Improving the visibility of **women in STEM**

Kruti Shroti, Iona Twaddell,
Jessica Norris, Alex Dack, Wei Toh

About the London Forum for Science and Policy

The London Forum of Science and Policy is a student-led think tank founded at Imperial College, London in 2013 focusing on science policy.

Our aim is to engage scientists at the beginning of their careers, encouraging them to consider how science is used and even governed by public policy.

Supporting the expertise and creativity of our authors, our work provides not just an opportunity for early-career scientists to get involved in policy writing, but a new perspective on the latest science policy issues across the globe.

For more information on the organization, our events and commissioning policy research, please visit our website at www.lfsp.org.uk or email chair @lfsp.org.uk

Contents

1 Executive Summary

There is a well-known problem of underrepresentation of women in science. For example, only 17% of UK STEM (Science, Technology, Engineering and Mathematics) professors are women. Despite numerous initiatives, talented women still continue to leave STEM at a rate far greater than their male counterparts. This has social, scientific and economic consequences.

In this paper we put forward recommendations to address this problem within Higher Education Institutions (HEIs). Most HEIs are working hard to create a more inclusive environment, but the majority of previous research and policy has focussed on areas such as childcare, mentoring and gender bias to retain female scientists in academia. Following a literature review, a general review of Russell Group universities' policies and interviewing representatives, we put forward a number of recommendations. We suggest methods that increase the visibility of female scientists, providing role models for younger scientists and young women interested in STEM subjects. Many problems in this area have been long-identified, and there are many other good papers about how to get or keep women in STEM. We are adopting an alternative approach: our suggestions offer innovative ways to depict female scientists in a positive and professional light and aim to normalise the image of women as scientists within HEIs.

- In Part 1, we discuss how events and methods of recognition can be used to celebrate the successes of female academics in STEM and increase their visibility on campus; for example, holding events to celebrate prominent female scientists, displaying portraits of women on campus (instead of just men) and naming lecture theatres or other rooms after women.
- In Part 2, we look at how universities can help increase the visibility of female academics online by improving their equality and diversity pages and with innovative events like Wikipedia edit-a-thons aimed at addressing the lack of prominent women online.
- In Part 3, we examine how universities can support women in the media; for example, by offering media training specifically aimed at women, who often feel less comfortable talking to the media, and by ensuring that there is a sufficient representation of women on 'find an expert' lists.

All our recommendations will be easy for universities to implement and may make a real impact in providing visible high-profile female scientists that can act as role models and show that women can of course be scientists, despite any preconceptions people may have.

2 Introduction

2.1 Current situation

The scientist is stereotypically depicted as a lone, bespectacled, white lab coat-wearing male. A 2014 House of Common Report about Women in Scientific Careers states that 70% of people associate being a scientist with being a man[1]. Yet the history of Science, Technology, Engineering and Mathematics (STEM) is peppered with the work and scientific endeavours of women, from Rosalind Franklin to Dorothy Hodgkin and Marie Curie.

However, the public's perception of science as a male-dominated field is not entirely without basis. Despite numerous efforts and initiatives to improve the under-representation of women in STEM, only 17% of UK STEM professors are women[2]. In the case of physics, out of the 650 professors in the UK, only a startling 36 are women[3]. Often the term 'glass ceiling' is used to refer to the lack of representation of women at top levels of organisation. It suggests that despite women's performance being equal to their male peers, invisible factors are responsible for preventing their rise to the top. This notion of invisible factors in STEM is explored in the theory of 'gender schemas'. Schemas are hypotheses we use to interpret the world around us. They skew our perceptions and affect our judgment of people's competence and ability. Dr Virginia Valian, a psychology researcher who studies gender schemas, says men and women both share these gender schemas - it means we view men as capable and independent members of societies, whilst females are considered nurturing and communal[4] [5]. We overvalue a male's professional capabilities and underrate women's. The accumulation of these small biases over a long period of time has a devastating impact on women's careers in STEM. The resulting underrepresentation of females in STEM is not only a significant and worrying issue for equality, but has far-reaching implications for society, science and, most importantly, the economy.

The Royal Society of Edinburgh[6] estimates that doubling the contribution of women to STEM would be worth £170 million per annum to the national economy. In addition, the UK

government, along with many other countries in Europe and the US, is looking to rebuild its economy with intellect and innovation, following the financial crisis of 2008[7]. This type of knowledge-based economy will require an increase in the number of skilled scientists and engineers. This shortage of skilled STEM workers cannot be met without addressing the situation of women in STEM. Business would also benefit from a greater representation of women in STEM. Mixed gender teams bring together a greater diversity of knowledge and social capital that are vital for innovation. Studies have shown that women can significantly impact on the robustness of policy decisions and research innovation[8]. At UCL, it was found that the presence of female professors not only positively affected female students, but also male students, improving the workplace for all[9].

Crucially, the under-representation of women in STEM represents a substantial loss of talent. It limits our potential research base and intellectual capital. It can skew and influence the nature and results of science, biasing our understanding of phenomena. The process of knowledge production has been shown to differ under male and female leadership. For example, the prevalence of male researchers historically is considered to have resulted in a bias towards male medical models e.g. our understanding of pain is based on male rat models and calculations of radiation dosage are based on the average middle-aged man[10]. In the context of healthcare, this can have major implications for therapy and diagnosis. STEM skilled women are a valuable asset to this country, and failure to recognise this threatens the quality of UK science and the prosperity of its economy.

However, few women remain in positions of power higher up the hierarchy within science institutions. In STEM subjects, 73% of female graduates leave research compared to 48% of male graduates[11]. Consequently, current schemes to inspire young girls to choose STEM subjects are commendable, but such efforts are wasted if women are then disproportionately disadvantaged in pursuing a scientific career. The retention of women in STEM requires serious attention. Science and technology experience a high attrition rate of highly trained women throughout the academic career structure. As demonstrated in Figure 1, while 47% of GCSE physical science students are girls, only 10% continue to become professors.

