

House of Commons Science and Technology Committee inquiry on Diversity in STEM: response from the British Neuroscience Association



Introduction

The British Neuroscience Association (BNA) is the largest UK organisation representing and promoting neuroscience and neuroscientists. We have over 2500 members, whose interests cover the whole range of neuroscience, from molecular ion channels to whole animal behaviour to real-life applications in the clinic and beyond.

Neuroscience research benefits when it brings together and builds on the diversity of views, backgrounds, and life experiences within the neuroscience community to help to tackle the complex challenges neuroscience presents. We know that there are long-standing barriers faced by underrepresented groups that negatively impact representation within science, technology, engineering and mathematics (STEM) disciplines, including neuroscience, and that these are particularly prevalent at advanced career stages.

We are committed to making the BNA, and neuroscience in general, more equitable and inclusive, and are proud to be a supporter of the Declaration on Equity and Inclusion from ALBA – an international network of brain scientists committed to fostering fair & diverse scientific communities.¹

The Committee's inquiry provides a much-needed opportunity to examine the issue of diversity within research more closely, and we welcome the opportunity to respond to it through this written evidence. We have consulted with members of the [BNA's Council and Committee](#) in the course of preparing this response.

This submission focuses on issues of underrepresentation that can be demonstrated through the BNA's own demographic data for the neuroscience community, alongside relevant literature, and we readily accept that this is not therefore able to capture the full extent of underrepresentation across the community; for example, underrepresentation relating to class, disability or sexuality. However, we believe that the information we have provided around gender and ethnicity will be helpful to the inquiry.

Summary:

- The BNA's data on the neuroscience research community suggest an underrepresentation of black groups in neuroscience research compared to the general population. These data also suggest that representation of ethnic minority groups, women and people who identify as non-binary decreases with seniority of research role.
- Underrepresentation manifests itself across neuroscience publishing, with disparity on editorial boards, authorship and citation contributing to a 'leaky pipeline' that impacts funding and career development opportunities according to gender and ethnicity.
- The BNA is actively involved in addressing instances of underrepresentation within neuroscience, from ensuring our meetings have a minimum number of female speakers, to

creating a new Scholars programme for neuroscience students from underrepresented ethnic groups.

- The UK Government should take a leading role on equity, diversity and inclusion in research through its new National Science and Technology Council, and ensure this forms a key part of its future science and technology strategy.
- There is a need for richer discipline-specific demographic data in research to better benchmark progress to address underrepresentation, for which UKRI is well placed to coordinate the collection. There is also a data gap for gender and ethnicity demographics of participants for each medical condition/disease category studied, which UKRI should explore filling with NIHR.
- Universities should ensure efforts from individuals to improve equity, diversity and inclusion are better recognised when assessing contributions to research. Institutions should also adopt the recently updated Athena Swan charter.
- Publishers need to take active steps to address issues of underrepresentation, including ensuring female and ethnic representation in their editorial boards, and moving away from single-blinded models of peer review to models that address biases.

The scale of underrepresentation in STEM in academia and industry

The BNA holds a number of events for the neuroscience community each year, with our largest event being the BNA's Festival of Neuroscience, held every two years. These are attended by researchers across the different fields of neuroscience, and across all career levels, with representation including delegates from a number of non-UK countries.

For the three festivals between 2015-2019, voluntary surveys of delegates have enabled the BNA to capture some demographic information about the attendees, such as career stage, ethnicity and gender. Our 2021 festival was the first virtual event, with online registration enabling us to gain a much larger and comprehensive dataset (*see Tables 1 and 2*). While the data are solely from delegates and speakers that attended these neuroscience events, it should be treated as indicative in terms of the UK neuroscience research community as a whole.

These data indicate i) an underrepresentation of black groups in neuroscience research compared to the general population (*Table 1*) and ii) that representation of ethnic minority groups, women and people who identify as non-binary decreases with seniority of research role (*Table 2*).

