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Gender Equality from a European Perspective: Myth and Reality

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In the past 50 years, significant progress in women's equality has been made worldwide. Western countries, particularly European countries, have implemented initiatives to attain a more gender-balanced workforce with the introduction of family friendly policies, by trying to narrow the gender pay gap and by promoting women's career progression. In academia, however, fewer women reach top leadership positions than those in the political arena. These findings suggest that academia needs to carefully evaluate why these new policies have not been very effective. In this NeuroView, we report on the progress made in higher education, the shortcomings, and how new initiatives hold great promise for improving gender equality in academia around the globe.

Introduction

Gender equality is of the utmost importance for productivity and economic growth (The Global Gender Gap Index, 2015, http://reports.weforum.org/global-gender-gap-report-2015/the-case-for-gender-equality/), equal access to healthcare, education, and protecting human rights and freedom. In 2000, UNESCO launched a campaign where countries agreed to "eliminate gender disparities in primary and secondary education by 2005, and achieve gender equality in education by 2015, with a focus on ensuring girls' full and equal access to and achievement in basic education of good quality" (http://uis.unesco.org/apps/visualisations/women-in-science/#overview!region=40525). Although progress was made, this goal was not achieved as just one in five countries has obtained gender parity, whereby 45% to 55% of researchers are women (Women in science, UIS fact sheet, http://uis.unesco.org/#overview!region=40500). In September 2015, 80 world leaders met at the United Nations to commit to ending discrimination against women by 2030 and announced concrete and measurable actions to kick-start rapid change in their respective countries. Governments were asked to make national commitments to address the challenges that are holding women and girls back from reaching their full potential (http://www.unwomen.org/en/news/stories/2015/9/press-release-global-leaders-meeting#sthash.YbWknTXt.dpuff). Although the impact of these policies is too early to assess, it is crucial that we determine where the problems lay to make informed decisions to reduce gender inequality.

Significant progress in the political sector has been made in women's equality in industrialized countries. For example, the number of women in European parliaments has almost doubled in the last 20 years. In Nordic countries, women parliamentarians are 41.7%, whereas they comprise only 25.3% in Europe excluding Nordic countries (http://www.unwomen.org/en/what-we-do/leadership-and-political-participation/facts-and-figures) (Table 1).

The biggest and most prominent problem in academia is the large number of women that leave their scientific career at early stages. There are striking imbalances between the numbers of women and men at the highest levels of academia. For the whole of the European Commission (EC), 20.9% of full professorships are held by women (European Commission, 2013, https://ec.europa.eu/research/swafs/pdf/pub_gender_equality/she_figures_2015-final.pdf) (Table 1). However, the percentage of female professors varies between countries (30.4% in Finland to 16.4% in the Netherlands). The number of female heads of higher education institutions rose over the last few years but it is still only 15%. Interestingly, an even lower percentage (5.2%) of leadership positions is held by women at S&P 500 companies (http://www.catalyst.org/knowledge/women-ceos-sp-500). Other highly qualified professions outside of academic research do not exhibit such large shifts in participation (European Commission, 2009, http://ec.europa.eu/commfrontoffice/publicopinion/archives/ebs/ebs_326_sum_en.pdf), as well as the near equal percentage of women in scientific fields at the undergraduate level (Figure 1). Numerous surveys point to the transition between postdoctoral researcher and group leader as the stage of critical loss, though clearly there are many leaks in the pipeline. More shocking has been the finding that only 30% of women with science, technology, engineering, and mathematics (STEM) qualifications have jobs in a related area (https://www2.deloitte.com/uk/en/pages/growth/articles/technology-career-pathways-gender-pay-gap.html). Thus, a significant number of women go on to take jobs in non-related roles, representing a loss of both talent and potential economic and scientific gains. To implement proper strategies/policies to ameliorate this loss of talent, we need to understand why women leave the

Table 1. Percentage of Women in Government and Scientific Research

Country	Parliament	Researcher	Professor	Professor in MS	Head of University	Gender Pay Gap[c]
UK	32[a]	37.8	22	23.2	15[b]	24.8
DE	37	26.8	17.3	11.5	16.8	19.3
FR	26	25.6	19.3	DU	13.4	15.6
CH	32	32.4	19.3	19.7	8.3	19.4
SE	44	37.2	23.8	28.1	50	20.1
NL	37	24.1	16.2	16.4	21.4	25.1
FL	42	32.2	26.6	30.4	40	18.7
IT	31	35.5	21.1	13.6	7.4	7.4
EU	24	33	20.9	23.3	15	17.9

DU, data unavailable. Data obtained from the She Figures 2015 report (https://data.europa.eu/euodp/data/dataset/she-figures-2015-gender-in-research-and-innovation) except for those indicated with [b].
[a]House of Commons
[b]Obtained from Times Higher Education
[c]Only for scientific research and development services statistics

work force. In this NeuroView, we will discuss these issues and propose potential solutions.

When Do Gender Differences Emerge?

