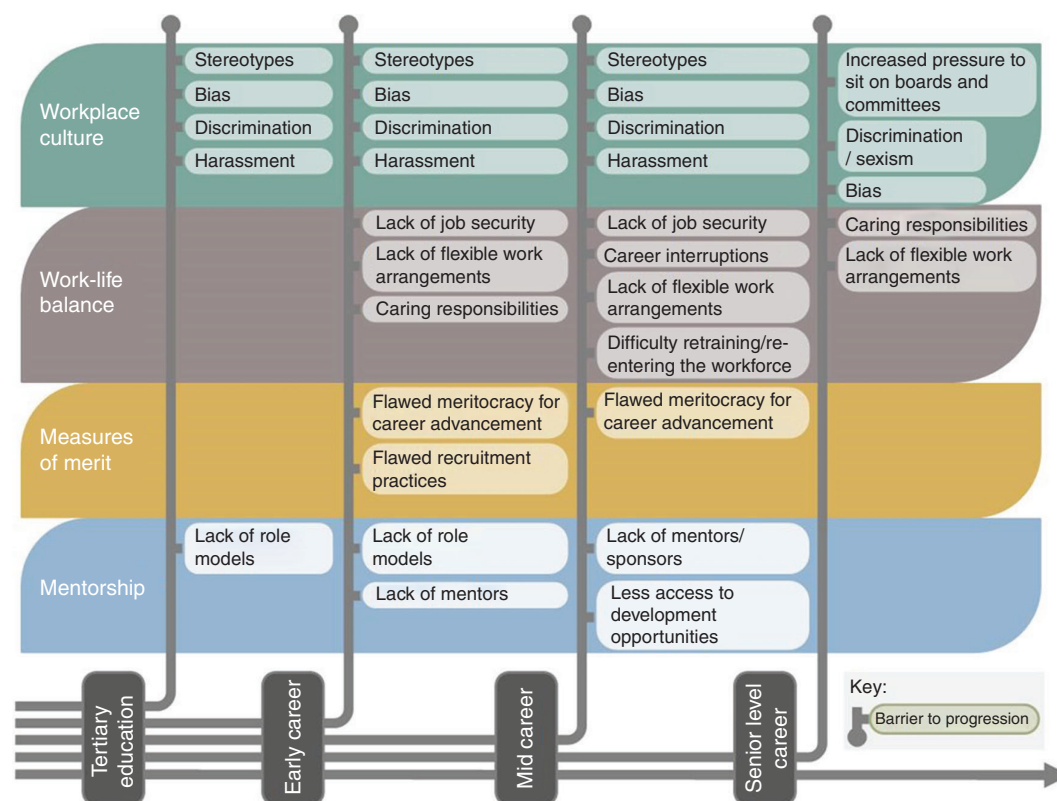The Australian Academy of Science's 'Women in STEM Decadal Plan' was developed in collaboration with stakeholders

Fig. 1. Categories of career progression barriers faced by women in the STEM sector. Modified from ref. [5].

to tackle the challenges of an increasingly digital and techno-logically driven world.[5] Much like WISET in 1995, the Decadal Plan recognises that a strong workforce is a diverse one, where we work to maximise the attraction, participation, and retention of both sexes. Evidence has shown that more diverse leadership leads to greater innovation and better perfor-mance,[11] and when there is a higher proportion of women in leadership, this can lead to better economic performance for the organisation.[12,13] There is also fear that a shortage of STEM professionals will mean that Australia is unable to meet the growing demands of the sector, termed a 'STEM crisis' by some.[14,15] To ensure we maximise our nation's STEM workforce, we clearly need to address the leaky pipeline so as to retain all of our best and brightest, regardless of their gender. As part of this process, the Decadal Plan acknowledges that women specifically face significant barriers across their educa-tion and all levels of the workforce. This was aptly illustrated in a career progression pipeline highlighting various barriers faced by women in STEM spanning their experiences at school to senior level employment.[5] Given our interest in the barriers faced by female talent in chemistry, and since attrition for female chemists occurs predominantly upon completion of a graduate or doctoral degree, we have chosen for this article to focus on the barriers faced by women in chemistry in early career roles and beyond. Consequently, the authors noted that the identified barriers could be summated into four specific categories; workplace culture, work–life balance, measures of merit, and mentorship (Fig. 1). Herein, we explore these four classes of barriers which continue to stifle the progression of women in chemistry and various 'catalysts' that could be implemented to enact meaningful change (summarised in Fig. 2).