Gaps in data

While there are some demographic open data provided by bodies including the Higher Education Statistics Agency and other sources¹, there is a lack of sufficiently fine-grained, discipline-specific demographic data within the broad category of STEM that would help us better assess the neuroscience research community. In all of the BNA's activities, we are intent on promoting an inclusive culture, and having clear demographic data on neuroscience researchers is something that is important to help us better understand the diversity of the community we represent, and better shape our future activities and programmes as a result. In 2018, the BNA attempted to fill some of that knowledge gap, through a project which aimed to gather statistics across academic institutions

¹ APPG on Diversity and Inclusion in STEM. [The State of the Sector: Diversity and representation in STEM industries in the UK](#). Data Analysis Brief Inquiry into the STEM Workforce; 2019.

on the number of established and postdoctoral neuroscientists, postgraduate and undergraduate students in neuroscience and neuroscience-related fields, in addition to finding out information on gender within that data. Data were gathered from over 20 institutions, and there was a clear trend throughout the institutions that the female population was generally much higher at the undergraduate stage (over 60% in nearly all institutions analysed) and decreased as the more senior stages of academia.² This also matches the trend seen in Table 2 above from our festivals data.

There are also gaps in our own data collection that we are actively looking to address in the future. For example, the BNA does not currently collect ethnicity data on its membership, and is therefore reliant on the survey data mentioned above from our events. However, the BNA does now collect data on gender within our current membership database, which follows the other trends we have seen within neuroscience showing female underrepresentation in more senior research positions.

While we have been able to provide some indication of the trends in gender and ethnicity at different stages of neuroscience in academia, there are still clear gaps in data on other underrepresented groups in academia, and gaps in data in general from neuroscience roles in other sectors in the UK.

Table 1: Demographic data from BNA Festivals of Neuroscience for combined delegates & speakers (approximately 80-85% of individuals based in the UK and Ireland), compared to 2011 census data for England & Wales.

Demographics	BNA2015	BNA2017	BNA2019	BNA2021	General population
Gender					
Female	56%	55%	62%	59%	51%
Male	44%	45%	37%	38%	49%
Other	-	-	1%	-	-
Non-binary	-	-	-	1%	-
Prefer not to say	-	-	-	2%	-
Number of individuals	464 (≈30% of total)	363 (≈32% of total)	304 (≈29% of total)	1,087 (≈98% of participants)	-
Ethnicity					
White/White British	83%	80%	87%	73%	86%
Mixed/multiple ethnic groups	4%	3%	4%	3%	2%
Asian/Asian British	10%	10%	4%	11%	8%
Black/African/Caribbean/Black British	1%	1%	1%	2%	3%
Arab/Arab British	-	-	-	1%	-
Other	2%	6%	4%	5%	1%
Prefer not to say	-	-	-	5%	-
Number of individuals	464 (≈30% of total)	363 (≈32% of total)	304 (≈29% of total)	1,046 (≈94% of total)	-

² British Neuroscience Association. Unpublished data from 21 higher education institutes in the UK; 2018

Table 2: Demographic data from BNA2021 Festival of Neuroscience by career stage (includes clinical research equivalent stages, excludes speakers)

Demographics – BNA2021	Undergraduate students	Postgraduate Researchers	Early Career Researchers	Established Researchers
Gender				
Female	60%	69%	60%	46%
Male	38%	28%	37%	48%
Non-binary	1%	1%	1%	0%
Prefer not to say	1%	2%	2%	6%
Ethnicity				
White	69%	68%	70%	77%
Mixed/multiple ethnic groups	5%	5%	3%	3%
Asian/Asian British	14%	13%	12%	7%
Black/African/Caribbean/Black British	3%	3%	2%	0%
Arab/Arab British	1%	2%	0%	1%
Other	6%	5%	7%	5%
Prefer not to say	2%	5%	7%	7%
Number of individuals	149	352	121	152

Causes of underrepresentation

Gender

The data we have included above show a trend where neuroscience students at undergraduate and postgraduate level have a greater tendency to be women, yet in more senior stages of academia they become underrepresented – often described as a ‘leaky pipeline’. Understanding the factors behind this is complex, therefore it is useful to breakdown where in neuroscience women may face barriers.

Publishing articles is quintessential for career progression in STEM disciplines. If there are gender-related barriers to publishing, this may limit career advancement for many women. A study using 53,351 articles from 29 of the most used international neuroscience journals published in 2009-10 found that 67.1% authors were male and 32.9% were female.³ For the study’s UK based authors, these figures were very similar ($m=68.2\%$, $f=31.8\%$). More recently, the organisation BiasWatchNeuro analysed four widely used neuroscience journals (The Journal of Neuroscience, Neuron, Nature Neuroscience, eNeuro) and found that female authors accounted for 36% of the articles from 2019 to 2021.⁴ Both analyses also found that there was a much lower percentage of females as the last author, typically allocated to a senior researcher.