This picture is mirrored across the sciences, even in those disciplines traditionally regarded as more ‘feminine’. For example, in biological sciences, while 57% of the students taking it at A Level are female, only 26% of professors are women[12]. This disproportionate loss of women

throughout academia is termed “the leaky pipeline”. At every step of the career ladder, from post-graduate through to professor, a larger proportion of females are lost than males, resulting in the under-representation of women in top positions and a large financial cost in wasted training.

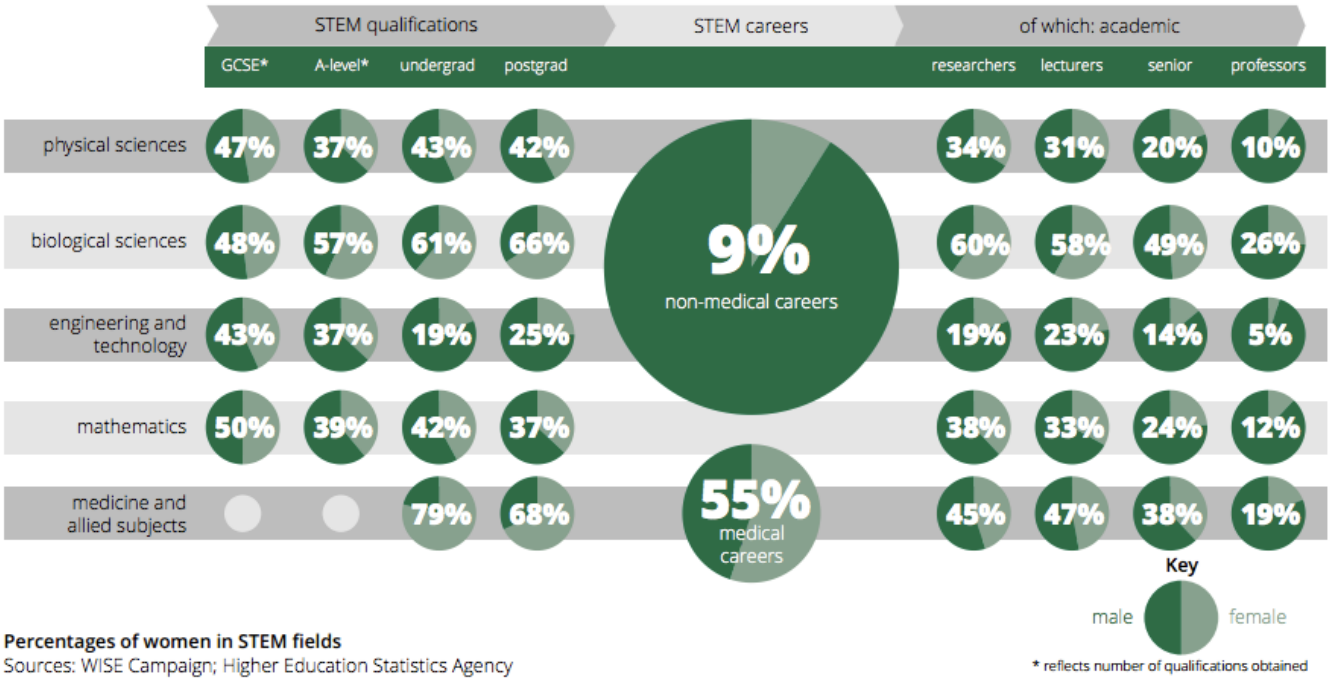

***Figure 1**- Scienceogram, Percentage of women in STEM fields*[13]

This picture is mirrored across the sciences, even in those disciplines traditionally regarded as more ‘feminine’. For example, in biological sciences, while 57% of the students taking it at A Level are female, only 26% of professors are women[14]. This disproportionate loss of women throughout academia is termed “the leaky pipeline”. At every step of the career ladder, from post-graduate through to professor, a larger proportion of females are lost than males, resulting in the under-representation of women in top positions and a large financial cost in wasted training.

Current efforts to re-adjust the gender bias in science have centred on the recruitment of females to science. Initiatives like the Women in Science Engineering (WISE) Campaign[15], Science Grrl[16], STEMettes[17] and STEM access grants all have yielded benefits and we are now

starting to see an improving picture[18]. The Athena SWAN charter, a national scheme launched in 2005, has also had a significant impact on universities' equality policies. The charter aims to "encourage and recognise the commitment of advancing the careers of women in Science, Technology, Engineering, Maths and Medicine (STEMM) employment in higher education and research"[19] It takes into account the representation of women, the progression of students into academia, and the working environment for all staff. The charter grants HEI awards of bronze, silver and gold based on their increasing levels of good practice of recruitment, retention and promotion of women in STEMM. Most universities now aim for recognition by Athena SWAN; currently there are 129 Athena SWAN members in the UK.

A number of reports by Government and scientific charities have studied the gradual loss of women from science, identifying a variety of factors. Practical issues, such as childcare and the insecure nature of science careers, have been found to be major factors and these are theoretically easy to address, given the political will[20]. However, the Government[21] and the Wellcome Trust [22] identify that the fundamental underlying barrier derives from the culture within science that lends to unconscious gender bias. The source of gender bias cannot be mitigated by simple measures, such as recruitment training and changing interview panels. In our current state, it is estimated that it will take 50-80 years before we get gender equality[23]. The UK needs a step-change in the culture, attitudes and perceptions that surround women in STEM. This is a view supported by the UK Research Council, which has mandated that all those in receipt of Research Council funding promote and lead cultural change within science[24].

2.2 The aims of our paper

Many studies conclude that ultimately an overhaul of the male dominated culture pervading universities and HEI is required. While many recognise this as crucial to averting the loss of female STEM academics, few explore how this could be realised. Our paper considers how this may be achieved by offering alternative recommendations to plug the gaps that exist within the current framework of STEM initiatives. Part of the culture arises from a lack of visible female presence in STEM. This is confirmed by a report by the Russell Group universities that identified one of the reasons for underrepresentation of women in STEM as the lack of female role models and prominent, successful senior women[25]. This unconsciously influences the confidence and beliefs of current female academics. Subverting the stereotype of the male scientist can improve women's work: Good, Woodzicka and Wingfield[26] found that when girls

were shown pictures of female scientists, rather than the stereotyped male scientists, they better understood the accompanying text about chemistry.

