A data-driven approach to reduce gender disparity in invited speaker programs at scientific meetings.

Ann-Maree Vallence[1], PhD

Mark Hinder[2], PhD

Hakuei Fujiyama[1], PhD

1. School of Psychology and Exercise Science, Murdoch University, Western Australia, Australia
2. School of Medicine, University of Tasmania, Tasmania, Australia

Corresponding Author:

Name: Ann-Maree Vallence

Address: 90 South Street, Murdoch, Western Australia, Australia, 6150

Email: Ann-Maree.Vallence@murdoch.edu.au

Phone: 0061 08 9360 7464

Abstract

Gender disparity continues to be an issue in STEM, with progress requiring consistent and focused efforts. Here, we present a data-driven approach to promote high quality, gender balanced invited speaker selection for neuroscience conferences. We have targeted invited speaker opportunities because underrepresentation of female speakers at international neuroscience conferences remains a major problem, and such opportunities are critical for career development. First, we audited the top ten neuroscience journals (indexed by SCImago Journal and Country Rank; SJR), identifying (1) highly cited papers, (2) gender of first and last authors, and (3) field-weighted citation impact and total publications of first and last authors. Second, we used these data to establish a database of high quality scientists that could be used to select speakers for conferences. We found that research quality (as indexed by field-weighted citation impact and total publications) of authors of highly cited publications in the top 10 neuroscience journals was similar for females and males. In summary, we present an objective, data-driven approach to invited speaker selection that enables a gender balanced and high quality conference program. This approach minimizes the influence of implicit gender bias in speaker selection decisions by using scientific quality metrics that STEM researchers are familiar with, and indeed use to evaluate their own performance. Having an immediate effect on reducing gender disparity in conference programs, our approach would generate a positive spiral for more long-term reduction of gender disparity in STEM.

Gender disparity in academia has been acknowledged for some time. In neuroscience, females represent approximately half of PhD graduates but only 25 - 30% of tenure-track faculty in the US[1,2]. Although many have called for potential solutions to the problem, the disparity persists and progress towards gender balance is slow [3,4].

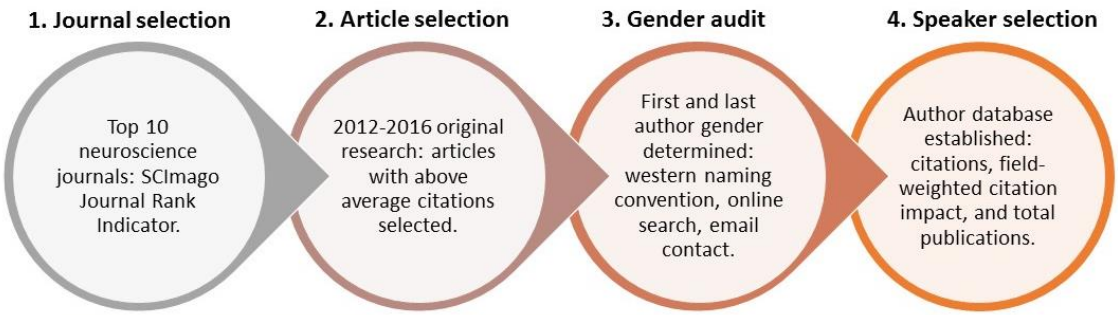
The persistence of gender disparity in neuroscience is likely due, at least in part, to implicit bias[5]: the covert attitudes that influence our understanding, actions, and decisions in an unconscious manner. Evidence suggests that implicit gender bias in science negatively affects outcomes for females in terms of hiring, promotion, and invitations for conference presentations and editorial roles[6-9]. For example, in a randomized double-blind study in which laboratory manager applications were randomly allocated male or female names, faculty at research intensive universities rated male applicants as more competent and offered a higher starting salary than the identical applicant with a female name[6].