Category 1: Workplace Culture

Workplace (or organisational) culture is the values, beliefs, assumptions, and expectations shared by staff that are reflected in their behaviour and interactions with others.[16] The preva-lence of bullying, harassment, and discrimination towards women in STEM workplaces is a well documented problem, with key statistics highlighted in Table 1.[5,17] While men are also subject to these negative behaviours, the prevalence and impacts on women occur at a disproportionally higher rate.[5]

In many instances, discrimination against diversity occurs without the person even knowing, as they act and make decisions using their deeply held personal beliefs and char-acteristics that are instinctively familiar to them.[5,24] This manifests in homophily, or the tendency for individuals to preference those that are like them,[25] and results in the perpetuation of long-held stereotypes (e.g. that most scientists are middle-aged Caucasian men[26]) and retention of the status quo in hiring practices and the workplace. The downstream effects of this are less access to talent, and missed opportunities for positive outcomes that are known to occur through greater team diversity.[5,24,27]

Informal networks within workplaces are known to be beneficial for the development and communication of tacit knowledge, yet can also pose a challenge for females in male-dominated environments.[28] Many studies show that females who are excluded from these male-only networks, commonly referred to as 'boys' clubs, are disadvantaged in their career as a result.[25] Anecdotally, women report feeling stressed and anx-ious when excluded from these networks and, frequently being in the minority, often find themselves taking active steps to change their behaviour in order to assimilate.[25,28]
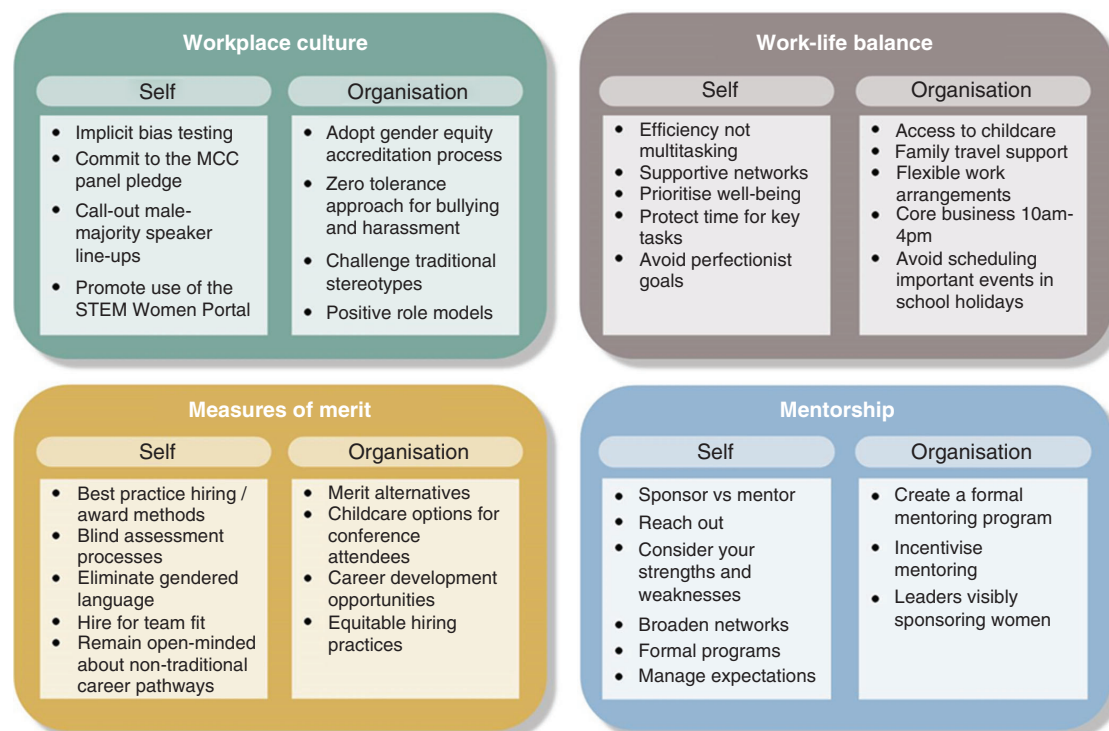
Fig. 2. Summary of self and organisation strategies that can help catalyse and drive gender equality in the Australian chemistry sector.

Table 1.   Definitions and supporting statistics for the incidence of harassment, bullying and discrimination in the workplace

	Harassment	Bullying	Discrimination and bias
What is it?	Aggressive pressure or intimidation. Sexual harassment includes unwelcome sexual advances, unwelcome request for sexual favours and other conduct of a sexual nature that makes a person feel offended, humiliated and/or intimidated.[18]	Repeated and intentional use of words or actions against someone or a group of people to cause distress and risk to their wellbeing. Perpetrators usually hold higher power or influence over victims, or want to make victims feel less powerful or helpless.[19]	A person, or a group of people, is treated less favourably because of their background or certain personal characteristics. In a STEM workplace context, discrimination and bias are often based on gender and perceptions of gendered roles.[20]
Key Australian statistics	50 % of women and 10 % of men in Australian STEM workplaces have faced sexual harassment.[21]	Evidence shows that all-male teams exacerbate toxic workplace cultures, deterring female chemists.[1]	51 % of women in STEM jobs have reported being discriminated against on the basis of their gender.[23]
	70 % of people choose not to report it due to fear of reprisal or concerns of inadequate organisation response.[21]	Of women who have been bullied in their STEM workplace, 25 % responded by leaving the workplace.[22]	41 % of women experience an everyday culture that excludes people based on gender compared with 8 % of men.[17]

How to Address Workplace Culture: Self Strategies

A wide range of strategies and tools are available, which can help individuals understand and challenge their own belief systems and biases, and improve self-awareness. 'Project Implicit' is a good example, a non-profit organisation whose goal is to 'educate the public about hidden biases'.[29] Their implicit bias tests on social attitudes are publicly available at https://implicit.harvard.edu/implicit/.