Our paper is based on the belief that, by highlighting STEM women's successes and by celebrating their achievements, we can begin to address and change the culture. Yet, we are aware that this culture of gender bias and embedded male dominance extends far beyond the confines of the laboratory. It encompasses all of society and underpins the wider problem of discrimination that women experience throughout the workplace[27]. However, to consider this would be far beyond the remit of our paper, and would require a revolution in mind-set for all. Our paper is firmly concerned with the issue of women in STEM and intends to provide achievable recommendations, hence our suggestions apply only within the academic settings. We regard universities and Higher Education Institutions (HEIs) as best-placed to implement our recommendations and we direct our paper for their attention. As the UK Government itself[1]recognised in its report, many of the issues surrounding the retention of women in STEM careers fall under the jurisdiction and responsibility of universities, not government. We believe that HEIs, as they are ultimately the employers of STEM academics, are best placed to change the perception of women in science and pervading cultural beliefs, which will help redress the current gender imbalance.

Promoting the visibility of female academics is a simple way of helping to break down the unconscious gender bias that works against women in STEM academia. By promoting visibility in the right way - a way that portrays female academics in a positive and professional manner - we may facilitate a culture in which women are recognised as worthy scientists, on an equal platform with men.

In line with this, we have split our paper into the following sections:

- In **Part 1**, we discuss how events and accolades can be used to celebrate the successes of female academics in STEM and increase their visibility on campus.

- In **Part 2**, we look at how universities can help increase the visibility of female academics online.

- In **Part 3**, we examine how universities can support women in the media.

In each section, we explain why each issue is important and why we think it can help change current cultural attitudes which work against women in STEM academia. We also draw out several recommendations, which are based on some best practice examples we have come across in our research.

There is a great deal that our paper does not explore. We have limited our paper by focusing on means of increasing the visibility of women in STEM academia, and as such have forgone research into some areas that are nevertheless key to the wider discussion. These areas include mentoring schemes for women, family-friendly and childcare policies, and gender bias training. We feel they have been sufficiently addressed in universities or elsewhere and much more is known about them[28] [29].

Despite focussing on the retention of talented women at the postgraduate level, we are aware that our recommendations will benefit the recruitment of women to science generally and complement existing efforts to make science appealing to young girls. We also recognise that there is an obvious problem with diversity beyond gender within British academia. For example, only 6% of UK STEM academics are from a BAME (Black, Asian and Minority Ethnic) background. Research has shown that focussing on diversity in one area can help in other dimensions[30]. Hence, although our paper focuses on gender equality, our recommendations may be applicable [31]to other campaigns for equality, along axes such as race, sexuality and disability[32].

More importantly, the belief and intention of our paper is that policies that benefit women will benefit men too. We are keen to assert that our paper does not promote the special treatment or singling out of women. In line with the UN HeForShe[33] campaign, our recommendations aim to benefit and include both men and women. For we are aware that a step-change in culture within academia and wider society will require the effort and inclusion of all. Our hope is that through highlighting women's success and celebrating them, we may begin the transformation of the institutionally sexist nature of science, technology, engineering and maths, encouraging women to pursue a research career to the highest level.

3 Part 1: Increasing the visibility of female academics on-campus

3.1 On-campus Events

On-campus events are an excellent way of increasing the visibility of female academics and can be relatively simple to organise. Most universities already hold events to this end at some point during the year, with internationally recognised days such as 'International Women's Day' and 'Ada Lovelace Day' providing a clear impetus.

We would like to encourage university officers, staff and students to put on more events that highlight the achievements of female academics and celebrate their successes. In this section, we describe some of the best events we have come across in our research, in the hope that they might become more widely adopted or used as inspiration for similar events. Some events have been highlighted because they are relatively simply to hold, and others have been highlighted because we view them as innovative, high-impact events that may significantly benefit from university support and involvement.

Annual Lecture Series

Given the function of a university, lectures serve as a relatively simple way of holding a potentially high-profile event. Many universities hold a lecture to mark International Women's Day.[343536] These lectures both raise awareness of issues around gender equality and celebrate the successes of women in academia. Furthermore, they give women the opportunity to speak at high-profile events, which help increase their confidence in speaking to large audiences. This may make them more inclined to speak to the media, which in turn helps raise the visibility of women in the public eye (refer to Part 3 for more details).

As an example, the University of Edinburgh has been holding a lecture given by an inspirational female academic every year since 2010. This year's lecture, called 'Make it Happen: Women into Science', was given by Professor Anneila Sargent, former President of the American

Astronomical Society and advisor to the White House. We encourage universities to hold lectures that showcase inspirational female scientists to help increase the visibility of women in STEM.

Women of the World Festival

The "Women of the World", or WOW, festival is "a festival of talks, debates, music, film, comedy, performance and conversations that celebrates the talents of women and girls from all walks of life and all parts of the world".[37] It is a global festival that has launched in three continents since its inception in 2011, with the hope that it will continue growing. In March 2015, the University of Cambridge partnered with Southbank Centre London to hold a WOW festival in Cambridge. WOW hope that they can spread to 12 location across the UK by 2018 and universities can potentially make a significant contribution to the growth of WOW by offering their support.

Soapbox Science

'Soapbox Science' is an initiative started in 2013 by Dr Seirian Sumner, a senior lecturer from the University of Bristol, and Dr Nathalie Pettorelli, a research fellow from the Zoological Society of London. It describes itself as "a novel public outreach platform for promoting women scientists and the science they do".[38] The event invites female scientists to talk about their research to passers-by in an open public space, such as a park, in an informal and interactive fashion.

The event was first held in London in 2013, but since then has expanded to other UK cities including Swansea, Bristol and Dublin. Its informal, grass-roots approach has been well-received and deemed a successful approach for increasing the visibility of female role models in science to the general public.[39] We suggest that this might be adopted by universities as a simple but effective model for showcasing the research and achievements of their female academics.

3.2 Portraits and Methods of Recognition

While events can help increase the visibility of women in a high impact manner, they are temporary. Thus, we deem it equally important to use more permanent and lasting methods of increasing the visibility of women alongside this.

