

# Policy should change to improve invited speaker diversity and reflect trainee diversity

Running title: Suggestions to improve invited speaker diversity

Ada K. Hagan, Ph.D.<sup>1†</sup>, Rebecca M. Pollet, Ph.D.<sup>1</sup>, and Josie Libertucci, Ph.D.<sup>2</sup>

† To whom correspondence should be addressed: [akhagan@umich.edu](mailto:akhagan@umich.edu)

1. Department of Microbiology & Immunology, University of Michigan, Ann Arbor, Michigan

2. Farncombe Family Digestive Health Research Institute, Department of Medicine, McMaster University, Hamilton, Ontario, Canada

Figures: 1

Tables: 1

Financial support: Department of Microbiology & Immunology, University of Michigan

## **Conflicts of Interest**

All authors affirm that there are no conflicts of interest.

## 1 **Abstract**

2 The biomedical sciences have a problem retaining white women and underrepresented minorities in  
3 academia. Despite increases in the representation of these groups in faculty candidate pools, they are still  
4 underrepresented at the faculty level, particularly at the Full Professor level. The lack of diverse individuals  
5 at the Full Professor level contributes to the attrition of women and under-represented minorities, as it  
6 confirms unconscious biases. The presence of unconscious biases contribute to feelings of not belonging  
7 by trainees and are amplified by visual representation of who is presented as the “top scientist in their  
8 field”. Top scientists are not only defined by the attainment of Full Professorships, but also through invited  
9 seminar series. Invitations for faculty to present their research at other university departments is highly  
10 valued offer that provides an opportunity for collaborations and networking. However, if invited speakers do  
11 not represent the demographics of current trainees, these visual representations of successful scientists  
12 may contribute to decreased attitudes of self-identification as a scientist, ultimately resulting in trainees  
13 leaving the field or the academy. In this study, we compare invited-speaker demographics to the current  
14 trainee demographics in one microbiology and immunology department and find that trainees are not  
15 proportionally represented by speakers invited to the department. Our investigation prompted changes  
16 in policy for how invited speakers are selected in the future to invite a more diverse group of scientists.  
17 To facilitate this process, we developed a set of tips and a web-based resource that allows scientists,  
18 committees, and moderators to identify members of under-served groups. These resources can be easily  
19 adapted by other fields or sub-fields to promote inclusion and diversity at seminar series’, conferences, and  
20 colloquia.

## 21 **Keywords**

22 inclusion, diversity, invited speakers, academia, graduate programs

## 23 Background

24 Long-standing systemic bias, sexism, and racism have contributed to the under-representation of many  
25 racial and ethnic groups, as well as women, in science, technology, engineering, and math (STEM)  
26 fields (1–4). Specifically, within the field of biomedical research in the United States, the proportion of  
27 underrepresented minorities at the full professor level has remained consistently low at 4% (survey data  
28 taken from the NIH from 2001 to 2013), compared to the U.S. population, which is 32.3% (5, 6). Similar  
29 discrepancies exist for women in biomedical sciences as full professorships are currently held mostly by  
30 men (7, 8). As demographics of faculty within the biomedical sciences remains skewed towards Caucasian  
31 men, the demographics of trainees (graduate students and postdocs) are becoming more diverse (5).

32 Policy changes are needed to support inclusion of all individuals, particularly in the biomedical sciences(9).  
33 To increase retention of historically under-represented minorities (HURM), non-Caucasian/non-HURM  
34 (NCNH) individuals, and white women in biomedical fields, it is important for trainees to have visual  
35 representations of themselves as scientists. The importance of representation in retaining a diverse group  
36 of individuals in STEM fields is supported by social role theory (10). Individuals make inferences about  
37 characteristics that are needed to be successful in a given role by examining individuals that most occupy  
38 that role (10, 11). However, there is a lack of diverse scientific experts in academia so underrepresented  
39 minorities are not seeing adequate visual representations of themselves at the faculty level. Therefore,  
40 trainees who do not see representation of themselves in senior faculty positions, may decide that they do  
41 not possess the characteristics that are required to succeed.