³ González-Álvarez, J., & Cervera-Crespo, T. (2017). Research production in high-impact journals of contemporary neuroscience: A gender analysis. *Journal of Informetrics*, 11(1), 232-243.

doi.org/10.1016/j.joi.2016.12.007

⁴ BiasWatchNeuro’s Journal Watch: biaswatchneuro.com/journal-watch/

One explanation for this may be that women produce less research output because of uneven distribution of households or child-caring tasks among the sexes.⁵ Alternatively, it may be that women produce similar levels of research output, yet fewer of their submissions get accepted by the journal. A mismatch between the female/male ratio at submission and publication would suggest a gender bias in the reviewing process. One potential reason for such a gender bias is a gender disparity in editorial boards: one study found that 88% of editorial boards of the top 50 neuroscience journals were comprised of more than 50% male editors.⁶ One study looking at authorship trends more broadly in neuroscience literature reported that women were first and last authors 29% and 18% respectively in three prominent journals (Nature, Neuroscience, and Neuron).⁷

Gender bias may also occur once an article is published. Whether an article gets cited by other authors or not has downstream effects on visibility and career advancement. Using data from five neuroscience journals with the highest Eigenfactor scores⁸, one study found that reference lists tend to include more men as first and last authors.⁹ This effect still remained when accounting for the ratio of male and female authors in these journals. The authors of this study proposed that over-representation of men in course syllabuses and conference speaking roles could explain the citation imbalance, which gives an indication of the importance of role models in reducing gender bias. BiasWatchNeuro's conference watch provides a helpful resource to track gender representation in neuroscience conferences.¹⁰

Besides publishing, gender bias may contribute to the leaky pipeline in other ways, such as hiring or grant applications. One randomized double-blind study found that when science faculties ($n = 127$) rated identical applications randomly assigned either a male or female name, they rated male applicants as more competent.¹¹ Drawing on US data for biomedical research funding, another study found that the median value of grant money assigned to male applicants was \$889,000 compared to the median value \$350,000 for women, despite there being no significant differences in their highest degree or years since receiving their highest degree.¹²

As alluded to previously, women do a lot more unpaid work such as household tasks or child care.¹³ This may be the result of societal gender stereotypes, but is often also influenced by institutional

⁵ Office for National Statistics:

ons.gov.uk/employmentandlabourmarket/peopleinwork/earningsandworkinghours/articles/womenshouldert heresponsibilityofunpaidwork/2016-11-10

⁶ Palser, E. R., Lazerwitz, M., & Fotopoulou, A. (2021). Gender and geographical disparity in editorial boards of journals in psychology and neuroscience. Cold Spring Harbor Laboratory.

⁷ Dubey D, Sawhney A, Atluru A, Amritphale A, Dubey A, Trivedi J. Trends in authorship based on gender and nationality in published neuroscience literature. *Neurol India*. (2016) 64:97–100. doi: 10.4103/0028-3886.173643

⁸ eigenfactor.org/

⁹ Dworkin, J. D., Linn, K. A., Teich, E. G., Zurn, P., Shinohara, R. T., & Bassett, D. S. (2020). The extent and drivers of gender imbalance in neuroscience reference lists. *Nature Neuroscience*, 23(8), 918-926.

<https://doi.org/10.1038/s41593-020-0658-y>

¹⁰ BiasWatchNeuro's Conference Watch: biaswatchneuro.com/conference-watch-visual/

¹¹ Moss-Racusin CA, Dovidio JF, Brescoll VL, Graham MJ & Handelsman J. (2012). Science faculty's subtle gender biases favor male students. *Proceedings of the National Academy of Sciences*, 109(41), 16474-16479. doi.org/10.1073/pnas.1211286109

¹² Sege R, Nykiel-Bub L & Selk S. (2015). Sex Differences in Institutional Support for Junior Biomedical Researchers. *JAMA*, 314(11), 1175. doi.org/10.1001/jama.2015.8517