If you are invited to speak publicly, for example, at a conference or panel event, take a moment to check whether they have a diversity policy. In particular, senior leaders are encouraged to commit to the Male Champions of Change (MCC) Panel Pledge, a commitment by leaders to be involved in panels that involve women in meaningful ways (https://malechampionsofchange.com/commit-to-the-panel-pledge/). If you are considering calling out conferences with male-majority panels, speakers, and keynotes, we encourage you to also contact organisers and suggest female speakers for the conference, and provide them with resources on how to achieve diversity. Recently launched by the Australian Academy of Science, the STEM Women Portal (https://www.stemwomen.org.au/) is an excellent resource. You can search for women and promote yourself (if you are female) via this website. Another option for public promotion is by registering as an expert with

the Australian Science Media Centre (AusSMC),[30] and supporting and promoting the 'Superstars of STEM' program.[31]

How to Address Workplace Culture: Workplace Policies

A significant cultural shift in workplaces is necessary to create gender equity for women in STEM. A culture that is inclusive and respectful, challenges traditional stereotypes and gendered expectations, and is free of discrimination and bias will help to maximise women's participation in the workforce.

Changing workplace culture is consistently touted as one of the critical steps in shifting towards a gender balance in the chemistry workforce.[5,27,32] Not only does this benefit women, but a positive workplace culture has been shown to lead to higher productivity, and better psychological health and overall work satisfaction for all employees.[33] Creating a respectful and inclusive environment requires policies to be implemented that improve reporting mechanisms, and that take strong action on key issues – for example, a zero-tolerance approach for bullying and harassment.[5] When implementing these policies, it is important that staff are supported through high-quality training and development activities.

To achieve these desired cultural shifts, many workplaces are adopting gender equity accreditation processes that encourage transparency around diversity and inclusion goals and the changes that are being implemented to achieve them. The Athena SWAN accreditation framework delivered through Science and Gender Equality in Australia (SAGE) is an excellent choice as it focusses on implementing institutional awards for higher education and STEM research organisations.[34,35] The Australian Government's Workplace Gender Equality Agency (WGEA) Employer of Choice for Gender Equality[36] is another good option, as they lead a practice recognition program that aims to encourage, recognise, and promote active commitment to achieving gender equality in Australian workplaces. Part of these strategies could be the development and promotion of informal supportive female networks, which have been demonstrated as effective at helping prolong female participation in the chemistry workforce.[37]

As we implement strategies and work towards gender diversity targets, it is important to ensure that changing workplace policies does not inadvertently impact women in a negative way. There is evidence that increased pressure can arise for women when new commitments, such as sitting on auxiliary boards and committees that are not directly science related (e.g. diversity, social, or wellbeing committees), reduces the time available to conduct core work activities such as research. While important to engage women in these strategies, it should not be to their detriment in terms of their capacity to deliver research outcomes and improve their career track record.

Category 2: Work–Life Balance

Work–life balance in its broadest sense involves harmony between your work and non-work commitments.[38] While it can affect both sexes, it disproportionally affects women, given the largest impact is often associated with caring roles for children, disabled dependants, or elderly parents.[5,39–41] Such tension can severely impact their quality of life, or require them to abandon critical obligations.[41] This is a widespread phenomenon, given 47.7 % of women with children who leave STEM professions in Australia, do so to seek a better work–life balance. Similarly, women in the latter stages of career progression may be disadvantaged upon assuming primary care roles for ailing parents,

partners, and extended family. In Australia 72 % of women assume caring roles for elderly parents and are more likely than men (77 %) to care for members of their extended family networks.[42] This is often put down to the fact that long working hours are perceived as improving STEM career progression,[43] and are typically incompatible with carer responsibilities. Many women hence see this as a resultant career penalty for taking on a carer role.[23] It follows that if a workplace develops policies to support flexible work patterns and improve work–life balance, this can translate into significant increases in staff retention. For instance, results from a survey run by Merck and Co. in 2008 showed that increased flexibility was a key factor for almost 50 % of employees staying with the company, while areas without such practices suffered double the turnover rate.[44] It can also send a powerful message to staff if leaders are seen to encourage the uptake of flexible work practices. Robbert Rietbroek, CEO of PepsiCo Australia and New Zealand, has encouraged his executive team to participate in a 'Leaders Leaving Loudly' campaign.[45] This involves management feeling comfortable to leave work early if they need to, but importantly, also clearly declaring this to the team so more junior members also feel able to adopt flexible work arrangements. Through this and other policies brought into place, the company has seen a dramatic increase in staff retention, with annual staff turnover dropping from 12 to 7 % over a two year period.