The negative effects of implicit gender bias can be overcome by either reducing the bias itself, or implementing protocols that minimize the influence of the bias. Here we have taken the latter approach as it can provide immediate, positive, and tangible outcomes that, in themselves, may facilitate the eventual elimination of bias itself. To this end, we present a data-driven approach to promote high quality, gender-balanced invited speaker selection for neuroscience conferences. We have targeted invited speaker opportunities because underrepresentation of female speakers at international neuroscience conferences remains a major problem[2], and such opportunities are critical for career development. Whilst there have been some recent suggestions for ensuring gender balance in invited speaker programs (including guidelines for selection[10] and diversity policies[11]), the selection of invited speakers remains largely subjective leaving it open to negative effects of implicit gender bias.

We developed a two-step approach to minimize the influence of implicit gender bias in invited speaker selection. First, we audited the top ten neuroscience journals (indexed by SCImago Journal and Country Rank; SJR), identifying (1) highly cited papers, (2) gender of first and last authors, and (3) field-weighted citation impact and total publications of first and last authors. Second, we used these data to establish a database of high quality scientists (irrespective of their gender) that could be used to select speakers for conferences. If the quality of scientists on this database is comparable across gender, this approach enables gender balance in invitations that is based on established metrics of quality frequently used by researchers, hiring committees, and funding bodies, thereby minimizing the influence of implicit gender bias on selection decisions. Notably, this approach can have an immediate effect to improve the underrepresentation of female invited speakers at neuroscience conferences, and will likely have a medium- to long-term effect to improve the progression of female scientists to senior levels within STEM.

Method

The study was approved by the Murdoch University Human Research Ethics Committee (2017/206). Figure 1 shows the study procedure. The journal ranking data and citation reports were extracted on the November 26, 2017.



Top 10 journals	SJR	Total articles	Articles audited
Nature Neuroscience	14.1	998	331
Neuron	11.1	1,583	563
The EMBO Journal	6.6	1,006	366
Acta Neuropathologica	6.5	452	154
Biological Psychiatry	6.0	918	341
eLIFE	5.9	2,787	857
Annals of Neurology	5.3	847	280
PLoS Biology	4.8	950	346
Journal of Neuroscience	4.7	7,264	2,618
The Lancet Psychiatry	4.6	146	56
		Total	5,912

Figure 1. Selection procedure for creating a database for speaker selection.

Journal Selection. Neuroscience journals were ranked using the SJR indicator system and Web of Science. The top ten journals comprising ≥50% original research articles were selected for auditing (see Figure 1). (Note: *Molecular Psychiatry* was excluded because more than 60% of publications reported authors' initials only).

Article Selection. Total citations and average citations per year were calculated for each original research article in the selected journals (Citations from 2012-2016 for all journals except *Lancet Psychiatry*, for which citation data were only available from 2014-2016) Articles were selected for the author gender audit if their total citation count was greater than the average total citations for the journal in which the article was published.

Gender identification. The gender of first and last authors of the selected articles was determined to be male, female, or unknown (last author was selected because it typically represents the senior author in neuroscience). Gender determination (using western naming convention) was completed independently by two investigators, and then cross-referenced. If gender could not be determined using this method, or the name was indeterminate or androgynous, an electronic search was conducted using institutional and academic networking websites: gender was determined if the online resources included the author's name, photo (with clear gender identification) and either a reference to the article or the author's affiliation (listed in the article). If gender of first or senior authors could not be determined using either of these methods (6.9%), the corresponding author was emailed to request gender identity information (email response rate: 20%). (In total, the gender of 163 author could not be determined.)

Database for speaker selection. The weighted total citations (2012-2016) were obtained by dividing the total citation counts for each paper by the number of years since its publication. The weighted total citations were then used to rank all articles; the first and last authors of the top 100 ranked articles were included on our 'potential speakers' lists. The field-weighted citation impact (FWCI) and their total number of career publications were obtained for these authors, and the rank order of the lists was then adjusted based on FWCI. (Note: if an author did not have an identifiable FWCI using SciVal they were not included in the database.)