¹³ McMunn A, Bird L, Webb E, Sacker A. Gender Divisions of Paid and Unpaid Work in Contemporary UK Couples. *Work, Employment and Society*. 2020;34(2):155-173. doi:10.1177/0950017019862153

incentive structure. For example, while mothers in the UK can receive 9 months of post-natal paid maternity leave, paid paternity leave is only 2 weeks.¹⁴ The UK Shared Parental Leave and Pay scheme¹⁵ facilitates more equitable distribution of unpaid work among parents, yet is often not utilised. A lack of awareness for this scheme may be one reason for this, with one qualitative study finding that “out of the 39 eligible respondents, [only] 2 (parents-to-be) had heard of shared parental leave”.¹⁶ A follow up survey in 2021 ($n=49$) found that another reason why some mothers do not want to share their leave is because they would be unable to breastfeed their child when returning to work.¹⁷ This study targeted women working in UK universities, and should therefore be very applicable to women in STEM.

Ethnicity

The leaky pipeline or ‘broken pipeline’ is also a term commonly used to describe barriers in STEM career paths for members of ethnic minorities. A 2019 report found that BME* representation is relatively high among first degree undergraduates and taught postgraduates (23.9% and 22.0%, respectively). However, this is markedly lower for postgraduate research students, where 16.4% are from a BME background, of which only 4% are Black. From Freedom of Information request data, the authors found that of 19,868 PhD funded studentships awarded by UKRI research councils, only 245 (1.2%) were awarded to Black or Black Mixed students.¹⁸

Similar to the research investigating gender imbalances in citation practices (see above), research has also looked at citation trends in terms of ethnicity. Analysing 33,934 articles from the top five neuroscience journals, a study found that articles written by authors of colour are under-cited relative to the proportion of such articles in the field, and that the under-citation is largely driven by White authors.¹⁹ Potentially even more alarming, the study suggests under-citation of authors of colour has been increasing with time (1995-2019), despite growing diversity in academia and more articles being published by people of colour. Looking at the intersection of gender and ethnicity, the study also found that under-citation of women of colour in particular contributed to this trend, showing how people with intersectional identities may be most affected.

* In referencing source material, we have kept terms as they are used by the sources, including Black and Minority Ethnic (BME), Black, Asian and minority ethnic (BAME), and authors/researchers of colour. We are aware that these terms are problematic and do not always encompass all marginalised and disadvantaged communities.

¹⁴ International Network on Leave Policies & Research: leavenetwork.org/annual-review-reports/cross-country/

¹⁵ UK Government: gov.uk/shared-parental-leave-and-pay

¹⁶ Ndzi E. (2017). Shared parental leave: Awareness is key. *International Journal of Law and Management*, 59(6), 1331-1336. [dx.doi.org/10.1108/IJLMA-07-2017-0160](https://doi.org/10.1108/IJLMA-07-2017-0160)

¹⁷ Ndzi EG & Westwood AR. (2021). The un-acknowledged relationship between shared parental leave, breastfeeding and workplace support in UK Universities. *International Journal of Business and Social Science Research*, 2(12), 1–7. doi.org/10.47742/ijbssr.v2n12p1

¹⁸ The Broken Pipeline – Barriers To Black PhD Students Accessing Research Council Funding: leadingroutes.org/mdocs-posts/the-broken-pipeline-barriers-to-black-students-accessing-research-council-funding

¹⁹ Bertolero, M. A., Dworkin, J. D., David, S. U., Lloreda, C. L., Srivastava, P., Stiso, J., . . . Bassett, D. S. (2020). *Racial and ethnic imbalance in neuroscience reference lists and intersections with gender*. Cold Spring Harbor Laboratory.

Another area, which is empirically more difficult to measure, yet has been voiced to be potentially the most significant, is mentoring. In an ‘open letter to past, current and future mentors of Black neuroscientists’, authors of another study discuss the immense benefits of good mentoring: “All of the diversity-led funding in the world will not retain a budding scholar who lacks critical guidance. As our mentors, you can provide us with opportunities to publish, present our work, co-author grants, develop networks and teach us to negotiate salaries.”²⁰ The respondents also highlight the negative impacts of bad mentoring: “Negative mentorship destroyed our confidence and made us question if we can succeed. This self-doubt can dissuade us from staying in the field. It becomes a self-fulfilling prophecy of the leaky pipe-line.” The authors also point out that besides receiving fewer grants, authorships and salary, Black mentors are often burdened with the majority of diversity, equity and inclusion work.