Gender inequality is evident at different stages in the career of women. Although the same number of boys and girls take STEM subjects at the lower high school (for example, GCSE levels in the UK), fewer girls continue with their STEM subjects in the last 2 years of high school (for example, A levels in the UK), with 40% more boys taking STEM subjects (Deloitte accounting firm data, 2016, https://www2.deloitte.com/uk/en/pages/growth/articles/technology-career-pathways-gender-pay-gap.html). This poses the question as to why fewer girls choose to take these subjects. Despite this early difference, the number of female undergraduate and PhD students in the life sciences is similar to male students in many European countries (Figure 1). While more women are enrolling in university, particularly in scientific majors, relatively few pursue careers in research. A recent document "The She Figures" produced in close collaboration between the European Commission, Eurostat, the Helsinki Group on Gender in Research and Innovation and Statistical Correspondent (https://data.europa.eu/euodp/data/dataset/she-figures-2015-gender-in-research-and-innovation) shows that overall European women are excelling in higher education, and yet, women represent only a third of researchers and around a fifth of grade A top-level academics (full professors, rectors, etc.). Data and sources for Australia, Canada, Europe, India, Japan, and the United States released by Catalyst, a nonprofit organization with a mission to accelerate progress for women through workplace inclusion (http://www.catalyst.org/knowledge/women-academia), show that although women in USA held nearly half (48.4%) of all tenure-track positions in 2013, they held just 37.5% of tenured positions. The European figures are different; women account for 40.1% of academic positions but only 20.9% of tenured positions.

Importantly, a significant drop in the number of female principal investigators (PIs) is observed (Figure 1), though the underlying causes are multifaceted and complex. For example, different STEM subfields appear to have leaks at varying points in the pipeline. Engineering and physics fields report low female involvement at the entry-level recruitment stages, while other specialties, such as chemistry and life sciences, report low female retention. At the University College of London (UCL) and at the Swiss University of Lausanne (UNIL), the ratio of PIs is 25% female and 75% male, while the ratio of postdoctoral researchers is equal (Athena SWAN application, UCL, L'égalité en chiffres UNIL, 2015, https://www.unil.ch/egalite/files/live/sites/egalite/files/pdf/2.%20Monitoring_WEB_20170902.pdf) (compare to Figure 1). Analyses of the female candidates applying for independent positions suggest that this is not due to discrimination against women, but rather to the fact that fewer women apply for jobs as independent investigators. Importantly, UNIL identified that once a female applicant enters the recruitment process, she has an equal chance to be offered the position compared to her male counterparts, suggesting that the gender bias is the result of recruitment failure, rather than institutional biases. This finding poses a real challenge to academic training programs and institutions that wish to promote women's careers to obtain a gender-balanced workforce and further highlights the transition from postdoctoral researcher to independent group leader as a major leak in the pipeline. The cause of this recruitment deficit, however, is not straightforward and does not necessarily explain the low proportion of female PIs in other institutions or scientific subfields. For instance, surveys of chemistry majors have identified dropout rates earlier in the career path, even as soon as the third year of the doctorate degree (UK Resource center for Women in SET, http://www.biochemistry.org/Portals/0/SciencePolicy/Docs/Chemistry%20Report%20For%20Web.pdf). The percentage of female doctoral students who reported planning for a research career was 72% in the first year of the program but fell to just 37% by the third year of study. This is in stark contrast to their male peers, who only showed a 2% change in interest between the same time period (61% planned a research career in the first year versus 59% in the third year). What might drive these dropout rates? Recent surveys found that 67% of Europeans felt that women did not possess the necessary capabilities to succeed in scientific positions (L'Oreal Change the Numbers, September 17, 2015, http://www.loreal.com/media/press-releases/2015/sep/the-loreal-foundation-unveils-the-results-of-its-exclusive-international-study), highlighting the persistence of a serious cultural prejudice that might influence the number of women who make it to the application stage. Surveys of chemistry students in the UK found that doctoral students indicated concerns about the demanding schedule but also had been warned of the future difficulties they would face because of their gender (UK Resource center for Women in SET, http://www.biochemistry.org/Portals/0/SciencePolicy/Docs/Chemistry%20Report%20For%20Web.pdf). These examples, as well as the overall EU data, suggest that solutions to promote women's careers might need to be tailored to the particular situation, after a thorough analysis of where women are under-represented: be it in the application pool, in the fraction interviewed or hired, or in the retention pool.

Family Matters: Choose or Lose?

There is no single answer to why fewer women move from a postdoctoral position to an independent investigator. However, this period coincides with the time when women are likely to start a family, raising several questions. Are family issues the main cause of this gap because women seek a more balanced work-life style? Do women perceive that having a family is an obstacle for pursuing an academic career when men don't? Interestingly, surveys of postdoctoral researchers funded by the U.S. National Institutes of Health (NIH) reported several different factors in their decisions to pursue a PI position that exhibited a significant gender bias, including the desire to have and spend time with children, the consideration for their spouse's career, the need to publish, and the demanding PI schedule. Indeed, the presence of a family appears to impact scientific careers. Among tenured faculty, only 44% of women were married with children, compared to 70% of men. In addition to children, women also take the career interests of their spouses into consideration more often than their male peers, with 31% of married women indicating a willingness to accommodate their husband's job (versus 21% of married men). Studies have identified a marriage and child premium for men, where publication rates and salaries are increased when male scientists have families. Conversely, female scientists in several STEM fields appear to pay a family penalty (Ceci et al., 2014).