How to Address Work–Life Balance: Self Strategies

While organisational culture often has the largest effect on a person's work–life balance, there are also strategies that individuals may be able to implement to help reduce this tension. For instance, emphasising efficient work practices, rather than multitasking, seeking a supportive network within the workplace and beyond, striving to prioritise well being, and actively cordoning off time for important tasks, can all be helpful practices to help drive a better balance.[46] It is also important to remember that an individual is in control of what they perceive as a successful work–life balance. This may not mean that you feel like you are excelling in both your carer and work roles, or striking an even balance between the two. What it does mean is that you are meeting the essential requirements for each and no longer strive for perfection in both worlds.[47]

How to Address Work–Life Balance: Workplace Policies

It has been identified that access to affordable, high-quality childcare is the single largest barrier to Australian women entering the workforce or working longer hours.[48] Organisations need to assess whether appropriate childcare access is available near the workplace site, and if not, consider the option of providing on-site childcare, crèche, or holiday programs for staff.[49] Workplaces could also consider providing targeted funding to support women travelling with or without their children (e.g. travel grants or funding stay-at-home care, where appropriate), ensuring they have continued access to important career development opportunities.[9]

Flexible working arrangements can also be a powerful way to allow employees to strike the appropriate balance between work and carer roles. This can involve offering the option of part-time roles, compressed work weeks (working the same number of hours across fewer days), flex time (flexibility with start and finish times beyond core business hours), working from home, or job-sharing arrangements.

Perhaps some of the simplest, but also powerful policies that a workplace can implement involve striving for inclusive scheduling. This could be through ensuring core business (e.g. meetings and seminars) is only scheduled between 10 a.m. and 4 p.m., thus avoiding issues with school drop off and pick up; or avoiding scheduling important events during school holiday periods. Workplaces could also encourage the uptake of technology to allow staff to attend meetings virtually, allowing them greater flexibility to dial in from home or while travelling.

Category 3: Measures of Merit

Women in STEM earn up to a quarter less than their male colleagues,[5,6,50] a pay gap that is larger than the national average. Their promotion and publication rates are slower, and they hold fewer leadership positions than men, with less than one in five STEM professors being female in Australia.[51,52] How did we get here?

Part of the issue is that the merit and promotion processes are inherently gendered, and allow for men with full-time, uninterrupted career track-records, and a high number of research publications to be advantaged over women.[52] Hence women, who are more likely to have career interruptions, are inherently disadvantaged in assessments of suitability for recruitment, career progression, and recognition. While it is recognised that both men and women can experience career interruptions (e.g. short-term contracts leading to periods of unemployment, and familial responsibilities), females experience these interruptions at a proportionately higher rate. This is because females have historically taken on primary responsibilities for child-rearing which exacerbates career interruptions. Thus, parenthood can be seen as one factor that further drives gender imbalance in science. Evidence for this can be seen in a 2019 study by Cech and colleagues, where they found that nearly one-half of new mothers left full-time STEM employment, as compared with one-quarter of new fathers.[53] This is changing as younger generations seek more balanced options, supported by parental leave provisions and flexible workplace policies.[54]

As over 80 % of senior positions are held by men, meritocracy (the holding of power by people selected according to merit) is known to strongly influence these entrenched gender inequalities.[55] Merit is a simple formula – past performance plus future potential – yet the factors that underlie these two components can perpetuate inequalities, particularly when quantitative indicators are used to assess merit.[56] A good example of this is in the publication sphere, where meritocracy and bias have been shown to affect the peer review process. Studies have shown that female author names are rated lower than male author names, and that when hidden, publication rates for females surpassed their male colleagues.[57,58] Furthermore, data also shows that women display a higher preference for teaching responsibilities and are assigned more pastoral duties than their male counterparts, placing them at an even greater disadvantage. This not only serves to reduce their capacity to conduct research and meet key performance targets, but also the systems do not typically reward their efforts to support student learning when assessing merit.[59]

How to Address Measures of Merit: Self Strategies

Aiming to adopt best practice when hiring and assessing and awarding scientific honours is a simple yet effective strategy to implement. When hiring, ensure equal numbers of male and female applicants are reviewed for all positions, consider using blind assessment processes, remove gendered language from position descriptions, award applications, and advertisements (e.g. gender decoder for job ads at http://gender-decoder. katmatfield.com/), and remain open-minded about who the 'best' candidate is, taking into consideration non-traditional outputs and career experiences. When building a team, look for the best fit for the team, rather than just publication and grant track record. To help achieve this, teams should agree ahead of time what the 'best fit' looks like, considering elements such as values and beliefs, and complementary skills, expertise, and personality traits; and consistently look for these elements when assessing each candidate. As an applicant, consider non-conventional items to add to your CV that display your full capacity and capability. This could be things like non-traditional research outputs, engagement activities within the sector, committee memberships, volunteer roles, and non-research roles held in the past. In addition, in workplaces where gender balance is severely lacking, quotas may be an appropriate measure to improve gender balance (e.g. advertising women-only positions in roles where female representation is below 30 %).

On an annual basis, another strategy could be to highlight gendered issues during performance appraisals, as this may help to identify and eliminate issues more easily. For example, if a staff member feels that their carer responsibilities may be impacting their output at work, this could be openly discussed to see if additional support measures may be provided by the workplace to alleviate such pressures.