42 Invited seminar series are common within biomedical departments across the United States (12). Usually,  
43 seminar series' consist of faculty members selecting a scientist from another institution to visit their  
44 university and present their research, as well as meet with other faculty members and trainees. Named  
45 lectureships follow the same format but are decided by committee and are considered more prestigious  
46 because they are named in honor of prominent local scientists. These seminar series and lectureships  
47 provide an opportunity for trainees to be exposed to research outside of their department. Additionally,  
48 being an invited speaker provides the scientist with an opportunity to make future collaborations and build  
49 their own *curriculum vitae* (CV). Scientists invited to give seminars are widely regarded as successful and  
50 the top in their field. Thus, if trainees are constantly being exposed to “the top scientist in their field”,  
51 according to social role theory, it signals who is successful in that field. While some have examined this  
52 issue by studying and promoting the inclusion of more women speakers at conferences, how department  
53 speaker series compare to the trainee diversity of that department is unknown (13–15).

54 In this study, we examine and compare the proportion of HURM, NCNH, and women invited speakers to  
55 white men in the Department of Microbiology and Immunology at the University of Michigan. Additionally,  
56 we compare invited-speaker demographics to the current trainee demographics as a means to gauge  
57 if trainee demographics are being represented accordingly throughout the seminar series. Following  
58 our investigation, we proposed a policy change to the Department of Microbiology and Immunology  
59 in how invited speakers are selected as a means to promote inclusion in our department and reduce  
60 unconscious bias. In order to facilitate inviting a more diverse group of scientists, we developed a set of  
61 resources that allow scientists, within the fields of microbiology and immunology, to self-identify as having  
62 an under-represented or under-served identity including: HURM, non-Caucasian/non-HURM, or a white  
63 woman. These resources will promote inclusion and diversity by providing greater representation of all  
64 scientists and will provide hosts an opportunity to invite a more diverse group of scientists.

## 65 **Methods**

66 Each academic year, each faculty member in the Department of Microbiology and Immunology at the  
67 University of Michigan has the opportunity to invite one speaker per year for a weekly seminar series.  
68 Some of these seminar slots are dedicated to named lectureships, which are decided by committee, and  
69 three trainee-invited speakers. We analyzed the demographics of invited speakers and faculty hosts for five  
70 academic years (Fall 2014 - Spring 2019), and compared them to the current trainees when the data were  
71 analyzed (Spring 2019). Each speaker was only counted once and those listed as departmental faculty  
72 members or as a “host” at any point could not also be considered “invited speakers”. The list of faculty  
73 hosts was used as a proxy for faculty demographics since as hosts, these faculty members are visible  
74 representatives of the department. The trainees were identified using departmental email lists that included  
75 masters students, doctoral students, and post-doctoral fellows.

76 This is a retrospective study, thus speakers were not asked for their identities at the time of visit. Instead  
77 we hand-coded proxy demographics using personal knowledge, photos, and CVs. The presenting  
78 gender of each individual was assigned using a binary system (man/woman). Due to the low number of  
79 individuals in the study, race/ethnicity demographics were split in three groups: Caucasian, Historically  
80 Under-represented Minority (HURM), and Non-Caucasian/Non-HURM (NCNH), each with a binary  
81 (yes/no) possibility. Caucasian was assigned using the current U.S. Census definition where those of  
82 Middle Eastern, European, and Russian descent are included. HURM individuals were restricted to those  
83 with African-American, Indigenous, Alaskan/Hawaiian Native, Latinx and/or Hispanic heritage. All others

84 were placed into the NCNH group. We recognize that our proxy demographics are a limitation of the  
85 analysis and want to acknowledge that biological sex (male/female) is not always equivalent to the gender  
86 that an individual presents as (man/woman), which is also distinct from the gender(s) that an individual  
87 self-identifies as. We also want to acknowledge that there are many other identities that are not captured  
88 in this limited analysis.