In this section, we consider how using portraits, photographs and other methods of recognition to highlight women's achievements can be a simple way of fostering a culture of gender equality. These honours are typically given to historical figures, a large proportion of whom are men. This means that most of the portraits that adorn the walls of a universities are male and most of the lecture theatres in a university are inevitably named after men. This imbalance contributes to creating a culture of gender schemas which favour men in academia. In this section, we encourage universities to counteract this imbalance by taking simple steps such as those described in the examples below.

Portraits of Women

In 2012, the University of Sheffield established their "Portrait of a Woman Prize". This prize asks colleagues from across the university to nominate women whom they admired or who had inspired them, whose portrait they would like to see in a prestigious place in the university. As a result, 28 female members of staff saw their portraits unveiled during a celebration in October 2012. The prize was set up by Rosie Valerio on her retirement from the university as HR Director, using the donations made by her colleagues for her retirement collection.

In September 2014, Hertford College in the University of Oxford removed its all-male portrait collection from the Great Hall and replaced it with an all-female portrait collection. The twenty-one women depicted in the portraits were chosen on the basis of nominations from staff, students and alumni.[40]

Imperial College London have held more than one exhibition aimed at improving the visibility of women. In 2009, the university's WSET (Women in Science, Engineering and Technology) group ran a portrait series called "100 Women - 100 Visions", which comprised of 100 photographic portraits celebrating women scientists and engineers across the university.[41]

These portraits were hung up in the College Main Entrance in support of International Women's Day that year. More recently, Imperial College London held a "Women@Imperial" exhibition, launched in March 2015, to celebrate International Women's Day, for which a number of photographs of female staff were prominently displayed in the College Main Entrance.[42] A similar initiative, called 'Meet the Professors' was launched in November 2014 by King's College London, for which personal commentaries accompany each portrait of the university's female professors.[43]

Finally, the University of Virginia launched a photography project in 2012 called the "U.Va. CHARGE Portraiture Project", in which portraits were taken of women in academia at every stage of their career.[44]

All of these are powerful methods of creating visible and realistic role models for aspiring female scientists, in addition to endearing the university staff and students to and familiarizing them with their in-house female academics.

Other Methods of Recognition

Although portraits are a very visible means of recognising an individual's achievement, there are also other simple methods that can be used to recognise and celebrate women. For instance, naming lecture theatres after important women can contribute to increasing the visibility of female academics, particularly given how these are key and central places, frequently used and referred to by staff and students alike. This can be extended to faculty buildings or even student halls of residence.

This strategy has been adopted by the Institute of Physics, whose main rooms in its headquarters in Portland Place are all named after female physicists. We encourage universities to pay particular consideration to female academics when awarding such honours.

In addition, universities often publish or produce their own media in the form of magazines and podcasts or videos, targeted at staff and students of the school. More coverage can be given to female scientists of note within the university through interviews, whether casual or formal, in these media.

3.3 'Women in Science' Officers

We understand that finding the time and capacity to organise the initiatives described in this section of the paper can be a challenge. From our research, we have seen that some university departments have posts to oversee these activities in the department and promote female academics. For example, the University of Sheffield's Engineering Faculty have appointed Dr Rachel Elder as their Director for Women in Engineering.[45] As well as ensuring there is someone to oversee and encourage 'women in science' activities on-campus, the existence of the role itself helps raise awareness of the need for more women in science to all those who come across it.

3.4 Recommendations

- Organise regular events that highlight the achievements of female academics and celebrate their successes.
- Ensure that women's achievements are memorialized and celebrated through honours such as portraits, photographs and lecture theatre names.
- Create a Women's Officer role in faculties or departments to direct the on-campus initiatives that promote female academics.

4 Part 2: Increasing the visibility of female academics online

4.1 University Websites

A simple way by which universities can help raise the visibility of its female academics is through its website. Equality and diversity initiatives mean that there is already widespread awareness of the importance of including pictures of a diverse range of the population on websites. Furthermore, all universities we have come across in our research (which includes all of the Russell Group universities) have an equality and diversity section on their website, where they detail their initiatives to support women in the workplace and emphasise the university's work towards achieving the Athena SWAN awards.

However, some of the pages dedicated to promoting women in STEM are not kept up-to-date. We understand that it is difficult to keep websites updated, especially when the digital nature of the current environment means that there are so many. However, we encourage universities to keep them updated as best as possible, as they are an accessible way of raising the visibility of female academics to a wider audience.

We have also noticed that individual departments tend to have their own website and we would like to encourage science departments to attribute some of their web space to encouraging girls and women into their subject. A number of departments already do this, and we have identified the University of Bristol's engineering faculty website as a good example.[46] This has a series of webpages dedicated to events, awards, news and female staff and student views.

Finally, we would like to emphasise how effectively websites can be used to increase the visibility of women in academia. To accompany their 'Meet the Professors' photographic frieze, King's College London put together a series of web pages about the initiative to go in the equality and diversity section of their website.[47] The first page of the series is made up of photographs of the female professors that comprise the on-campus frieze and the rest of the pages include a Q&A from the professors about their experiences of being a woman in academia. It is visually memorable and we consider it very effective in raising the visibility of female academics and the issue of gender inequality in general.

4.2 Raising the profile of female scientists through Wikipedia

Wikipedia is often the first stop for someone looking for information online and yet, even on here, there is a serious problem of underrepresentation of women in STEM. However, as Wikipedia is an open-source website, this is something that can be fixed, and events known as 'Edit-a-thons' have been used to do just this.

A portmanteau of the words "edit" and "marathons", edit-a-thons are meet-ups arranged for members of particular groups to mass edit Wikipedia article content in order to meet some imposed standard. Edit-a-thons with the special purpose of increasing the visibility of women in STEM have already been organised and held by a number of institutions, including the University of Oxford[48], the Royal Society[49] and the Royal Academy of Engineering.[50] These events have endeavoured to improve the visibility of women in STEM in Wikipedia articles by substantiating existing entries on women in STEM or adding new entries.