Implications of underrepresentation

Below we consider some of the ‘direct effects’ experienced by underrepresented women and ethnic minorities in STEM and ‘second-order effects’ that may affect wider society. The term implicit bias will be used to describe bias that may affect both/either women or BME members.

Direct effects

The negative impacts of barriers in the leaky pipeline are often self-explanatory. For example, being hired, cited or given a grant less often, or expected to do more unpaid work because of one’s gender or ethnicity is naturally problematic. Yet, what is worth highlighting is that career paths in neuroscience (or STEM generally) are very competitive, which means that if someone is viewed as slightly less competent because of implicit bias, this may have stark effects on their career path and opportunities.

Also worth highlighting are the subjective and health effects associated with underrepresentation. During the Women in Neuroscience conferences in 2018 and 2019, many women discussed experiencing ‘imposter syndrome’, the feeling that they do not belong and/or are undeserving of their current position in the field.²¹ The summary report of the Research Partnership on Women in Science Careers also found that ‘stereotype threat’ has affected many women in academia, as women are often characterized by negative stereotypes, which can influence them to underperform.²² It is plausible that imposter syndrome and stereotype threat may also impact the BME population. Implicit bias is also likely to have negative effects on health: a prospective study of 4883 ethnic minority participants in the UK found that individuals who perceived more racial discrimination, experienced poorer mental and physical health.²³

Second-order effects

²⁰ Singleton, K. S., Tesfaye, R., Dominguez, E. N., & Dukes, A. J. (2021). An open letter to past, current and future mentors of Black neuroscientists. *Nature Reviews Neuroscience*, 22(2), 71-72. doi.org/10.1038/s41583-020-00421-9

²¹ Berryhill, M. E., & Desrochers, T. M. (2021). Addressing the Gender Gap in Research: Insights from a Women in Neuroscience Conference. *Trends in Neurosciences*, 44(6), 419-421. doi.org/10.1016/j.tins.2021.03.004

²² Carr, P. L., Helitzer, D., Freund, K., Westring, A., Mcgee, R., Campbell, P. B., . . . Villablanca, A. (2019). A Summary Report from the Research Partnership on Women in Science Careers. *Journal of General Internal Medicine*, 34(3), 356-362. doi.org/10.1007/s11606-018-4547-y

²³ Hackett, R.A., Ronaldson, A., Bhui, K. et al. Racial discrimination and health: a prospective study of ethnic minorities in the United Kingdom. *BMC Public Health* 20, 1652 (2020). doi.org/10.1186/s12889-020-09792-1

Whether a group is represented now has downstream effects on whether this group will be represented in the future, because representation facilitates role modelling and the lack thereof may foster implicit bias. In a review article of female representation in neuroscience, the authors highlight that if a group is represented only by 15% or less, the minority may assimilate to the majority.²⁴ They found that just 15-30% female representation may be enough to significantly affect group dynamics and leadership style, and signal to younger female neuroscientists that women are welcome in the field.

Diversity is important for innovation. One review article highlighted how disparate representation of women in science has led to a prolonged lack of understanding, such as assuming that the egg plays a passive role in fertilization, and physical harm, such as introducing drugs into the market that have adverse effects for women since they were tested only in men.²⁵ This bias appears particularly prevalent in preclinical neuroscience research with over five studies on males for each study on females, having potentially negative ramifications on generalisation further along the drug pipeline with poorer treatment outcomes for women as a result.²⁶

One study looking at 2.5 million articles written between 1985 and 2008 found that articles co-authored by people with different ethnicities and authors coming from different locations tended to get published in higher-impact journals and receive more citations.²⁷ Ensuring representation therefore is vital in the field of neuroscience to dispel 'neuromyths'²⁸, promote innovation, and to ensure that clinical research and practice is not influenced by implicit bias.