89 Data were analyzed and figures generated in R Statistical Software, using relevant packages (16–28).

## 90 **Results**

91 To understand the representation of women, we compared the proportion of women in each academic role.  
92 At the trainee level, more than half of students and postdoctoral fellows were women. That dropped to  
93 46.77% of faculty hosts and 38.73% of the invited speakers (Fig. 1A). Of 27 lectureships over the five year  
94 period, 37.04% were awarded to women.

95 Our analysis identified an over-representation of Caucasian individuals as hosting faculty and invited  
96 speakers (80% each), relative to the proportion of Caucasian trainees, which was 55% (Fig. 1B). We also  
97 observed declines in the representation of HURM and NCNH faculty and speakers relative to the trainees  
98 (Fig 1B). HURM trainees made up 11% of the department, on track with the 11% of U.S. microbiology and  
99 immunology doctorates awarded in 2017 (29). However, only 8.5% of invited speakers, and none of the  
100 hosting faculty, were HURM scientists. NCNH trainees were 34% of department students and postdocs  
101 (versus 22% of U.S. microbiology and immunology doctorates in 2017), but only 19% of hosting faculty and  
102 10.5% of invited speakers (29).

103 The more prestigious invited speaker lectureships were also dominated by Caucasian scientists, who  
104 comprised 81.48% of those awarded (Fig. 1C). HURM and NCNH scientists were awarded 3 and 2  
105 lectureships, respectively. Because the intersection of identities can compound biases and outcomes, we  
106 further examined the lectureships by gender and race/ethnicity status (30). Caucasian men and women  
107 accounted for 44.44% and 37.04% of the lectureships, respectively. Just 18.52% of lectureships were held  
108 by non-Caucasian men while none were held by non-Caucasian women (Fig. 1D).

## 109 Discussion

110 This study found that the proportion of HURM and NCNH invited speakers were under-representative of  
111 the trainee populations for each group. Additionally, within the last 5 years, no HURM or NCNH woman  
112 was awarded a lectureship. This means that the department is not providing non-Caucasian trainees  
113 with adequate representation of successful scientists. Taking this into context of social role theory, by  
114 not adequately representing the diversity of all trainees, the department is not supporting an inclusive  
115 environment in terms of visual faculty representation. We also found that the proportion of women as faculty  
116 hosts and speakers in our study population is equivalent to global estimates that 40% of microbiologists are  
117 women, though women only represent about 30% of academic biomedical faculty (7, 31). Women are also  
118 over-represented as graduate students and postdoctoral fellows in this department. Overall, Caucasian  
119 scientists are over-represented as host faculty and invited speakers, compared to their presence as trainees,  
120 particularly when lectureships were considered.

121 Several papers have investigated the representation of women at scientific conferences, however, we have  
122 only identified one that focused on invited speakers at universities (12). In their study, Nittrouer et al,  
123 examined 3,652 talks at 50 U.S. institutions in 2013 - 2014 and found that women faculty are less likely to be  
124 invited speakers, despite similar acceptance rates (12). We have not been able to identify any publications  
125 examining scientific speaker diversity beyond gender. This seems to be the first, which is concerning since  
126 conclusions drawn from gender-based studies are often framed, and considered, to be applicable to other  
127 marginalized groups (e.g., HURM). This is a flawed assumption. While there is no doubt some overlap,  
128 each group remains marginalized due to a unique complex set of factors that cannot always be solved by  
129 gender-based solutions. U.S. institutions, such as the University of Michigan have a particular responsibility  
130 to the historically suppressed populations included in our definition of HURMs. We therefore implore U.S.  
131 institutions to apply this framing to their discussions and research.