The University of Oxford set up the event so that it took place over a three-hour period. Those who had volunteered to be part of the initiative received a brief training session at the beginning of the event, and then spent the remaining hours improving the content of 15 Wikipedia articles and creating 7 new ones, all on women in STEM. Using this and other edit-a-thons as a model, we encourage universities to hold such events, as a means of increasing the visibility of women online.

4.3 Recommendations

- Ensure that online equality and diversity pages are kept up-to-date.
- Ask individual science departments within a university to dedicate some of their web space to encouraging women into their field of study.
- Help address the gender imbalance across online content by, for example, holding edit-a-thons to raise the profile of female scientists on Wikipedia.

5 Part 3: Increasing the visibility of female academics in the media

There is a fundamental lack of female academics present in the media. The Government recognised the lack of female experts in the media in a 2015 report from the House of Lords Select Committee on Communications[51]. In this section, we look at two ways in which universities can help: firstly, by helping the staff become more confident in front of the media, and secondly, by ensuring that they are accessible to the media.

Female scientists are under-represented in the media, even taking into account the low numbers of women at a high level in science. From an analysis of British newspapers in 2006, Chimba and Kitzinger[52] found that only 16% of scientists profiled in the media were female, with half of the articles about women referring to their appearance compared to only 21% of those profiling men. As the researchers argue: “Our overview of newspaper coverage documents the fact that there is a scarcity of profiles of women scientists in the press—which, even if it reflects the reality of gender inequality in the field, may also help to perpetuate it” (p. 13).

More recently, the Jones report, looking into BBC science output in 2011[53], showed a lack of female scientists on BBC programmes. For example, on Material World (Radio 4), only 1 in 12 interviewees were female. Only 1 of 20 Horizon episodes examined was presented by a woman. An appendix to this report[54] found that on BBC news items, only 17% of those who appeared to have scientific expertise were women. Of those introduced as professors, 11% were women. For the contributors with no professional experience, around half were women, suggesting that women could be heard as lay voices, but not as experts. Similarly, for non-news items sampled, only 20% of contributors with scientific expertise were women, with women more likely to be lay voices than men.

It is key to note that there are women interviewed in the media, but fewer of them are portrayed as experts. Despite being a problem for all female experts, this is especially concerning for STEM subjects, in which there is already a lack of women.

On top of the under-representation issue, there is a perspective problem with the representation of female scientists in the media. When female scientists appear in the media, the reporter has a habit of focusing on their appearance, often sexualising them in a way that does not happen with male scientists[5556]. The media is important in influencing perceptions of a particular profession, and can be a source of 'role models'[57], making the distortion of female scientists an unwelcome addition to the already worrying problem of underrepresentation.

5.1 The role of universities

There are two issues causing the lack of female scientists' representation in the media: a lack of women in STEM fields in general (which universities recognise well) and the fact that women tend to be less confident about engaging with the media (an issue that universities have not addressed as much). There are measures that universities can take to tackle the latter issue, ensuring their female academics are confident enough to speak to the media and accessible to journalists.

Boyce and Kitzinger[58] found that press officers in STEM organisations did not see it within their remit to promote women in STEM, focussing instead on prioritising their area of science, especially when their deadlines were tight. However, press officers should be aware of the influence of their role in this matter. The idea of having a database of female experts on hand, as discussed below, is something that may be particularly relevant for them.

It is important not to consider the lack of confidence as 'women's problem'. Boyce and Kitzinger[59] argue that men often put themselves forward more assertively, with old boys' networks excluding women. In addition, sexist representations of women in the media means that some women may be concerned that they will be misrepresented. Some interviewees also identified an 'alpha male' or 'bullying' culture in STEM, which could discourage women.

Anecdotal reports also suggest that there is a 'laddish' culture around science on television in particular, with men being more assertive and likely to interrupt[60], a particular problem in debates. Even if men are also nervous, the perception of having an assertive opponent puts women off working with the media and, as such, measures should be taken to increase women's confidence.

Some media organisations have started taking measures to address this problem. While it would require a large culture shift within the media to ensure that female scientists are represented in the same way as male scientists, universities and STEM organisations can make the voice of female academics heard with several relatively easy measures. These measures would increase the visibility of female researchers and hopefully encourage other women to speak to the media, as well as reducing stereotypes of the scientist as male.

Julia Barry, Director of Media Woman, summarised the issue well: "It's vital that women take part in the big public debates on the future of science and technology. Their voices need to be heard, and they need to be providing a positive role model to future generations - thereby challenging the stereotyping of career options for young women."

5.2 Media training

Media training can help women to overcome the barriers that they perceive. These training sessions mainly serve to increase the confidence of women, meaning they are more likely to agree to talk to the media in the future.

The BBC has started this by setting up the Expert Women initiative in 2013. They ran training days for female experts in areas where women are underrepresented in the media[61]. They now have a database of contributors based on these training days. This was overwhelmingly popular, with 2,000 applicants for 30 initial places[62]. Universities and STEM organisations can carry out similar initiatives for scientists.

Promoting the transferable skills associated with working with the media could encourage more women to take part and the training does not need to be media-specific. Any training for women at all levels of public speaking would increase their confidence in talking to the media. As Boyce and Kitzinger[63] argue, since public speaking can be a gateway into the media, ensuring there are spaces for women to speak at high profile public events could give female scientists the confidence to engage with the media later on.

These training days can also be a way for female researchers to network with other prominent women, something they may not be able to do in their day-to-day work. One important issue to

note is that women at different stages of their careers may have different requirements from training. For example, more senior researchers may be more likely to require television media training, whereas early-career researchers are more likely to be contacted by print media. Furthermore, senior fellows may feel uncomfortable in training with earlier-career researchers, as they may feel that they should be figures of authority. For example, a conversation with Nick Hillier, Communications Director from the Academy of Medical sciences, informed us that senior researchers felt uncomfortable with the training sessions offered by their institutions because they were mixed with early-career researchers. This may also be linked to increased sexism in the media with regard to older women. The more senior researchers also felt that they were representing their institutions more than their early-career colleagues, providing an added pressure.

Some universities, such as Stirling, put increased media training for women in their equality and diversity action plan[64], but this is rare. Some are using media training for women as part of their Athena SWAN applications, but a more widespread concerted effort from universities is needed.