Addressing underrepresentation

The BNA is seeking to address some of the issues around underrepresentation in neuroscience through its own initiatives. We have a policy on ensuring a minimum number of female speakers at our meetings, achieving around 50:50 male:female representation for our speakers at our 2019 and 2021 Festivals of Neuroscience. In 2021, the BNA launched its new BNA Scholars programme for neuroscience students from underrepresented ethnic groups, with a second cohort of students to be matched with mentors in 2022.²⁹ We have created this in consultation with BNA members and others interested in improving representation, diversity and equity in neuroscience, to support students from currently under-represented ethnic groups in neuroscience and build a supportive community through networking opportunities, bursaries and mentorship. The mentorship scheme is at the core of the BNA Scholars programme, after being identified from our community events as a key way to make a difference, and through talking to individuals about what they needed for their careers. We have also in the past year added a set of anti-racist tools and resources on the BNA

²⁴ Joëls, M., & Mason, C. (2014). A Tale of Two Sexes. *Neuron*, 82(6), 1196-1199. doi.org/10.1016/j.neuron.2014.05.021

²⁵ Zakiniaez, Y., Cosgrove, K. P., Potenza, M. N., & Mazure, C. M. (2016). Balance of the sexes: Addressing sex differences in preclinical research. *Yale Journal of Biology and Medicine*, 89(2), 255–259.

²⁶ Beery AK. Inclusion of females does not increase variability in rodent research studies. *Curr Opin Behav Sci*. 2018 Oct;23:143-149. doi: 10.1016/j.cobeha.2018.06.016. Epub 2018 Aug 2. PMID: 30560152; PMCID: PMC6294461.

²⁷ Freeman, R. B., & Huang, W. (2015). Collaborating with People Like Me: Ethnic Coauthorship within the United States. *Journal of Labor Economics*, 33(S1), S289-S318. doi.org/10.1086/678973

²⁸ BNA: bna.org.uk/mediacentre/news/mind-the-myth-neuroscientists-arent-immune-to-them-either/

²⁹ bna.org.uk/about/our-prizes/#bna-scholars-programme

website, aimed at helping to tackle racial discrimination and promote racial justice, on both systemic and individual levels, across the neuroscience sector.³⁰

There are a number of initiatives within neuroscience aiming to impact recruitment and retention of neuroscience researchers from underrepresented groups. Within the US for example, the NINDS OPEN strategy seeks to enhance neuroscience workforce diversity through a combination of resources and funding opportunities at the National Institutes of Health.³¹ The BNA is a founding supporter of the Women in Science Database (WISDATABASE) hosted by Royal Holloway, which aims to increase the visibility of women scientists by providing a searchable database that contains information about their expertise and research interests.³²

An important part of making the neuroscience environment inclusive is through raising the profile of voices from underrepresented groups. We are a supporter of #BlackInNeuroWeek, when an international collaboration of neuroscientists, neuro-engineers, and science communicators help to raise this profile through celebrating, amplifying, and supporting Black voices in STEM.³³

ALBA is an international network of brain scientists committed to fostering fair and diverse scientific communities through a focus on tackling implicit bias and workplace culture. The ALBA declaration, which the BNA endorsed at its launch in January 2021, is a show of support from the neuroscience community for evidence-based actions that individuals and organisations at any level can take to promote equity and inclusivity. These include specific commitments on:

- recognising and counteracting bias
- supporting allyship and advocacy
- improvements to selection, hiring and assessment
- establishing a positive workplace environment
- establishing transparent career structures
- promoting healthy work-life balance.³⁴

The BNA is also a member of the Royal Society of Biology, which works with its member organisations to help inspire and promote the STEM subjects to students; for example , through its Bioscience Careers Day.³⁵ We also provide a number of educational resources helping to promote neuroscience and neuroscience careers.³⁶

Key actions to address underrepresentation

UK Government

Addressing issues of underrepresentation in research should be a key activity of the new Office for Science and Technology Strategy to help encourage and drive change across the research sector. We agree with the All-Party Parliamentary Group on Diversity and Inclusion in STEM that a member of the new National Science and Technology Council be tasked with leading on equity, diversity and

³⁰ bna.org.uk/resources/anti-racist-neuroscience-tools-and-resources/

³¹ Jones-London M. NINDS Strategies for Enhancing the Diversity of Neuroscience Researchers. *Neuron*. 2020 Jul 22;107(2):212-214. doi: 10.1016/j.neuron.2020.06.033. Epub 2020 Jul 10.

³² wisdat.royalholloway.ac.uk/

³³ blackinneuro.com/

³⁴ alba.network/declaration

³⁵ rsb.org.uk/careers-and-cpd/careers/bioscience-careers-day

³⁶ bna.org.uk/resources/

inclusion in science, so that diversity and inclusion forms a key part of the UK Government's future science and technology strategy.³⁷ The same report highlights that the UK Government could also play a coordinating role in forming a coalition for STEM diversity with different sectors across research, including industry, to address the structural inequity in the STEM workforce.