132 Departments have different processes and criteria for selecting invited speakers, but it is a matter of  
133 pride to bring the best scientists possible. It may be that the definition of "best" poses a problem to  
134 under-represented and under-served groups (e.g., white women, HURM, and Asian) who are held to stricter  
135 competency standards and report having to work harder than white men to be perceived as legitimate  
136 scholars (32, 33). Some departments only invite tenured faculty, which severely limits the number of  
137 potential speakers who are white women or non-Caucasian. Yet, another scenario is that pre-tenure  
138 faculty members invite prestigious, tenured faculty in their field to network and secure letters for their own  
139 tenure package. The increased burden of white women and non-Caucasian scientists to prove competency

140 decreases their likelihood to be considered for either tenure or as possible source of tenure letters.

141 Each underrepresented group in our cohort faces a complex set of barriers to achieving faculty status.  
142 For instance, the decision to invite a woman may also be negatively impacted by assumptions about  
143 competency and dedication. The dedication of women who have children to their work is perceived to  
144 be less than that of their colleagues, i.e., men who also have children (34–36). The perceived prioritization  
145 and commitments of women to family over work may cause faculty to doubt their acceptance of a speaking  
146 invitation, despite the prestigious nature of these invitations and evidence that men and women accept at  
147 similar rates (12, 37). As a result, the faculty member may invite a different colleague who they feel is  
148 more likely to agree (and is a man). Another large portion of our sample were the NCNH cohort, who are  
149 predominately Asian/Asian American individuals. Although Asian scientists are well-represented in the US  
150 scientific workforce, they face significant bias and barriers to inclusion in society and academia (38, 39).  
151 For instance, despite the higher employment rate of Asian scientists, they were not well-represented in the  
152 more prestigious lectureships.

153 While HURM and NCNH share some experiences, differences including varying rates of hiring and tenure  
154 promotion mean unique considerations are important for inclusion of each group (3). For instance, a major  
155 barrier to inclusion of HURM faculty at similar proportions to HURM trainees is the low transition rate of  
156 scientists from HURM backgrounds to faculty positions and the associated low proportion of HURM faculty  
157 (40). The proportion of HURM faculty at the Assistant and Associate Professor level is currently higher than  
158 at Full Professor so it will be difficult to increase speaker diversity if early-career researchers are not being  
159 considered (41). Increased performance expectations and patterns of exclusions are consistent themes  
160 in studies characterizing the HURM faculty experience (42, 43). Therefore, inclusion of HURM faculty in  
161 seminar series is likely essential to increasing the number of HURM Associate and Full Professors. Even  
162 when HURM speaker rates match the proportion of HURM faculty employment, HURM trainees will be  
163 represented at a significantly higher proportion. Inclusion of HURM faculty in these seminar series is just  
164 one aspect of larger institutional change that is needed (44).

## 165 **Instituting Policy Change**

166 In an attempt to promote inclusion within the Department of Microbiology and Immunology at the University  
167 of Michigan, these data were presented to faculty members and the department chair (Dr. Mobley). Since  
168 trainee demographics were not represented by the seminar speaker demographics over the past 5 years,



169 we proposed a policy change as to how seminar speakers were being invited. One suggestion was to  
170 switch from faculty-invited to lab-invited speakers in an attempt to allow trainees to choose a speaker that  
171 best represented themselves (Table 1).

172 The implicit biases that affect perceptions of marginalized groups are an issue, but we must acknowledge  
173 that it is not always possible to identify members of historically under-served communities. For instance,  
174 after data analysis, we learned that at least one speaker in our data set should have been categorized  
175 as a HURM instead of Caucasian, but it wasn't readily apparent from their internet presence or CV. This  
176 limitation makes two important points: that perceived identity often plays a larger role than self-identification,  
177 and that we need better tools to identify members of marginalized groups. Another policy suggestion is for  
178 departments to invite their speakers to spend time discussing their personal journeys through science,  
179 in addition to their scientific stories (Table 1). This would enable those who wish, to discuss how their  
180 identity(ies) interacted with their careers. In addition to these suggestions for policy change, we have  
181 created resources that allow scientists to self-identify as under-served groups and thus provide host faculty  
182 with more diverse choices (Table 1).