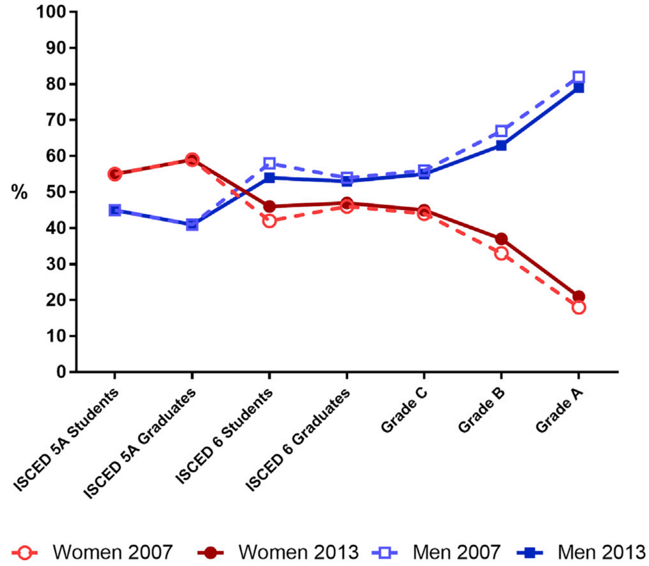

Figure 1. Proportion of Women and Men in a Typical Academic Career, Students and Academic Staff
The data are taken from the She Figures 2015 report (https://data.europa.eu/euodp/data/dataset/she-figures-2015-gender-in-research-and-innovation). Countries represented include EU-28 reporting from years 2007–2013.

These penalties, while startling, might not be surprising as recent surveys found that women express more concern for potential conflicts between academia and family compared to men (50% more female versus male postdoctoral researchers, and four times as many female graduate students) and that this greatly influences their later career and family decisions (Ecklund and Lincoln, 2011).

Despite the progressive gender equality policies in Nordic countries, the number of female academics is not that dissimilar to the rest of Europe. Statistical comparison between countries with a strong family support system, such as Sweden and Norway, and those less supportive of families, like the U.S., Italy, and Spain, suggests that family support policies have not improved the number of women in science. In Sweden, for example, only 23.8% of professors are women even though the number of bachelor and graduate students is around 55%–59%, with 45% obtaining a PhD degree. The lack of improvement following implementation of such family support policies could reflect unforeseen gaps (family policies targeted to the wrong career stage) or inadvertent issues stemming from the support itself. Thus, policies surrounding family support need to be reassessed for effectiveness at the early career stages.

Unconscious Bias

We are all influenced by our background, cultural environment, and personal experiences (ECU: 2013 Unconscious bias in higher education, https://www.ecu.ac.uk/publications/unconscious-bias-in-higher-education/) and these factors determine our unconscious bias. Unconscious bias refers to a bias that we are unaware of, and which happens outside of our control. It is a bias that happens automatically and is triggered by our brain making quick judgments and assessments of people and situations reflecting the influences of our background, cultural environment, and personal experiences (as for ECU: 2013 Unconscious bias in higher education). Unconscious bias has a profound impact on our decision making and our perception of people. Indeed, a study showed that gender stereotypes about intellectual ability are evident in young children from the age of 6 (Bian et al., 2017).

Conscious and unconscious bias is observed at different levels. This is particularly evident in the aforementioned European population's self-reported perception of women lacking sufficient capabilities to succeed in science (L'Oreal Change the Numbers, September 17, 2015, http://www.loreal.com/media/press-releases/2015/sep/the-loreal-foundation-unveils-the-results-of-its-exclusive-international-study). Studies also show that both men and women give higher scores to male than female candidates when evaluating very similar CVs. Additionally, letters of recommendations for women are shorter than for men. Gender bias is also observed in the use of words describing candidates in reference letters. While men are described as intelligent, creative, outstanding, assertive, decisive, or passionate, women are described as nice, organized, helpful, and diligent (van der Lee and Ellemers, 2015). There is also evidence of gendered language in the instructions to applicants, panel members, and reviewers. For example, gender-exclusive (e.g., he) was more often used that gender-inclusive language (e.g., he/she or they). Fewer women are invited to give talks, to participate in committees or panels with executive powers, and are member of reviewing panels (74% male and 26% female) (MRC data from 2014 and Wellcome Trust report 2000). The biggest problem is that when bias is noticed, people tend to ignore it or not to report it, thus contributing to further gender inequality. The creation of databases to record the speaker composition of scientific conferences, such as the BiasWatchNeuro (https://biaswatchneuro.com/about/), could raise awareness of any gender bias in the selection of conference speakers, so that these disparities can be addressed.