UK Research and Innovation

As UKRI publishes very detailed demographics reports of the recipients of grants, this facilitates a better understanding of whether funding processes contribute to underrepresentation in who conducts the research.³⁸ Providing richer discipline-specific demographic data would help individual disciplines to better benchmark progress to address underrepresentation. This would also align with UKRI's provisional objective to advance how EDI data are collected, used and analysed and to broaden its data collection capabilities.³⁹

More data should also be collected on underrepresentation in the study participants in research. The US National Institutes of Health have published an interactive report of the gender and ethnicity demographics of participants for each medical condition/disease category studied.⁴⁰ This could be explored in a UK context by UKRI and NIHR, which would enable the research community to assess progress in tackling underrepresentation in research participation.

Academia

There are a number of actions different stakeholders in academia can take to address underrepresentation. Evidence-based interventions and training can help reduce implicit bias and give underrepresented groups the tools to tackle barriers in the leaky pipeline described above. The Summary Report from the Research Partnership on Women in Science Careers comprehensively discusses interventions such as addressing prescriptive gender norms and positive counter-stereotype imaging.⁴¹ The Society for Neuroscience also provides useful resources and training on increasing female representation and improving promotion and tenure practices.⁴² Universities and scientific societies can provide similar resources to their members.

Universities and societies should also support those burdened with unpaid work commitments. Academics committed to EDI work (i.e. Black mentors) should be recognised for this vital contribution to the research environment. Because these efforts might come at the expense of traditional metrics for performance (i.e. publication output), universities should consider how academics' EDI work could positively influence their chances for hiring and promotions. For example, the BNA is a signatory of the Hong Kong Principles for assessing researchers, which includes recognition for essential activities in research such as mentoring.⁴³ The Future Research Assessment

³⁷ APPG on Diversity and Inclusion. [Inquiry into Equity in the STEM Workforce](#); 2021

³⁸ UKRI Diversity Data: ukri.org/our-work/supporting-healthy-research-and-innovation-culture/equality-diversity-and-inclusion/diversity-data/

³⁹ UKRI. [UKRI equality diversity and inclusion strategy: draft for consultation](#); 2022

⁴⁰ NIH RCDC Inclusion Statistics Report: report.nih.gov/RISR/#/

⁴¹ Carr, P. L., Helitzer, D., Freund, K., Westring, A., Mcgee, R., Campbell, P. B., . . . Villablanca, A. (2019). A Summary Report from the Research Partnership on Women in Science Careers. *Journal of General Internal Medicine*, 34(3), 356-362. <https://doi.org/10.1007/s11606-018-4547-y>

⁴² Society for Neuroscience: sfn.org/Initiatives/Women-and-Neuroscience/Increasing-Women-in-Neuroscience

⁴³ wcrif.org/guidance/hong-kong-principles

Programme⁴⁴, led by the four higher education funding bodies, presents an opportunity to include this in future assessment of research performance.

Universities should ensure better awareness amongst staff of Shared Parental Leave, alongside providing more accessible breastfeeding locations, to help provide supportive environments for women returning to research following maternity leave. Both measures could incentivise unpaid work responsibilities to be shared more equitably amongst both parents.⁴⁵ Recent revisions to the UK Athena Swan Charter have made the process of applying for awards demonstrating good practice on gender equality less administratively burdensome for universities, and the charter is now more inclusive of people of all gender identities and those facing intersectional inequalities.⁴⁶

Finally, academia can facilitate more role modelling of underrepresented groups. Publishers of course syllabuses and organisers of conferences can make sure to facilitate female and ethnic representation of authors and speakers. Some research has shown that conferences with more female organisers tend to have more female speakers.⁴⁷ Public directories to foster this have emerged that champion women in neuroscience.^{48,49} Simply having data on underrepresentation can have a significant and immediate impact. For example, after BiasWatchNeuro highlighted that only 0% in 2014 and 10% in 2015 of the speakers invited to the largest annual Computational Neuroscience conference in Europe were female, yet in the following year (2016), 42% female speakers were invited.

Other funders

Besides UKRI and its councils, some of the major neuroscience-related funding organisation in the UK are Alzheimer's Research UK, Epilepsy Research UK, and UK Mental Health Research Funding. All three organisations do not currently publish demographic reports of their grant recipients. Following the example of UKRI, funders could make this information publicly available.