## 183 **Building Diversify**

184 Motivated by a lack of resources to identify scientists who are members of marginalized and/or historically  
185 under-served groups, and inspired by resources in other fields—DiversifyEEB and DiversifyChemistry—we  
186 created DiversifyMicrobiology and DiversifyImmunology (45–48). These resources are a tool for symposium  
187 organizers, award committees, search committees, and other scientists to identify individuals to diversify  
188 their pools. Additionally, we have built these as a template to be used by other fields and organizations that  
189 wish to create their own lists. Since these lists are compiled by self-nomination, we can ensure that only  
190 scientists comfortable revealing their marginalized identities are included.

191 The self-nomination form is a Google Form with entries logged in a private Google Sheet. This form is  
192 embedded within the website and can be linked to directly. The use of a Google Forms allows us to  
193 maintain this database at no cost and gives us the flexibility to add questions or change response options  
194 without disrupting previous responses. Entries are logged in a private spreadsheet so that entries can be  
195 screened before being added to the public database. This screening includes two steps: confirming that  
196 each person is listed in the database only once and that any submitted website is a personal, professional  
197 website. If both criteria are met, a new entry is added to the public database spreadsheet. If a person is

198 already listed in the database, their information is updated to the most recent submission.

199 This public spreadsheet is embedded in the website and can be open separately as a locked (uneditable)  
200 Google Sheet, allowing the list to be easily searched. We have chosen to list individuals' academic  
201 information first in the spreadsheet to encourage a focus on academic achievement rather than tokenization  
202 of marginalized identities. Currently the database lists individuals in order of self-nomination but future  
203 versions will be re-sorted based on name and/or academic field to varying the individuals who may receive  
204 more attention for simply being at the top of the list.

205 The website provides an interface to the Google forms and spreadsheets with template pages for viewing  
206 the list, adding a name to the list, and finding additional resources. Importantly, our website creation tool  
207 is hosted for free by GitHub, which provides a free website for each GitHub organization. Basic tools and  
208 skills required to set up a Diversify site include knowledge of, or experience with, the version control tool git,  
209 the web-tool GitHub, and a text editor. A tutorial in the DiversifyMicrobiology repository on GitHub provides  
210 links to these resources and instructions for adapting the tool to your own field (47).

## 211 **Conclusion**

212 To increase the retention of white women, HURM and NCNH trainees in the biomedical sciences, they  
213 must also be represented as experts. However, the invited speaker diversity at one department does not  
214 represent the diversity of trainees. To facilitate the identification and recruitment of individuals in these  
215 historically under-served groups, we have built a tool to create self-nominated, field-specific lists.

## 216 **Acknowledgements**

217 We thank Drs. Beth Moore and Harry Mobley and the Department of Microbiology & Immunology, University  
218 of Michigan for their input and financial support that enabled publication of our manuscript. We thank Bonnie  
219 Krey and former speaker series coordinators Drs. Nicole Koropatkin and Kathy Spindler for access to invited  
220 speaker data. We would also like to acknowledge and thank Nick Lesniak and Dr. Ariangela Kozick for their  
221 comments and suggestions.

## 222 **Author Contributions**

223 A.K.H. collected the data, assigned demographics, analyzed the data, created the website, and wrote the  
224 methods and results. R.M.P. created the Google lists, forms, and website content and the description of  
225 their maintenance. J.L. wrote the introduction and provided conceptual advice. A.K.H. and J.L. facilitated the  
226 policy change to the UM Department of Microbiology and Immunology. All authors contributed to preparing  
227 the final manuscript.