Several European institutions have implemented policies to increase awareness of unconscious bias and to address how to tackle this problem. In the UK, many universities have introduced unconscious bias courses for faculty members. However, the attendance to these courses is patchy and is not yet a requirement for those who serve on board or reviewing panels. Given that both men and women are biased against women, there is a real need to increase awareness such that each individual should evaluate his/her bias and correct their conduct accordingly. The introduction of unconscious gender bias courses should be implemented from the early stages of the scientific career to eradicate this serious problem.

Gender Pay Gap

The gender pay gap varies between European countries with an average of 17.9% in favor of men overall. Surprisingly, in countries where gender equality policies have been implemented for more than a decade (Sweden, Norway, and Finland), there is still a significant gender pay gap (Table 1). In the UK, significant progress has been made in narrowing the gender pay gap since the introduction of the Equal Pay Act in 1970. However, around 154 Higher Education Institutes (HEIs) pay less to women than men, whereas only 8 institutions pay men and women equally. On average, women are paid 11.3% less than men in UK academia (ranging from 19.3% to 8%) and overall, the UK ranks 18th on gender parity according to the World Economic Forum (2015). One of the biggest impediments in narrowing the gender pay gap is the lack of transparency on the salary of women and men in academia. In the commercial sector, increasing numbers of companies are beginning to publically report gender pay gap. As of April 2017, private companies with more than 250 employees are beginning to publicly report gender pay gap (https://www.ashurst.com/en/news-and-insights/legal-updates/reporting-on-the-gender-pay-gap/). However, in Europe, not all universities publish the salary of their faculty members. This lack of transparency jeopardizes the empowerment of women and their ability to request pay raises or promotions. Public universities in the United States, for example, publish the salary of faculty members (e.g., University of California: ucpay.globl.org), reinforcing the concept that there is no longer any valid argument to maintain secrecy on salary. Thus, transparency is crucial to achieve a more gender-balanced workforce.

Institutional Influence

Academic institutions play a critical role in the career of young scientists. They are instrumental in the implementation of mentoring programs for students, postdocs, and early career research fellows and they also hire and promote young as well as established investigators. There has been a long-held view that academic institutions might discriminate against women. Although conscious and unconscious bias might contribute to discrimination, data from different countries revealed sharp differences.

Italian universities, for example, suffer from such discrimination in line with the data contained in the She Figures 2015 (https://data.europa.eu/euodp/data/dataset/she-figures-2015-gender-in-research-and-innovation). However, in the past 10 years an increasing number of women undertaking an academic career has been observed. In 2015 the number of women with a university degree (Laurea) has reached 58.5% of the total population obtaining a degree. The percentage of women who enrolled in a PhD or specialization program is around 50%. Unfortunately, the passage from the training to the academic career signals a bottleneck with a major inversion of the gender, as positions of women at the top levels are low. In Italy, 35.5% of women are researchers but just 21% are full professors. In the EU, 33% of researchers and 20.9% of professors are women (Table 1). Thus, women fail to achieve the higher ranks of academia compared to their male counterparts in many EU countries. While part of the reason for this phenomenon could be due to fewer women putting themselves forward, many European countries do not have any gender equality policies to ensure that the recruitment and promotion is unbiased.

Inequality at academic institutions is also evident in the difference in the support level received by female compared to male independent investigators. According to a recent U.S. report, a significant difference in the amount of start-up funds was observed between recently appointed male and female faculty members, with men obtaining a median of $889,000 against a median of $350,000 for women (Sege et al., 2015). This inequality could be ameliorated or abolished if salaries and research support were made publicly available. Interestingly, a number of scientists within some fields have taken matters into their own hands and created online databases where recently hired PIs can post their offers and negotiations for others to see. For example, the ecology and evolution field has a database where people post new jobs and salary figures and sometimes negotiation processes (whether there was a spousal hire or not, additional start-up funding, delayed start date, reduced teaching load, etc.). Resources such as this can not only offer transparency, but also might provide valuable insight into the hiring/negotiation process for both female and male researchers in the early stages of their careers.

Academic institutions are implementing new initiatives to ameliorate these gender inequalities. The "Bureau de l'Égalité" at UNIL (Switzerland) has the mission to promote gender equality at all academic levels supporting female scientists and families with specific programs (https://www.unil.ch/egalite/fr/home/menuinst/acteurs-et-actrices/bureau-de-legalite/lequipe.html). KU Leuven (Belgium) has recently launched a gender action plan aimed at improving the hiring and advancement of women in the Senior Academic Staff (https://www.kuleuven.be/english/news/2014/ku-leuven-pushes-for-more-female-professors). In 2012, only 13% of full professors were women. The plan stipulates the creation of a central solidarity fund to cover extra costs such as extended due to leaves of absence or pregnancy. Absence due to illness, maternity leave, or paternity leave will now be taken into consideration when calculating an employee's total research time. This new policy is welcome and should be implemented widely. In Germany, the government has allocated €150 million to equal-opportunity programs in academia to create 200 additional posts for the hiring of highly qualified female academics. The program is making an impact in the number of female academics (http://www.spiegel.de/international/germany/sexism-in-germany-universities-rewarded-for-hiring-women-professors-a-576238.html). In Switzerland, the Swiss National Science Foundation had a funding program (Marie Heim-Vogtlin Initiative: http://www.snf.ch/en/funding/careers/mhv-grants/Pages/default.aspx) targeted toward retaining women in science following a career break due to family obligations. This program specifically recruited early-stage researchers to receive funding for a 2–3 year project at a host institution that commits to retain them afterward. As of 2017, this program has unfortunately been discontinued and partially replaced by a different initiative called PRIMA, see later. In England, the Daphne Jackson Trust also provides support for women and men to return to research in STEM after a career break (http://www.daphnejackson.org/). Such programs should be implemented more widely as they can particularly provide an incentive and career boost to young female researchers who might find it difficult to return to work following an extended period of leave.