Several media training courses for female scientists exist, largely run by external organisations. For example, the Academy of Medical Sciences partnered with Media Woman to offer media training to their senior fellows and separately for their early-career researchers. The Academy has around 1100 fellows, 200 of which are women. They have run three sessions so far for their female fellows.

The training sessions involved a day-long practical workshop, focussing mainly on broadcast skills in professional studios used by major TV networks. This was useful for senior researchers as they are more likely to be invited on television. Being an exclusively female session meant that women could ask questions that they may not have felt comfortable asking if men were present: for example, what they should wear or how they should do their make-up.

The feedback from these training days indicate that the main outcome was an increase in the confidence of the women who received the training. An additional outcome was that participants enjoyed spending a day with other female senior academics. This would be rare for them in their everyday lives.

Additionally, Screenhouse hosts public speaking and communication masterclasses[65] and have trained almost 600 women so far. Unlike Media Woman, they mix groups between graduate

students and professors, with 21 women in total, which has its pros and cons. Splitting the groups makes senior fellows feel less vulnerable as they are among peers with similar levels of experience, but grouping them together gives the younger researchers role models to look up to that they may not see in their normal working life.

Screenhouse launched their public speaking and communication course in 2013. The course included guidance from scientist and TV presenter Dr Maggie Aderin-Pocock. The day started with a talk by Dr Aderin-Pocock, who acted as a role model for the attendees. Attendees then learned how to present a scientific paper to a general audience. There are various workshops throughout the day, including a session with a boardroom voice coach and the chance to be on camera three times. This meant that participants could increase their confidence as the day went on and could see noticeable improvements. These sessions were not limited to women, and a couple of men went to one training session. As men were in the minority, it gave the women confidence and opened the men's eyes to how the women felt at work every day. Screenhouse have been appointed as media skills trainer for the Royal Society, which will be mixed groups of fellows.

While the training is focussed on television and radio, it gives female scientists the skills needed to raise their profiles and talk to a wide range of audiences in general. Women reported in feedback from the sessions that the positive effects of the session were not limited to media, but ranged across the spectrum of public speaking, from speaking at a large conference and being in television or radio to getting funding.

SciConnect also developed a training course in 2013[66], which dealt with issues of media portrayal and how to communicate effectively with the media. Although it was designed for early career female researchers, both women and men were welcome to attend. The course included a recording session at BBC Broadcasting House. This was in association with Imperial College, London, University of Warwick and Quercus training. They ran another session in 2014[67] sponsored by the Royal Academy of Engineering, EPSRC, the Royal Society of Chemistry, the Institute of Physics and the University of Warwick. This was a residential course, with many sessions held over two days. Feedback suggested increasing the length of the course as attendees felt that it was rushed. This would allow the practical skills of radio and TV to be fully developed. However, one day courses seem to boost women's confidence equally well and they are more labour- and cost-effective. Therefore, one day courses could be more effective than residential courses. In addition, this particular course also developed skills in production, rather

than focussing on TV and radio appearances, which is perhaps less necessary. These training sessions are available for women in STEM and universities are in a great position to help women to utilise these opportunities. However, they can be fairly expensive so having a dedicated fund towards these media training sessions could be beneficial.

Recommendations for designing a media training session:

- Creating an all-female environment allows women to ask more questions and feel more comfortable, as well as providing a unique networking event for them.
- A realistic setting, such as a real TV studio, rather than an ordinary room is useful for developing the practical skills.
- Media training should be tailored towards each career stage, as researchers at different stages will have different needs.
- Press officers at universities may not be utilising women that attend these training sessions. Creating a database of women who have had specialist training would allow them to use their new skills. Additionally, proactively engaging journalists with these women would allow them to practice their skills and make more media appearances.

Feedback from various training sessions suggests that the main benefit of media training was increasing the confidence of female researchers, which not only improved their ability to talk to the media, but gave them skills for their everyday working lives.

5.3 Database of experts

Many press office teams in universities currently maintain a database of experts available for media comment. Ensuring strong representation of high-ranking female academics, with or without media training, on these databases could ensure that more female academics are represented in the media. Using databases to increase the visibility of women in the media has already been suggested in the past. In their recent report, the House of Lords Select Committee on Communications recommended that broadcasters should create internal databases to ensure enough female experts in the news, using external databases if necessary[68].

These expert databases exist outside universities as well. The Women's Room[69] and HerSay[70] are websites that list female experts available for the media. However, anyone can list themselves as an expert on these websites, whereas journalists look for experts approved by a university or credible STEM organisation. This is why databases of experts from professional STEM organisations or universities give extra credibility and can be very useful for making female scientists accessible to the media.

Additionally, while universities are using media training now, there are some concerns from those running the media training sessions that they are not taking advantage of the media-trained women effectively. Institutions should harness the empowerment of the women and link it to expert databases. Press officers should be made aware of these training sessions so they can add these women to their databases and ensure that they have the opportunity to speak to the media. Additionally, though it is time-consuming, proactively pushing these media-trained women to journalists could increase their profile and give the media confident women to speak to. This would make sure that these skills are used and female scientists are better represented in the media, providing role models and challenging the stereotype of the scientist as male. Therefore, as well as making sure expert databases represent women sufficiently, we recommend a subset of this database should list media-trained women. If possible, press officers should proactively push these women to the media.

5.4 Recommendations

- University press offices should ensure a good representation of female academics on their 'find an expert' databases.
- University press offices should offer or find media training, specifically targeting women.
- University press offices should ensure these skills are used, either by creating a database of media-trained women or proactively engaging the media with trained women.
- Ensuring women are invited to speak at high profile events can increase their confidence in public speaking and make them more likely to speak to the media.

Of these recommendations, media training would probably be the most effective, as it can give women the confidence to engage with the media, which is one of the barriers to engagement, especially among senior scientists. This is starting to happen within universities, but having a dedicated fund towards it would be useful.