In addition, consider nominating women for awards, as they can have an immensely positive impact on an individual's career, yet women often remain underrepresented in many award categories. This often stems from a low rate of women applying for such awards.[43,60] Part time work arrangements and competing demands mean that there is often a delay in the information reaching potential female applicants, and the ensuing time pressure to submit an application invariably leads to it becoming a missed opportunity. Organisations may be able to encourage increased female participation in award schemes through creating awards that are only open to female applications such as the creation of the RACI Rita Cornforth and Margaret Sheil awards in 2017.[60]

On a day-to-day basis, there are simple strategies you can implement for meetings, such as addressing the group in a non-gendered fashion ('Hello everyone' rather than 'Gents, and Ladies'). In addition, ensure all staff members have equal opportunities to speak up in meetings, and agree on equitable strategies for handling administration tasks (e.g. taking minutes) at the beginning of the meetings, so that they do not fall to the same individual each time.

How to Address Measures of Merit: Workplace Policies

Many universities and funding bodies[34,54,61] have implemented policies that incorporate principles of 'achievement relative to opportunity', such as the Australian Research Council's Research Opportunity and Performance Evidence (ROPE) statement to describe a candidate's track record. While the latter provides the opportunity to describe factors that have led to reduced research capacity, it has received criticism due to the fact that there is no formal process for 'special consideration' to be given to these candidates.[62] Given the low female representation on grants, systematic changes are needed to address this disparity. This will first require transparency from

grant bodies as to the degree of gender-based discrepancies in schemes, followed by a commitment to bring in measures to encourage increased female participation. It is pleasing to see that the Australian Research Council have begun to action this, with the recent proposal of a 30 % female representation target for one of their fellowship schemes.[63] It is hoped that such measures will further help catalyse much needed changes across the sector.

Workplace policies that have been effective include funding and programs to re-establish women after a career break,[64] and offering options for childcare at conferences.[9] To satisfy funding body requirements, allocating funding in grant proposals for similar initiatives is increasingly common practice, particularly for large research centres (e.g. ARC Centres of Excellence).[65]

All staff, regardless of gender and career stage should be given access to career development and networking opportunities (for examples see leadership and career progression programs listed in the Women in STEM Decadal plan[5]). Women should be encouraged and supported to attend these events alongside informal development opportunities such as on-the-job learning and shadowing practices. Organisations are encouraged to carefully monitor uptake of these opportunities by staff to ensure they are genuinely equitable and accessible.[56]

Organisations should promote the equitable hiring practices as outlined in *Measures of Merit – Self Strategies* and consider including public engagement and outreach achievements as measures for recruitment and promotion. Furthermore, when female staff leave an organisation, understanding their reasons for doing so may highlight gaps in policies and implementation that should be addressed.

Category 4: Mentorship

Mentoring can be thought of as a partnership where a person or peer, typically with more experience in a given area, provides guidance and support to someone less experienced.[66] They can help accelerate career progression for the mentee, encourage them to take up new challenges, develop new skills, or to perform tasks more effectively.[67] Mentees may also choose to seek mentorship from multiple mentors over the course of their careers. Some mentoring relationships can also provide key emotional support, working towards increasing the mentee's feeling of competence, or providing counselling and advice regarding difficult professional situations.[68] Having a mentor can have a large impact on your career, and has been associated with more successful promotions, higher job satisfaction, higher salaries, and more self-esteem and creativity.[68,69]

Often associated with mentorship, is the concept of sponsorship. Sponsors can be thought of as advocates for their protégé in professional settings, making you more visible in an organisation, or putting your name forward for opportunities.[70] This can often involve putting their reputation on the line in the process, so it requires a deeper level of commitment from both parties than some mentoring relationships. However, while mentoring can be seen to be a valuable influence, many believe that it is in fact sponsorship that is essential for career advancement.[71,72]

How to Address a Lack of Mentorship: Self Strategies

Mentorship can be as simple as senior leaders, particularly women, making the effort to reach out to more junior scientists.[9] This could be to directly provide support and encouragement, or to simply provide invitations for new opportunities.

For early to mid-career researchers, it is to have the courage to make your desire for a mentor known, and to begin to reach out to appropriate candidates.

There is a helpful guide on mentoring produced by Women in STEMM Australia that provides practical advice on how to how to find a good mentor, manage relationship expectations, and get the most out of mentoring.[67] They recommend considering your existing strengths and weaknesses before you seek a mentor to understand what skills you wish to target. This may mean you seek out more than one mentor, and this should not be discouraged. To aid in identifying these mentors, they recommend taking up activities to broaden your networks such as committees or attending social events, symposia, seminars, and conferences. While the authors acknowledge that most mentoring is informal in nature, they also recommend investigating what formal programs might be available in their networks. They also point out that while finding a mentor is the first step, maintaining a productive mentoring relationship takes good communication and hard work. It may also be helpful to join female focussed networks such as the RACI Women in Chemistry or Women in STEMM Australia groups. This will allow you to learn from the collective wisdom of women who have faced similar career challenges, and may give you the opportunity to identify new potential mentors.

How to Address a Lack of Mentorship: Workplace Policies

The obvious solution for a lack of mentorship, is for organisations to create formal mentoring programs that match willing, more senior employees with more junior ones. The issue with such approaches is that they often suffer from low uptake and engagement.[73] One potential mechanism to offset this is to incentivise mentorship[9] through measures such as integrating it into annual performance metrics, or by providing recognition for outstanding mentoring relationships.