While mobility and family factors play a role in the transition from post-doctoral researcher to faculty member, there appears to be another dynamic at play when it comes to advancement beyond the assistant professor level. Women tend to spend more time at the assistant professor rank than their male peers (National Research Council, 2010, http://spot.colorado.edu/~tooley/Gender%20Differences%20at%20Critical%20Transitions%20in%20the%20Careers%20of%20Science,%20Engineering,%20and%20Mathematics%20Faculty.pdf), and studies found a stagnation in advancement that could not be explained by the presence of children, spouse, or mobility (Wolfinger et al., 2008). Are women less likely to advance in their career trajectory due to institutional biases? Or does this stem more from a lack of self-confidence and unwillingness to put themselves forward for promotion? In the case of the latter possibility, a number of academic institutions have implemented new strategies to identify women who deserve to be promoted and invite them to apply for promotion. However, these policies have only been introduced recently and therefore it is not possible to evaluate their impact yet. This type of policy should be implemented across institutions.

Impact of Scientific Journals

There is a clear gender disparity in the number of publications between women and men. For every article with a female as a first author, there is almost twice the number of articles with a male first author (Larivière et al., 2013). Moreover, when a woman appears in a prominent author position (first or last author), this paper attracts fewer citations than when a man was in the same position (Larivière et al., 2013). Scientific journals are beginning to recognize that gender equality is crucial for the progress of science and for the economy. Several journals have evaluated whether there is a gender bias on scientific boards and reviewers and whether gender of the first or last author has an impact of the acceptance rate of scientific papers. Although the data are patchy, some studies are beginning to reveal important biases. In 2012, *Nature* reported that only 14% of its reviewers and 19% of invited comments and World View were by female scientists. Since then *Nature* has pledged to tackle this bias (Editorial, 2012). *Science* has also conducted a report on gender issues (Berg, 2017). Elsevier has recently published a report on research performance from a gender perspective at the global level, revealing important behavioral differences based on gender (https://www.elsevier.com/research-intelligence/campaigns/gender-17). This is clearly a step forward. However, a number of questions have not been addressed. For example, what is the proportion of female senior authors that submit a paper in comparison with senior male authors? Do papers submitted by female leading authors have the same success rate as those from male authors? Are there differences in the number of revisions requested to papers from senior female authors? Importantly, this and similar data should be made available by journals to assess the overall trend and evaluate the necessary next steps for action.

Gender Inequality at Funding Organizations

In 2008, the European Research Council (ERC) set up a dedicated working group to monitor gender balance in ERC calls. The Working Group on Gender Balance drafted the ERC Gender Equality Plan 2007–2013 and the ERC Gender Equality Plan 2014–2020, endorsed by the ERC Scientific Council (https://erc.europa.eu/thematic-working-groups/working-group-gender-balance). The main objectives of the ERC Scientific Council Gender Equality Plan was to raise awareness about ERC gender policy among potential applicants; to improve gender balance among ERC candidates and within ERC-funded research teams; to identify and remove any potential gender bias in the ERC evaluation procedures; and to embed gender awareness at all levels while keeping the focus on excellence.

The lower share of women in the ERC mirrors the overall situation in science in Europe. A report covering the period of 2007–2013 showed that 30% of applicants for Starting/Consolidator grants in the life sciences were female but only 24% of grants were awarded to women. In 2014, the ERC published a new report showing that the success rate of women for starting and consolidator grants was the same as men. For advanced grants in the life sciences in 2015, the success rate of female applicants was 6.67%, whereas for male applicants it was 17.11%. By 2016, this difference was almost reversed with a 17.39% success rate for female versus 8.33% success rate for male applicants. Although the number of grants is very low (10–14 per year) and therefore difficult to reach a clear conclusion, the situation for female applicants seems to have improved dramatically. However, the most striking feature was the very low number of female applicants (6/35). Why do fewer women apply? Academic institutions and funding organizations such as the ERC should implement policies to improve this situation.