Results

The lists of top 100 first and senior authors based on weighted total citations and subsequently re-ranked based on FWCI showed that 32% of first authors and 21% of senior authors were female (supplementary material: Table 1 and Table 2). Figure 2 shows the

gender breakdown of authors in the top 100 list for FWCI and total publications. FWCI did not differ between males and females for either first or senior authors (p>0.49, Cohen's d<0.15, Bayes Factor, BF_{10}<0.29), indicating no difference in the impact of research between males and females irrespective of career stage.

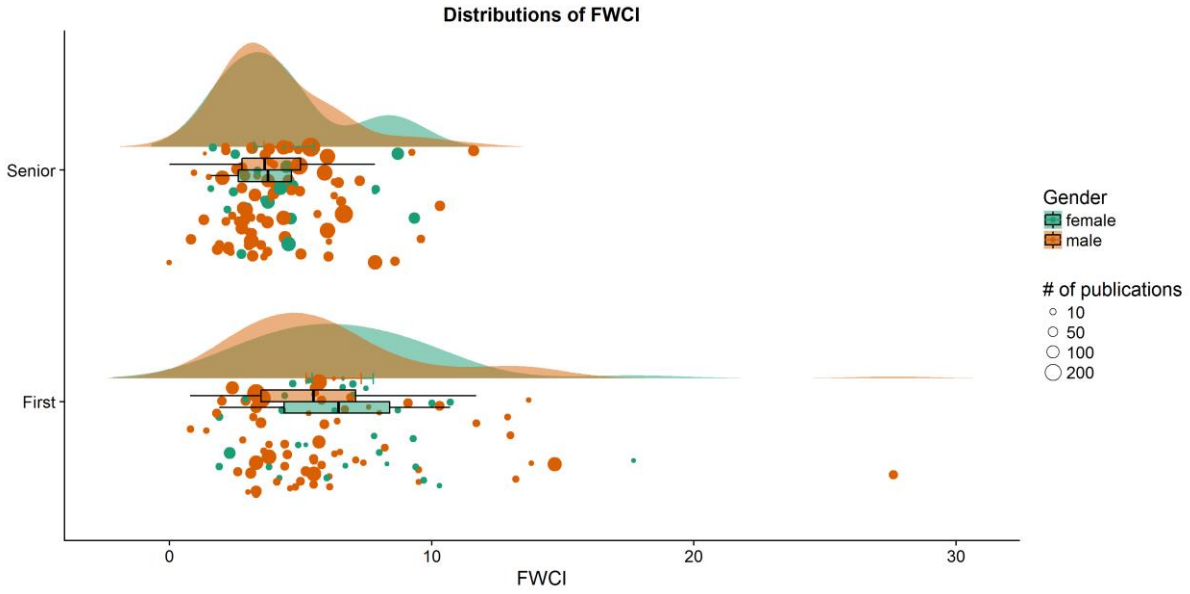


Figure 2. Raincloud plots of field weighted citation impact for female and male first (lower plot) and senior (upper plot) authors in the top 100 list; each circle represents one author, with the size of the circle reflecting the total number of publications (see legend).

Discussion

The objective, data driven approach presented here enables speaker selection based on scientific impact, thereby minimizing the influence of implicit bias. Notably, this approach can ensure gender balance, given that the current results show that scientific impact does not differ between males and females in the potential speaker database.

Implicit gender bias is widespread and is proving challenging to overcome, and gender bias in STEM is no exception. Indeed, in a series of randomized, double-blind experiments, males

and females evaluated the quality of scientific journal abstracts reporting gender bias in a STEM context: males evaluated abstracts less favorably than females, with male STEM faculty evaluating abstracts less favorably than female STEM faculty and male and female members of the general community[12]. If evidence demonstrating gender bias in STEM is not convincing to the majority group in STEM, who serve as panel members that make decisions regarding hiring, promotion, speaking invitations, editorial invitations, we have to develop new approaches to negate, or at least minimize, the effects of implicit gender bias. Our approach purposefully includes established metrics of quality that are frequently used by researchers, hiring committees, and funding bodies. The benefits of this approach are twofold. First, it provides an objective method for selecting invited speakers, which can have an immediate effect on reducing gender disparity at scientific conferences. Second, establishing a database of high quality researchers based on these metrics provides convincing evidence of parity in scientific quality between males and females at the highest level. These benefits should, in turn, lead to a positive spiral in which invited speaking opportunities for females facilitate career development through recognition of high-quality research, providing greater opportunity for collaborative outreach, which will increase likelihood of academic promotion and female leadership within STEM, as well as providing an environment in which implicit bias should become less pervasive.