6 Conclusion and Summary of Recommendations

As we have shown, there is a problem with the representation of women within STEM. We believe that universities can take measures to make high-profile female scientists more visible to provide role models for younger scientists and tackle the gender schemas that discourage women from entering and staying in STEM academia. Women are a vital asset to UK science and to ignore their under-representation is to undermine our future scientific potential. We need to address the loss of women from science to meet future demands in a knowledge economy.

We believe the current male dominance found in STEM academia can change - this will not only involve physically implementing changes but will also require a transformation in culture. We offer practical means by which HEIs can begin to achieve a change in the pervading beliefs, ethos and traditions surrounding STEM. By celebrating the involvement and presence of women in science, we propose a positive and inclusive structure through which we can highlight science as an equally female endeavour.

Gender equality is on the agenda across the world, and our suggestions feed into this wider change in discourse and culture. Universities hold a central position within this culture and, therefore, are a key stimulus for changing the attitudes towards women in STEM.

Summary of recommendations

Part 1: On-campus visibility of women

- Organise regular events that highlight the achievements of female academics and celebrate their successes.
- Ensure that women's achievements are memorialized and celebrated through honours such as portraits, photographs and lecture theatre names.
- Create a Women's Officer role in faculties or departments to direct the on-campus initiatives that promote female academics.

Part 2: Online visibility of women

- Ensure that the online equality and diversity pages are up-to-date.
- Ask individual science departments within a university to dedicate some of their web space to encouraging women into their field of study.
- Help address the gender imbalance across online content by, for example, holding edit-a-thons to raise the profile of female scientists within Wikipedia.

Part 3: Female scientists in the media

- University press offices should ensure a good representation of female academics on their 'find an expert' databases
- University press offices should offer or find media training, specifically targeting women.
- University press offices should ensure these skills are used, either by creating a database of media-trained women or proactively engaging the media with the women.
- Ensuring women are invited to speak at high profile events can increase their confidence in public speaking and make them more likely to speak to the media.

Acknowledgements

Thank you to Nick Hillier, Barbara Govan, Felicity Mellor, Julia Barry and Bryony Merritt for their assistance on our 'Media training' section.

References

[1] House of Commons Science and technology Committee. 2014. *Women in Scientific Careers; Sixth Report of Session 2013-2014:* UK.
[2] ibid
[3] The Royal Society of Edinburgh, 2012. *Tapping all our talents, Women in Science Engineering and Mathematics: A Strategy for Scotland*
[4] Valian, V. 1999. *Why so slow? The Advancement of women*, The MIT Press.
[5] Valain, V. 2004 "Beyond Gender Schemas: Improving the Advancement of Women in Academia", *NWSA Journal*, vol 16, 1, p.207-220
[6] The Royal Society of Edinburgh, 2012. op. cit.
[7] Cable, V. Innovation and the UK's Knowledge economy. Mazzucato conference July 2014 London. Department for Business, Innovation and Skills.
[8] House of Commons Science and technology Committee 2014. op. cit.
[9] House of Commons Science and technology Committee 2014. op. cit.
[10] ibid
[11] Royal society of Edinburgh op.cit.
[12] CaSE. May 2014. *Improving Diversity in STEM.*
[13] CaSE, 2014. op. cit.
[14] ibid
[15] WISE, 2013, Annual Report 2013/2014 [Online] Available : http://wise.statementdigital.com/about-us/annual-reports/2013-2014-annual-report [Accessed 7/5 2015]
[16] Science GRRI 2015 Annual Report 2014/2015 [Online] Available : http://sciencegrrl.co.uk/assets/sciencegrrl_annual_report_2014-15.pdf [Accessed 7/5 2015]
[17] STEMettes Our story [Online] Available: http://www.stemettes.org/about-us#story [Accessed 7/5 2015]
[18] CaSE op. cit.
[19] Athena Swan Charter [Online]. Available: http://www.ecu.ac.uk/equality-charters/athena-swan/ [Accessed 20/5 2015].
[20] Nature 2013 Science for all, [Online]. Available: http://www.nature.com/news/science-for-all-1.12535 [Accessed 8/5 2015]
[21] House of Commons (ed.).2014. *Women in Scientific Careers: Government Response to the Committee sixth report of the session 2013-2014*.London.
[22] House of Commons Committee on Science and technology. 2013. *Women in STEM careers- response by Wellcome Trust.*
[23] House of Commons 2014 op. cit
[24] ibid
[25] Russell International Excellence Group. 2013 *The House of Commons Science and technology select Committee Inquiry into Women in STEM careers. Evidence from Russell Group Universities*.
[26] Good, J.J., Woodzicka, J.A. & Wingfield, L.C. 2010. The Effects of Gender Stereotypic and Counter-Stereotypic Textbook Images on Science Performance. *The Journal of Social Psychology, 150 (2),* pp.132-147.
[27] Investor in People. 2015 *Creating inclusive and diverse workplaces Employees' views on gender discrimination*
[28] CaSE, op.cit.
[29] Science GRRL. 2014. *Through both eyes: The case for a gender lens in STEM.*
[30] CaSE, op. cit.
[31] United Nations, 2014, Equality for women means progress for all [Online] Available : http://www.un.org/apps/news/story.asp?NewsID=47308#.VYPGL_lVhBd [Accessed 19/6 2015]
[32] Jones, P. & Elias, P. 2005. *Science, engineering and technology and the UK's ethnic minority population*. Warwick Institute for employment research.
[33] United Nations Women 2014 HeForShe [Online]. Available: http://www.heforshe.org/ [Accessed 12/04/2015 2015].