## 228 **Code and data availability**

229 The anonymized data, code for all analysis steps, and an Rmarkdown version of this manuscript is available  
230 at [https://github.com/akhagan/Hagan\\_SpeakerDiversity\\_JMBE\\_2019](https://github.com/akhagan/Hagan_SpeakerDiversity_JMBE_2019). Template and complete instructions  
231 for generating a field-specific Diversity website are available at [https://github.com/diversifymicrobiology/](https://github.com/diversifymicrobiology/DiversifyMicrobiology.github.io/)  
232 [DiversifyMicrobiology.github.io/](https://github.com/diversifymicrobiology/DiversifyMicrobiology.github.io/).

233

Table 1: List of suggestions and resources to increase invited speaker diversity.

| Suggestion            | Description   | Resource  |
|-----------------------|---|---|
| Lab-invited speakers  | Faculty members can request suggestions from trainees                                 |   |
| Use a list            | Many lists of scientists from under-represented and under-served groups are available | <a href="https://DiversifyMicrobiology.github.io/resources">https://DiversifyMicrobiology.github.io/resources</a>   |
| Create a list         | Use the GitHub template create a self-nomination list and resource for your field     | <a href="https://github.com/diversifymicrobiology/DiversifyMicrobiology.github.io">https://github.com/diversifymicrobiology/DiversifyMicrobiology.github.io</a> |
| Highlight the journey | Invite all speakers to spend a few moments describing their personal science journey  |   |