In the UK and Switzerland, studies from funding organizations show a complex picture. Data from the Medical Research Council (MRC), the Wellcome Trust (WT), and Swiss National Science Foundation (SNSF) show that although fewer women apply for research grants than men, women are as successful as men in getting funded for all MRC grants. For program grants (5 years), however, the male success rate is 53% of the total number of male applicants, whereas female success rate is 39% (information provided by the MRC). The Wellcome Trust's data also show that fewer women apply for grants (42% female and 58% male applicants). However, the success rate for women and men is similar with 40% of grants awarded to women and 60% to men, reflecting the gender difference at the application level (https://wellcome.ac.uk/sites/default/files/wtd003209_0.pdf). These findings from the MRC and WT are remarkable in light of the vast amount of evidence for bias in favor of men in the evaluation of job applications and promotions in many sectors including academia. This puzzling finding could be resolved if funding organizations and also academic institutions collect data on the success rate, level of funding (amount and period) of male versus female applicants, and the number of grants where women applicants are co-applicants or have male co-applicants. These comparative data are essential to tackle the problem of fewer women at the top.

In Italy, the Charity Foundation Telethon (http://www.telethon.it/en) has received gender-balanced applications over the past 10 years (2007–2016), as 42.9% of submitted grants were from female scientists. Importantly, in the past 5 years the gap has decreased to 47.4% female versus 52.6% male applicants. In contrast, 41% of grants were funded to female versus 59% to male applicants (over the 10 years) and 44% and 56% (over the 5 years). Despite the improvement, there is still a significant bias in favor of male applicants. For instance, in the Netherlands, a recent study showed that female applicants are less successful than male applicants at obtaining grant funding. Importantly, this is evident at every step of the selection process (van der Lee and Ellemers, 2015).

Another inequality is also evident in the level of funding. Studies by the Wellcome Trust found that men are awarded on average £44,735 more than women (data covering a period from 2000 to 2008). The reason for this difference is unclear. Do women request less funding? Do funding organizations reduce the budget or the length of grants more in those awarded to women than men? Given that organizations, such as the Wellcome Trust, usually award the requested amount, these findings suggest that women may apply for smaller grants. However, we also need to consider that applicants often discuss their application with program managers who will provide advice on the amount requested. Could unconscious bias play a role here?

In summary, gender bias in the overall success of grants varies per country and scheme. In addition, data obtained from several studies consistently show that women apply for fewer grants and are likely to receive less money. Institutions need to address these issues by implementing better mentoring programs and funding organizations need to evaluate where the biases might originate.

The Way Forward: Think Positive

Clearly the cause for the gender inequality is complex and needs careful analysis. To what extent is this due to stereotypes encountered by girls at an early age with respect to family-caring responsibilities and to the bias women may face when choosing a career? How can institutions, publishers, funding organizations, and society help to increase women's participation in higher levels of academia?

A snapshot of Western societies 50 years ago would show intense social pressures to be a wife and a mother while maintaining a job. In the past, fewer women could not economically afford to enter academia, and it was quite rare that they could combine both. Now, we are well aware that women can successfully balance a family and a career. Many successful woman scientists are able to work efficiently and still be a loving parent and member of a family. Still, several steps lie ahead of us before reaching a more balanced gender representation in academia. Furthermore, how to strengthen women leadership is still a challenging question. Society, institutions, and funding organizations must support woman's motivation to lead and also increase the likelihood that others will recognize and encourage women's efforts.

Many academic institutions, funding organizations, and publishers are committed to tackle gender inequality and have implemented policies to address this important issue. For example, as briefly discussed earlier, Switzerland has "ad hoc" programs for junior women in science. For 25 years, MHV grants have supported female doctoral students and postdocs in Switzerland who had to interrupt or reduce their research activities due to family commitments through the Marie Heim-Vögtlin initiative (MHV). Recognizing that these initiatives have not been as successful as initially hoped, the Swiss National Science Foundation (SNSF) has recently decided to overhaul their MHV funding program and introduce a new initiative called Promoting Women in Academia (PRIMA). The PRIMA program will highlight the best women in academic research and provide them with up to 5 years of funding for their research in a host Swiss institute (http://www.snf.ch/en/funding/careers/prima/Pages/default.aspx). Additionally, within Swiss institutes, there are also specific fellowships for women in science, given for example at the Faculty of Biology and Medicine of UNIL (https://www.unil.ch/fbm/home/menuinst/faculte/egalite-femmes-hommes/bourses-et-subventions.html) that also aim to increase female academic participation. However, policies such as these are not active in many European countries and/or have not been sufficiently effective or successful. Still many women are lost during the transition from a postdoctoral to an independent group leader position. The data are insufficient to discern how much this is due to women staying in non-faculty research posts for longer or to leaving academia, although there is evidence that women disproportionately occupy temporary research positions below the faculty level in comparison