[34] The University of Edinburgh. 2015. International Women's Day Annual Lectures. [ONLINE] Available at: http://www.ed.ac.uk/equality-diversity/innovation-development/international-womens-day. [Accessed 18 May 15].
[35] The University of Oxford. 2014. International Women's Day. [ONLINE] Available at: http://www.admin.ox.ac.uk/eop/gender/internationalwomensday. [Accessed 18 May 15].
[36] The University of Nottingham. 2015. International Women's Day 2015 public lecture - geographer without a roadmap. [ONLINE] Available at: http://www.nottingham.ac.uk/home/events/international-womens-day-2015-public-lecture-geographer-without-a-roadmap.aspx. [Accessed 18 May 15].
[37] University of Cambridge. 2015. Women of the World Cambridge. [ONLINE] Available at: http://www.wowcambridge.cam.ac.uk/what-wow. [Accessed 18 May 15].
[38] Soapbox Science. n.d. Soapbox Science - Home. [ONLINE] Available at http://soapboxscience.org. [Accessed 18 May 15].
[39] Nature. 2013. Positive Thinking (Editorial), *Nature Reviews Microbiology*, 11, 593
[40] Hertford College. 2015. Hertford College Women: portrait display. [ONLINE] Available at: http://www.hertford.ox.ac.uk/hertford-college-women-portrait-display. [Accessed 18 May 15].
[41] WSET. n.d. 100 Women, 100 Visions. [ONLINE] Available at: https://www.union.ic.ac.uk/scc/100women100visions/about.html. [Accessed 18 May 15].
[42] Imperial College London. 2015. Women@Imperial exhibition 2015. [ONLINE] Available at: http://www.imperial.ac.uk/staff/imperial-women/exhibition2015/. [Accessed 18 May 15].
[43] King's College London. 2015. King's College London - Visit the Frieze. [ONLINE] Available at: www.kcl.ac.uk/aboutkings/governance/equality/meettheprofessors/visit.aspx [Accessed 19 May 15].
[44] University of Virginia. 2015. U.Va. CHARGE Initiatives. [ONLINE] Available at: http://advance.virginia.edu/initiative2.html. [Accessed 20 May 15].
[45] University of Sheffield. 2015. About the Portrait of a Women Prize. [ONLINE] Available at: www.sheffield.ac.uk/hr/equality/femaleprogression/portraits/about. [Accessed 18 May 15].
[46] University of Bristol. 2015. Women in Engineering. [ONLINE] Available at: http://www.bristol.ac.uk/engineering/women/. [Accessed 18 May 15].
[47] King's College London. 2015. King's College London - Meet the Professors. [ONLINE] Available at: http://www.kcl.ac.uk/aboutkings/governance/equality/meettheprofessors/index.aspx. [Accessed 19 May 15].
[48] Lindsay. 2013. Ada Lovelace Day at Oxford. [ONLINE] Available at: https://blogs.it.ox.ac.uk/adalovelace [Accessed 19 May 15].
[49] Wikipedia. 2015. WikiProject Royal Society/Women in Science Wikipedia Edit-a-thon at the Royal Society, March 2014. [ONLINE] Available at: http://en.wikipedia.org/wiki/Wikipedia:WikiProject_Royal_Society/Women_in_Science_Wikipedia_Edit-a-thon_at_the_Royal_Society,_March_2014 [Accessed 19 May 15].
[50] Royal Academy of Engineering. n.d. Wikipedia Editathon for Women in Engineering. [ONLINE] Available at: www.raeng.org.uk/events/list-of-events/2014/june/wikipedia-editathon-for-women-in-engineering [Accessed 19 May 15].
[51] House of Lords Select Committee on Communications, 2015. *Women in news and current affairs broadcasting*. London: The Stationery Office Ltd.
[52] Chimba, M. & Kitzinger, J., 2009. Bimbo or boffin? Women in science: an analysis of media representations and how female scientists negotiate cultural contradictions. *Public Understanding of Science*, pp.1-16.
[53] BBC Trust, 2011. *BBC Trust review of impartiality and accuracy of the BBC's coverage of science*. London: BBC Trust.
[54] Mellor, F., Webster, S. & Bell, A.R., 2011. *Content analysis of the BBC's science coverage*. London: BBC Trust.
[55] Attenborough, F.T., 2013. Discourse analysis and sexualisation: a study of scientists in the media. *Critical Discourse Studies*, 10, pp.223-36.
[56] Chimba, M. & Kitzinger, J., 2009. Bimbo or boffin? Women in science: an analysis of media representations and how female scientists negotiate cultural contradictions. *Public Understanding of Science*, pp.1-16.
[57] Boyce, T. & Kitzinger, J., 2008. *Promoting Women in the Media: The Role of SET Organisations and their Science Media Communicators.* London: Report for the UKRC.
[58] ibid

[59] ibid
[60] Nelson, S., 2013. *Women in TV science: time to shift out of Top Gear*. [Online] Available at: http://www.telegraph.co.uk/news/science/10350039/Women-in-TV-science-time-to-shift-out-of-Top-Gear.html [Accessed 25 March 2015].
[61] BBC Trust, 2014. *Trust Conclusions on the Executive Report on Science Impartiality Review Actions*. London: BBC Trust.
[62] Howell, L., 2014. *Women Experts – or the lack of them – on TV and radio news*. [Online]. Available at: https://www.nuj.org.uk/news/women-experts--or-the-lack-of-them--on-tv-and-radio-news/ [Accessed 26 March 2015].
[63] Boyce, T. & Kitzinger, J., 2008. *op cit*.
[64] University of Stirling, n.d. *Athena SWAN Action plan: Bronze Award*. [Online] Available at: http://www.diversityandequality.stir.ac.uk/documents/Actionplan.pdf [Accessed 17 June 2015].
[65] Screenhouse. *Masterclass with Dr Maggie Aderin-Pocock MBE.* [Online]. Available at: http://www.screenhouse.co.uk/inspiration.html [Accessed 17 June, 2015].
[66] SciConnect, 2012. *Women in Science and the Media*. [Online]. Available at: http://www.sciconnect.co.uk/blog/2012/11/women-in-science-and-the-media/ [Accessed 17 June, 2015].
[67] University of Warwick, 2014. *Communication & Impact for Female Early Career Researchers*. [Online]. Available at: http://www2.warwick.ac.uk/fac/sci/wcas/events/communicationandimpact/ [Accessed 17 June 2015].
[68] House of Lords Select Committee on Communications, 2015. *Women in news and current affairs broadcasting*. London: The Stationery Office Ltd.
[69] The Women's Room, n.d.. *The Women's Room.* [Online]. Available at: http://thewomensroom.org.uk/ [Accessed 17 June 2015].
[70] HerSay, n.d.. *HerSay*. [Online]. Available at: http://www.hersay.co.uk/ [Accessed 17 June 2015].