In terms of addressing underrepresentation in study participants, Alzheimer's Research UK sets a good example with their Inspire Fund, where one criteria for funding is to engage with "underserved audiences on the topic of dementia, including minority ethnic communities, marginalised or socioeconomically disadvantaged people."⁵⁰

Publishers

As highlighted above, neuroscience journals play a key role affecting recognition and reward in research. Publishers could address underrepresentation in the field in a number of ways. Following the example of eNeuro, journals could decide to implement a Double-Blind review procedure, where

⁴⁴ [jisc.ac.uk/future-research-assessment-programme](https://www.jisc.ac.uk/future-research-assessment-programme)

⁴⁵ Ndzi EG & Westwood AR. (2021). The un-acknowledged relationship between shared parental leave, breastfeeding and workplace support in UK Universities. *International Journal of Business and Social Science Research*, 2(12), 1–7. doi.org/10.47742/ijbssr.v2n12p1

⁴⁶ advance-he.ac.uk/equality-charters/transformed-uk-athena-swan-charter

⁴⁷ Asplund, M., & Welle, C. G. (2018). Advancing Science: How Bias Holds Us Back. *Neuron*, 99(4), 635–639. doi.org/10.1016/j.neuron.2018.07.045

⁴⁸ Anne's List: anneslist.net/

⁴⁹ Women in Neuroscience: winrepo.org/

⁵⁰ Alzheimer's Research UK's Inspire Fund: www.alzheimersresearchuk.org/grants/inspire-fund-public-engagement-grant-2021/

reviewers (except the reviewing editor) are unaware of the gender (or ethnicity) of an author.⁵¹ On surveying the neuroscience community about the peer review process for the BNA's journal, *Brain and Neuroscience Advances*, it was found that double blind review was considered preferable to single blind review⁵²; we aim to introduce this in due course.

Journals could also implement quotas that ensure female and ethnic representation in their editorial boards. The efficacy of this approach is evidenced by Nature Neuroscience, who after increasing female representation in their pool of authors and reviewers in late 2016, found that News & Views pieces commissioned by women increased from 17% in 2016 to 28% in 2017.⁵³

Journals should also consider whether relying on Journal Impact Factor metrics contributes to issues of under-representation, and how seeking alternative ways of evaluating research may help; for more information on this, see the information provided by DORA – the San Francisco Declaration on Research Assessment – of which the BNA is a signatory.⁵⁴

Finally, on an individual level, creators, arbiters and reflectors of neuroscience articles can use different strategies and tools to reduce gender and ethnicity imbalances in citation practices. For a very comprehensive review on this see '(In)citing Action to Realize an Equitable Future'.⁵⁵

Conclusion

When neuroscience research brings together and builds on the diversity of views, backgrounds, and life experiences within the neuroscience community, we can more effectively tackle the complex challenges presented by neuroscience. Fostering a research culture that is inclusive and supportive of that diversity is essential to achieving this across STEM, as is ensuring that we effectively research our own sector to identify needs and solutions. While more information is being collected to help provide a fuller picture, significant gaps remain across the sector. Tackling underrepresentation will require a long-term commitment from stakeholders across STEM to fully address.

⁵¹ Bernard, C. (2018). Editorial: Gender Bias in Publishing: Double-Blind Reviewing as a Solution? *eneuro*, 5(3), ENEURO.0225-0218. doi.org/10.1523/eneuro.0225-18.2018

⁵² Clift J, Cooke A, Isles AR, Dalley JW, Henson RN. Lifting the lid on impact and peer review. *Brain Neurosci Adv*. 2021 Apr 11;5:23982128211006574. doi: 10.1177/23982128211006574.

⁵³ Promoting diversity in neuroscience. (2018). *Nature Neuroscience*, 21(1), 1-1. doi.org/10.1038/s41593-017-0052-6

⁵⁴ DORA - The impact of research assessment on diversity: sfedora.org/2019/10/07/the-impact-of-research-assessment-on-diversity/

⁵⁵ Dworkin, J., Zurn, P., & Bassett, D. S. (2020). (In)citing Action to Realize an Equitable Future. *Neuron*, 106(6), 890-894. doi.org/10.1016/j.neuron.2020.05.011

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