Table 2. Websites and Reports on Gender Balance

Topic	Web Address
Statistics on female participation in science and leadership	http://reports.weforum.org/global-gender-gap-report-2015/the-case-for-gender-equality/ http://uis.unesco.org/#overview!region=40500 http://www.unwomen.org/en/news/stories/2015/9/press-release-global-leaders-meeting#sthash.YbWknTXt.dpuff http://www.unwomen.org/en/what-we-do/leadership-and-political-participation/facts-and-figures https://data.europa.eu/euodp/data/dataset/she-figures-2015-gender-in-research-and-innovation http://www.catalyst.org/knowledge/women-ceos-sp-500 http://www.catalyst.org/knowledge/women-academia http://ec.europa.eu/justice/gender-equality/files/swd_2014_142_en.pdf http://ec.europa.eu/commfrontoffice/publicopinion/archives/ebs/ebs_326_sum_en.pdf https://www.unil.ch/egalite/files/live/sites/egalite/files/pdf/2. Monitoring_WEB_20170902.pdf http://www.loreal.com/media/press-releases/2015/sep/the-loreal-foundation-unveils-the-results-of-its-exclusive-international-study http://spot.colorado.edu/∼tooley/Gender Differences at Critical Transitions in the Careers of Science, Engineering, and Mathematics Faculty.pdf https://erc.europa.eu/thematic-working-groups/working-group-gender-balance
Salary information	https://www.ashurst.com/en/news-and-insights/legal-updates/reporting-on-the-gender-pay-gap/ http://ucpay.globl.org https://www2.deloitte.com/uk/en/pages/growth/articles/technology-career-pathways-gender-pay-gap.html
Institutional programs for to increase female scientists	https://www.kuleuven.be/english/news/2014/ku-leuven-pushes-for-more-female-professors http://www.spiegel.de/international/germany/sexism-in-germany-universities-rewarded-for-hiring-women-professors-a-576238.html http://www.daphnejackson.org/ http://www.setwomenstats.org.uk/
Gender bias in publication	https://www.elsevier.com/research-intelligence/campaigns/gender-17
Gender bias in funding agencies	https://erc.europa.eu/thematic-working-groups/working-group-gender-balance https://wellcome.ac.uk/sites/default/files/wtd003209_0.pdf http://www.telethon.it/en
Implicit bias in recruitment	https://biaswatchneuro.com/about/ https://erc.europa.eu/thematic-working-groups/working-group-gender-balance https://www.rri-tools.eu/-/recruitment-bias-in-research-institutes http://www.academia-net.org/project/ http://www.embo.org/documents/science_policy/exploring_quotas.pdf https://www.ecu.ac.uk/publications/unconscious-bias-in-higher-education/

Links to different websites that were consulted for the writing of this manuscript containing extensive and different information on gender balance.

to men (She Figures 2015, https://data.europa.eu/euodp/data/dataset/she-figures-2015-gender-in-research-and-innovation). Some countries have made a significant effort to provide longer maternity leave, childcare, and flexible hours. However, studies show an inverse correlation between the length of maternity leave and the number of women returning to work after maternity. These findings suggest that some women are more likely than men to opt for caring for their family than pursuing a career in academia. It is important that institutions, funding organizations, publishers, and the scientific community recognize that for many women, like for men, their career is as important as raising a family. Thus, family policies need to be re-evaluated to determine whether they are actually meeting the needs of female scientists at each level of the academic career track. Are current policies missing a critical area of need resulting in the poor success of recruiting/retaining female academic workforce? Additionally, many family policies only focus on women, reinforcing the idea that childcare and family matters are only a woman's concern. Policies that take an equal approach with respect to both female and male scientists will undoubtedly reduce this inherent bias and potentially reduce biased hiring of women due to maternity leave fears.

New approaches to increase awareness of gender inequality and new policies to improve the career prospects of female researchers are beginning to make some difference. In the UK, for example, the Athena SWAN chapter was created in 2005 to promote gender equality in academia, and in particular to promote and recognize the commitment for advancing the career of women in higher education and research. In 2006, Athena SWAN chapter gave the first awards to Higher Educational Institutions (HEI) in the UK. While some people have questioned the success of this initiative, HEIs are now actively seeking to obtain this award, which requires effective implementation of policies to improve gender equality and promote women's career progression. Importantly, this award has to be continuously renewed. The Catalan Research Centre Institute (CERCA,