Here we use the broad discipline of neuroscience as an exemplar. It is important to note that we recommend refining the data-driven approach using keywords and/or the selection of specialist journals to ensure that the resultant database of potential speakers is suitable for the target conference or focussed symposia within conferences. Indeed, we have previously shown that the proposed approach would be effective in the sub-discipline of brain stimulation [13].

Our approach takes an important step in addressing the complex issue of gender disparity in STEM. Our data-driven approach to ensure gender parity in speaking programs goes beyond current approaches proposed to reduce gender disparity that only use data to increase accountability for gender disparity in conference programs, such as www.biaswatchneuro.com, or offer guidelines such as diversity policies, gender balance on selection panels, and child-care facilities at conference. Nonetheless, it is important to acknowledge some limitations with the approach. First, achieving gender balance is not equal to achieving diversity and inclusion: our approach should be extended to ensure representation of minority groups. Second, our approach relies on publications in high impact journals, a process that, in itself, is subject to implicit gender bias that negatively affects female scientists [3,4]: our approach should be continually refined to include the most reliable and well-accepted quality metrics for STEM researchers. In light of the strengths and limitations of our approach, we argue strongly that a combination of approaches will be most effective at reducing the persistent gender disparity in STEM.

Acknowledgments: We would like to thank Brigid Bolton, Ellika Carson, Courtney McAuliffe, Chelsea Moran, and Tayla Stucke for their assistance with this project.

Funding: AMV is supported by a National Health and Medical Research Council Early Career Fellowship (GNT1088295). MH is supported by an Australian Research Council Future Fellowship (FT150100406).

Conflict of interest statement: The authors have no potential conflicts of interest to disclose.

1. Programs. SoNDa. Surveying the Landscape of Neuroscience Higher Education. *Neuroscience Quarterly.* 2017.
2. BiasWatchNeuro. Neuroscience base rates.
3. Promoting diversity in neuroscience. *Nature Neuroscience.* 2018; 21(1):1-1.
4. Women in neuroscience: a numbers game. *Nature Neuroscience.* 2006; 9:853.
5. Raymond J. Most of us are biased. *Nature.* 2013; 495:33.
6. Moss-Racusin CA, Dovidio JF, Brescoll VL, et al. Science faculty's subtle gender biases favor male students. *Proceedings of the National Academy of Sciences.* 2012; 109(41):16474-16479.
7. Reuben E, Sapienza P, Zingales L. How stereotypes impair women's careers in science. *Proceedings of the National Academy of Sciences.* 2014; 111(12):4403-4408.
8. Lariviere V, Ni C, Gingras Y, et al. Bibliometrics: global gender disparities in science. *Nature.* 2013; 504(7479):211-213.
9. Sheltzer JM, Smith JC. Elite male faculty in the life sciences employ fewer women. *Proceedings of the National Academy of Sciences.* 2014; 111(28):10107-10112.
10. Martin JL. Ten Simple Rules to Achieve Conference Speaker Gender Balance. *PLOS Computational Biology.* 2014; 10(11):e1003903.
11. Neuroscience Sf. Guidelines for Meetings and Conferences.
12. Handley IM, Brown ER, Moss-Racusin CA, et al. Quality of evidence revealing subtle gender biases in science is in the eye of the beholder. *Proceedings of the National Academy of Sciences.* 2015; 112(43):13201-13206.
13. Hinder MR, Fujiyama H, Vallence A-M. Response to "Response to Hoy, 'Gender imbalance and brain stimulation conferences: We have a problem and it is everyone's problem'". *Brain Stimulation.* 2017; 10(1):158-159.