It can also be powerful in an organisation if leaders are seen to advocate for the role of mentoring in the workplace. A recent Male Champions of Change (MCC) report that investigates how to best harness our innovation potential recommends that all Male Champions be visible in their sponsorship of women working in STEM roles, and request that all leaders within their organisations do the same.[17]

Summary and conclusion

There is a clear and growing body of evidence that indicates we are not maximising Australian female talent in the chemistry sector. The reasons behind this are not straightforward, with women facing many and varied challenges throughout each stage of their career. If we as a nation want to address this issue and ensure that we retain the best and brightest in our field, we all need to work towards implementing incremental change now, to see these actions translate into the long-term impacts we desire. We all need to recognise that we can act as catalysts to speed up this process, and that no change is too small to make a difference.

Here we have identified the four major categories of career challenges faced by women, workplace culture, work–life balance, measures of merit, and mentorship (Fig. 2). For each, we present strategies that can be implemented personally, as well as at the organisational level to offset these. Self-strategies not only aim to better equip you to face these challenges, but also allow you to act as a positive role model for other colleagues, potentially helping others on their journey. We also present

organisation level approaches that aim to 'change the system' and create workplaces that are truly more equitable for all. While these approaches can sometimes be the most difficult to action, through enlisting the help of similarly motivated individuals in your workplace, such measures can often translate into the largest impacts on the problem. Ultimately, increasing the visibility of women at all levels in chemistry will have positive effects on diversity, create role models for future generations and improve overall retention.

It is our hope that this article not only inspires you to take up this task, but that it also provides practical advice that you can share with your fellow colleagues as to how we might all work towards true gender equality in chemistry. We challenge you to become a #catalystforchangeinchemistry.

Conflicts of Interest

The authors declare no conflicts of interest.

Acknowledgements

References

[1] M. Peplow, *Nat. Rev. Chem.* **2019**, *3*, 283. doi:10.1038/S41570-019-0098-Y

[2] Women in Science, Engineering and Technology Advisory Group (Australia). Office of the Chief Scientist. Women in Science, Engineering and Technology: A Discussion Paper. Australian Government, Canberra, **1995**.

[3] E. Brockwell, *Girls: The Next Generation of STEM Leaders* **2018**. Available at: https://careerswithstem.com.au/women-in-stem-fields/ (accessed 18 July 2019)

[4] *Australia's STEM Workforce: Science, Technology, Engineering and Mathematics* **2016** (Australian Government: Canberra).

[5] Australian Academy of Science, Women in STEM Decadal Plan **2019**.

[6] R. Cassells, A. Duncan, R. Ong, *Gender Equity Insights 2017: Inside Australia's Gender Pay Gap* **2017**.

[7] Australian Curriculum Assessment and Reporting Authority, *Year 12 Enrolments, 2017* [database on the Internet] **2017**.

[8] S. Bell, L. Yates, *Women in the Science Research Workforce: Identifying and Sustaining the Diversity Advantage* **2015** (L. H. Martin Institute, University of Melbourne Melbourne).

[9] C. A. Moyer, N. C. Abedini, J. Youngblood, Z. Talib, T. Jayaraman, M. Manzoor, H. J. Larson, P. J. Garcia, A. Binagwaho, K. S. Burke, M. Barry, *Ann. Glob. Health* **2018**, *84*, 743. doi:10.29024/AOGH.2384

[10] Royal Society of Chemistry, *Breaking the Barriers: Women's Retention and Progression in the Chemical Sciences* **2018**.

[11] S. A. Hewlett, M. Marshall, L. Sherbin, *Harv. Bus. Rev.* **2013**, *91*, 30.

[12] Credit Suisse Research Institute, The CS Gender 3000: The Reward for Change 2016.

[13] C. L. Dezso, D. G. Ross, *Strateg. Manage. J.* **2012**, *33*, 1072. doi:10.1002/SMJ.1955

[14] Good Schools Guide, *How is Australia Dealing with the STEM Crisis?* **2015**. Available at: https://www.goodschools.com.au/insights/education-updates/how-is-australia-dealing-with-the-stem-crisis (accessed 23 October 2019)

[15] C. Lugg, *STEM Crisis Threatens Australia's Business Future* **2017**. Available at: https://portal.engineersaustralia.org.au/news/stem-crisis-threatens-australia%E2%80%99s-business-future (accessed 23 October 2019)

[16] R. Cooke, J. Szumal, *Psychol. Rep.* **1993**, *72*, 1299. doi:10.2466/PR0.1993.72.3C.1299

[17] Male Champions of Change, *Harnessing Our Innovation Potential: Gender Equality in STEM* **2019**.