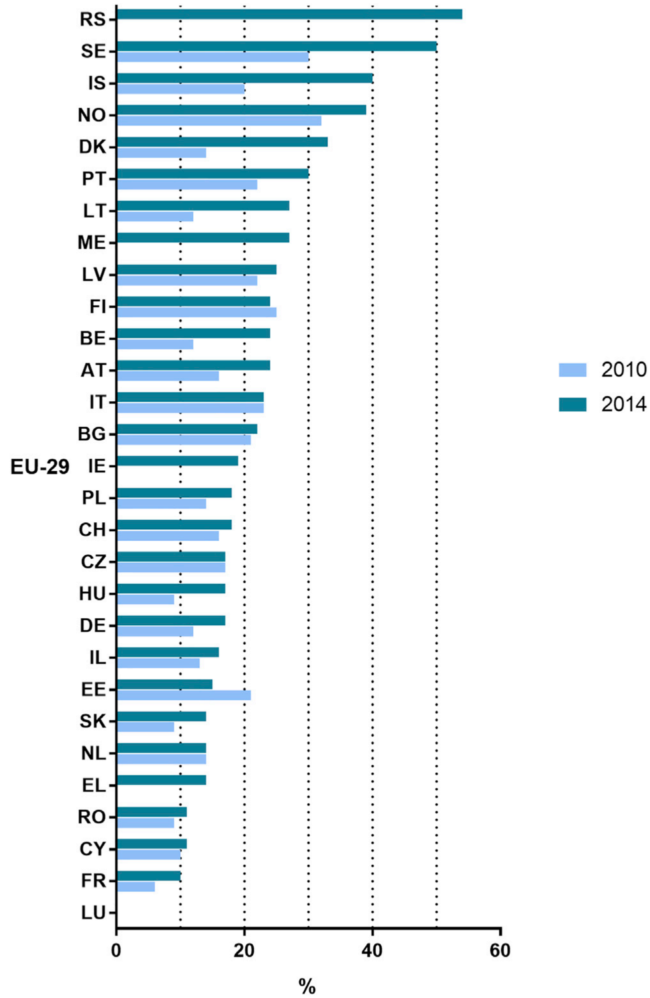

Figure 2. Evolution of the Proportion of Female Heads of Institutions, 2010 versus 2014

Taken from She Figures 2015 report (https://data.europa.eu/euodp/data/dataset/she-figures-2015-gender-in-research-and-innovation).

https://erc.europa.eu/thematic-working-groups/working-group-gender-balance) has implemented policies to increase women's roles in the system, including the creation of a Diversity Commission to measure and remove gender bias (https://www.rri-tools.eu/-/recruitment-bias-in-research-institutes).

Gender balance in decision making and the integration of the gender dimension in research will make a significant impact on the progression of women's career. For review committees and oversight bodies, it is clear that the presence of women at these committees reduces isolation and tokenism and broadens the points of view during discussions, including minority concerns. A potential solution would be to introduce gender quotas (http://www.embo.org/documents/science_policy/exploring_quotas.pdf). However, the potential harm is the work overload for the few women in high positions who would be asked to sit on many committees. This would limit the amount of time they can invest in research and penalize them in terms of scientific output. The negative impact could be mitigated by, for example, relief from administrative duties and support for research and non-research-related academic duties.

How Can We Change the Current Status of Gender Unbalance?

Although several articles have made sensible and important suggestions on how to improve gender equality (Smith et al., 2015; www.scienceeurope.org/wp-content/uploads/2017/01/SE_Gender_Practical-Guide.pdf), we envision that the following changes might help to support career paths in academia. (1) Institutions and funding organizations should introduce a comprehensive gender-bias training for all PhD students, to tackle explicit and implicit gender bias at early stages of the scientific career. This training should also be continued through the scientific progression (postdoctoral fellows and faculty members). (2) Institutions should implement effective mentoring programs for PhD students, postdocs, and young research scientists. Women in leadership positions need to recognize that they can not only be mentors but also serve as role models to young female and male scientists. (3) Institutions should provide clear criteria for the promotion of young scientists and encourage more women to take on leadership roles. (4) Academic institutions should implement policies to ensure equal pay between male and female faculty members. Transparency in the salary should be rewarded by government organizations. (5) Both funders and employers should collect and publish information about the success rate for grant applications according to gender (including amount requested and amount awarded, length of the grant requested and awarded, and the gender of co-applicants). This will allow the cross referencing of data. (6) Academic institutions and the community should provide better child care systems to support young parents (both female and male scientists will benefit from this). (7) All academic members and in particular those serving grant reviewing panels or appointment panels should attend unconscious bias courses to increase awareness of this problem and to enable people to self-evaluate and self-correct their behavior in academia and in society. (8) Governments should introduce initiatives such as Athena SWAN to all academic institutions to reward those with good practice and have demonstrated improvement in gender equality. (9) Support and increase awareness of initiatives such as the one from Robert Bosch Stiftung and Spektrum der Wissenschaft with AcademiaNet (http://www.academia-net.org/project/). AcademiaNet is a profile database of excellent female researchers from all disciplines selected based on their academic excellence. This database is making women more visible and making it easier to fill leadership positions. (10) Reducing the rigidity of the academic pipeline, making it more acceptable to return after a career break or move from part-time to full-time positions could also help women to minimize the delay in their career development. (11) Finally, we must encourage future generations to create more egalitarian households where women and men share domestic duties and family responsibilities. Additional reading to explore more options for women in science can be found in Table 2.

Conclusion and Challenge

The proportion of women leading higher educational institutions is increasing (Figure 2). However, there is still a significant gap. Despite the lack of discriminatory intent, the underrepresentation of women in top positions reinforces entrenched beliefs, prompts and supports men's bids for leadership, and thus maintains the status quo. For a woman, it is not enjoyable and constructive to work in an institution with very few women. Together women and men create a community in scientific research and this diversity really matters by making a workplace creative and successful.

We urge institutions, funding organizations, and scientific journals to implement an equality plan to increase the contribution of women in the work force. This will not only benefit the progress of science but will increase economic growth and impact.

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