[18] Australian Human Rights Commission, *Sexual Harassment in the Workplace – The Legal Definition of Sexual Harassment* **2004**. Available at: https://www.humanrights.gov.au/our-work/sexual-harassment-workplace-legal-definition-sexual-harassment (accessed 23 October 2019)

[19] Australian Human Rights Commission, *What is Bullying?: Violence, Harassment and Bullying Fact Sheet* **2004**. Available at: https://www.humanrights.gov.au/our-work/commission-general/what-bullying-violence-harassment-and-bullying-fact-sheet (accessed 23 October 2019)

[20] Australian Human Rights Commission, *Discrimination: Quick Guide* **2004**. Available at: https://www.humanrights.gov.au/quick-guide/12030 (accessed 23 October 2019)

[21] Science and Technology Australia, *Submission to the Human Rights Commission Inquiry into Sexual Harassment in Australian Workplaces* **2019**. Available at: https://scienceandtechnologyaustralia.org.au/wp-content/uploads/2019/02/STA-Submission-Sexual-harassment-in-the-workplace-.pdf (accessed 23 October 2019)

[22] P. Australia, *Gender Segregation in the STEM Professions* **2017**. Available at: http://www.professionalsaustralia.org.au/professional-women/wp-content/uploads/sites/48/2014/03/Gender-segregation-in-the-STEM-professions-submission.pdf (accessed 23 October 2019)

[23] Professionals Australia, *All Talk: Gap Between Policy and Practice a Key Obstacle to Gender Equity in STEM* – **2018** Women in STEM Professions Survey Report. 2018.

[24] Chief Executive Women and Male Champions of Change, *In the Eye of the Beholder: Avoiding the Merit Trap* **2016**.

[25] S. Durbin, *Gend. Work Organ.* **2011**, *18*, 90. doi:10.1111/J.1468-0432.2010.00536.X

[26] D. I. Miller, K. M. Nolla, A. H. Eagly, D. H. Uttal, *Child Dev.* **2018**, *89*, 1943. doi:10.1111/CDEV.13039

[27] Department of Industry, Innovation and Science, *Advancing Women in STEM* **2019**.

[28] S. McDonald, *Soc. Networks* **2011**, *33*, 317. doi:10.1016/J.SOCNET.2011.10.002

[29] *Project Implicit* **2011**. Available at: https://implicit.harvard.edu/implicit/aboutus.html (accessed 23 October 2019)

[30] Australian Science Media Centre **2005**. Available at: https://www.smc.org.au/experts (accessed 23 October 2019)

[31] Science and Technology Australia, *Superstars of STEM* **2019**. Available at: https://scienceandtechnologyaustralia.org.au/what-we-do/superstars-of-stem/ (accessed 23 October 2019)

[32] Professionals Australia, *Stemming the Tide: Addressing the Attrition of Women from the STEM Workforce* **2014**.

[33] *Sexual Harassment of Women: Climate, Culture, and Consequences in Academic Sciences, Engineering, and Medicine* (Eds P. A. Johnson, S. E. Widnall, F. F. Benya) **2018** (The National Academies Press: Washington, DC).

[34] Australian Government Australian Research Council, *ARC Research Opportunity and Performance Evidence (ROPE) Statement* **2018**. Available at: https://www.arc.gov.au/policies-strategies/policy/arc-research-opportunity-and-performance-evidence-rope-statement (accessed 23 October 2019)

[35] Science and Gender Equality in Australia (SAGE) **2019**. Available at: https://www.sciencegenderequity.org.au (accessed 23 October 2019)

[36] Australian Government, *Employer of Choice for Gender Equality* **2018**. Available at: https://www.wgea.gov.au/leading-practice/employer-of-choice-for-gender-equality (accessed 23 October 2019)

[37] J. Miller-Friedmann, A. Childs, J. Hillier, *Chem. Educ. Res. Pract.* **2018**, *19*, 24. doi:10.1039/C6RP00252H

[38] K. L. Brue, *J. Leadersh. Educ.* **2019**, *18*, 32. doi:10.12806/V18/I2/R3

[39] A. Grigoryeva, *Gerontologist* **2015**, *55*, 108. doi:10.1093/GERONT/GNV503.05

[40] M. A. P. Stephens, A. L. Townsend, L. M. Martire, J. A. Druley, *J. Gerontol. B – Psychol.* **2001**, *56*, P24. doi:10.1093/GERONB/56.1.P24

[41] M. Hilbrecht, S. M. Shaw, L. C. Johnson, J. Andrey, *Gend. Work Organ.* **2008**, *15*, 454. doi:10.1111/J.1468-0432.2008.00413.X

[42] Australian Bureau of Statistics, *4125.0 - Gender Indicators, Australia, Feb 2015: PROVIDING PRIMARY CARE TO PEOPLE WITH A*

DISABILITY **2015** Available at: https://www.abs.gov.au/ausstats/abs@.nsf/Lookup/4125.0Feature+Article10009Feb%202015 (accessed 22 October 2019)

[43] Royal Society of Chemistry, *Breaking the Barriers: Women's Retention and Progression in the Chemical Sciences* **2018**.

[44] L. A. Muse, *Community Work Fam.* **2011**, *14*, 249. doi:10.1080/13668803.2011.571404

[45] F. Chung, *Why PepsiCo CEO Asks his Team to 'Leave Loudly'*. Available at: https://www.news.com.au/finance/work/leaders/why-pepsico-ceo-asks-his-team-to-leave-loudly/news-story/5467b3ffff387c3a5dd79ac3a245c868 (accessed 23 October 2019)

[46] E. M. Herndon, *Perspective.* **2016**, *94*, 30.

[47] A. Nitzsche, J. L. Jung, C. Kowalski, H. Pfaff, *Work* **2014**, *49*, 133. doi:10.3233/WOR-131643

[48] Australian Bureau of Statistics, *Barriers and Incentives to Labour Force Participation, Australia July 2016 to June 2017* **2017**.

[49] C. Solomon, *Workplace Creches: The Dream Solution to Childcare* **2015**. Available at: https://www.news.com.au/lifestyle/parenting/kids/workplace-creches-the-dream-solution-to-childcare/news-story/311d753ad309f5170612617326a1b286 (accessed 24 September 2019)

[50] Science & Technology Australia and Professionals Australia, *Annual Scientists Employment and Remuneration Survey* **2018**.

[51] Office of the Chief Scientist, *Datasheet 2. Women in STEM: A Story of Attrition* **2016**.

[52] S. Bell, *Women in Science in Australia: Maximising Productivity, Diversity and Innovation* **2009** (Federation of Australian Scientific & Technological Societies (FASTS): Canberra)

[53] E. A. Cech, M. Blair-Loy, *Proc. Natl. Acad. Sci. USA* **2019**, *116*, 4182. doi:10.1073/PNAS.1810862116

[54] University of Western Australia Equity and Diversity for the Vice Chancellor's Equity and Diversity Advisory Committee, *The Impact of a Non-Linear Career on Achievement* **2012**.

[55] E. A. Cech, M. Blair-Loy, *Soc. Probl.* **2010**, *57*, 371. doi:10.1525/SP.2010.57.3.371

[56] UN Women National Committee Australia, *Re-thinking Merit: Why the Meritocracy is Failing Australian Business* **2015**.

[57] A. E. Budden, T. Tregenza, L. W. Aarssen, J. Koricheva, R. Leimu, C. J. Lortie, *Trends Ecol. Evol.* **2008**, *23*, 4. doi:10.1016/J.TREE.2007.07.008

[58] M. A. Paludi, W. D. Bauer, *Sex Roles* **1983**, *9*, 387. doi:10.1007/BF00289673

[59] B. Probert, *Gend. Work Organ.* **2005**, *12*, 50. doi:10.1111/J.1468-0432.2005.00262.X

[60] M. Schultz, M. Coote, A. Bissember, *RACI Inclusion and Diversity: A Report on Progress.* Chemistry Australia **2019** (May/June).

[61] Monash University, *Assessing Achievement Relative to Opportunity: Evaluating and Rewarding Academic Performance Fairly* – Discussion Paper 2011.

[62] N. Klocker, D. Drozdzewski, *Environ. Plann. A* **2012**, *44*, 1271. doi:10.1068/A4547

[63] Austrlian Research Council, *Increasing Female Participation in Research* **2019**. Available at: https://www.arc.gov.au/news-publications/media/media-releases/increasing-female-participation-research (accessed 23 October 2019)

[64] Women in STEMM Australia, *The Ruby Payne-Scott Award at CSIRO* **2017**. Available at: https://womeninscienceaust.org/2017/08/21/the-ruby-payne-scott-award-at-csiro/ (accessed 23 October 2019)

[65] Australian Government Australian Research Council, *ARC Centre of Excellence Leads the Way to Create Fellowships for Women* **2019**. Available at: https://www.arc.gov.au/news-publications/media/feature-articles/arc-centre-excellence-leads-way-create-fellowships-women (accessed 23 October 2019)

[66] American Psychological Association, *Introduction to Mentoring: A Guide for Mentors and Mentees* **2006**. Available at: https://www.apa.org/education/grad/mentoring (accessed 25 September 2019)

[67] Women in STEMM Australia, *The Value of Mentoring* **2015**. Available at: https://womeninscienceaust.org/2015/05/31/the-value-of-mentoring/ (accessed 25 September 2019)

[68] J. R. Arseneau, P. A. Asay, J. D. Paquin, H. M. Walton, V. Downing, M. S. Roffman, R. E. Fassinger, *ACS Symp. Ser.* **2017**, *1255*, 145. doi:10.1021/BK-2017-1255.CH006

[69] J. D. Paquin, J. R. Arseneau, P. A. Asay, V. Downing, M. S. Roffman, H. M. Walton, R. E. Fassinger, *ACS Symp. Ser.* **2017**, *1255*, 173. doi:10.1021/BK-2017-1255.CH007

[70] R. C. Hilsabeck, *Clin. Neuropsychol.* **2018**, *32*, 284. doi:10.1080/13854046.2017.1406142

[71] D. Johnson, *Mentoring Vs. Sponsoring* **2012**. Available at: http://www.diversityjournal.com/7962-mentoring-vs-sponsoring/ (accessed 25 September 2019)

[72] S. A. Hewlett, Mentors Are Good. Sponsors Are Better. *The New York Times*, 14 April 2013; Sect. BU.

[73] L. Ehrich, B. Hansford, J. F. Ehrich, in *Practical Experiences in Professional Education: A Transdisciplinary Approach* (Eds J. Millwater, D. Beutal D) **2011**, pp. 93–113 (Post Pressed: Brisbane).