234

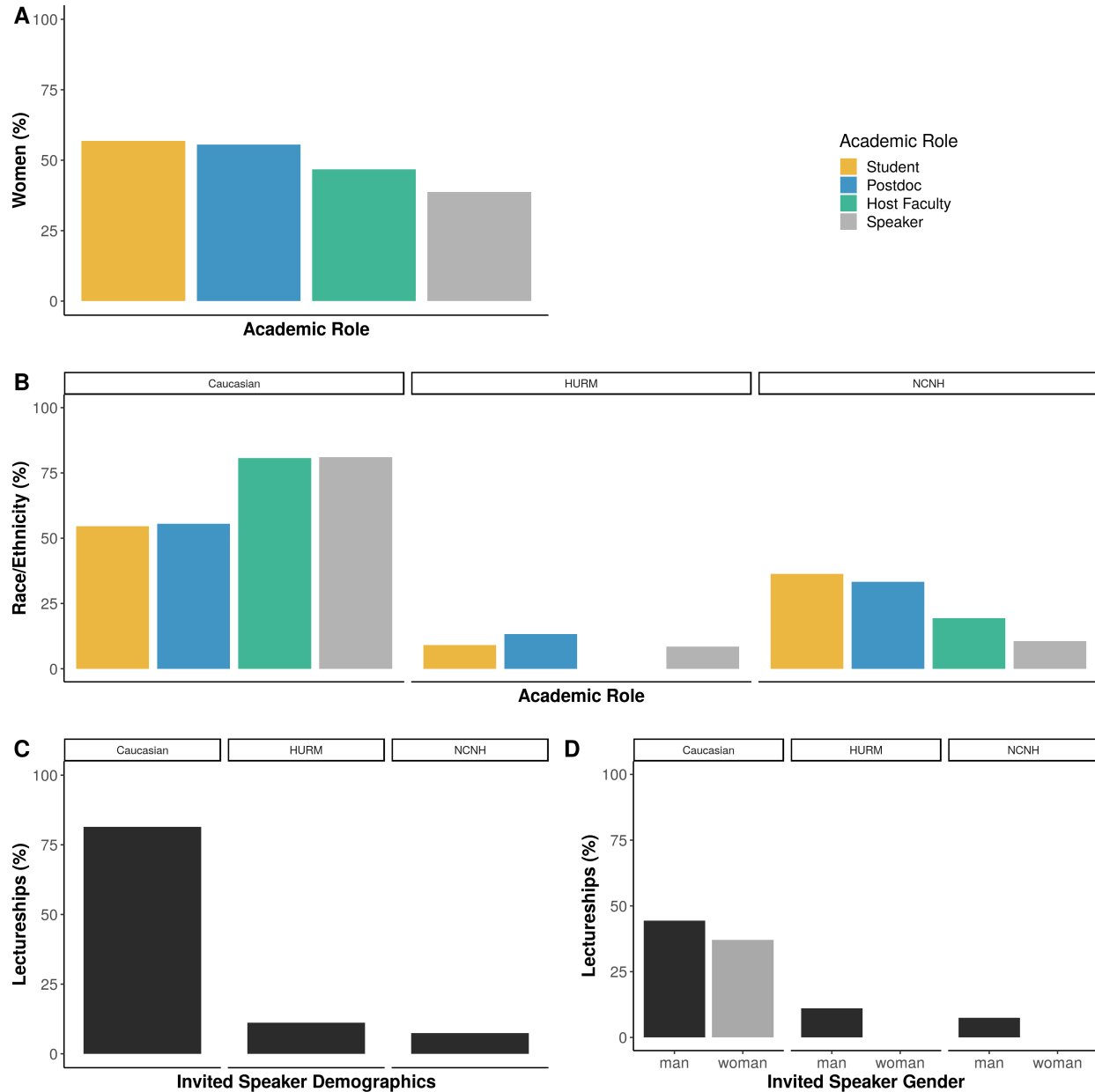


Figure 1: **The demographics of invited speakers, hosting faculty, and trainees.** A) The proportion of women in each academic role. B) The proportion of each academic role represented by individuals that are Caucasian (left), Historically Underrepresented Minorities (HURM, center) or Non-Caucasian/Non-HURM (NCNH, right). C-D) The percent of lectureships awarded to individuals that are C) Caucasian, HURM, or NCNH and D) Caucasian, HURM, or NCNH by gender.

## 235 References

- 236 1. **Martinez LR, Boucaud DW, Casadevall A, August A.** 2018. Factors contributing to the success of  
237 NIH-designated underrepresented minorities in academic and nonacademic research positions. *CBE Life*  
238 *Sciences Education* **17**:ar32. doi:10.1187/cbe.16-09-0287.
- 239 2. **Allen-Ramdial S-AA, Campbell AG.** 2014. Reimagining the pipeline: Advancing STEM diversity,  
240 persistence, and success. *BioScience* **64**:612–618. doi:10.1093/biosci/biu076.
- 241 3. **Fang D.** 2000. Racial and ethnic disparities in faculty promotion in academic medicine. *JAMA* **284**:1085.  
242 doi:10.1001/jama.284.9.1085.
- 243 4. **Gibbs KD, McGready J, Bennett JC, Griffin K.** 2014. Biomedical science ph.D. career interest patterns  
244 by race/ethnicity and gender. *PLoS ONE* **9**:e114736. doi:10.1371/journal.pone.0114736.
- 245 5. **Meyers LC, Brown AM, Moneta-Koehler L, Chalkley R.** 2018. Survey of checkpoints along the pathway  
246 to diverse biomedical research faculty. *PLOS ONE* **13**:e0190606. doi:10.1371/journal.pone.0190606.
- 247 6. **National Center for Science and Engineering Statistics.** 2014. Women, minorities, and persons with  
248 disabilities in science and engineering. National Science Foundation, Alexandria, VA.
- 249 7. **Jena AB, Khullar D, Ho O, Olenski AR, Blumenthal DM.** 2015. Sex differences in academic rank in  
250 US medical schools in 2014. *JAMA* **314**:1149. doi:10.1001/jama.2015.10680.
- 251 8. **Rotbart HA, McMillen D, Taussig H, Daniels SR.** 2012. Assessing gender equity in a large academic  
252 department of pediatrics. *Academic Medicine* **87**:98–104. doi:10.1097/acm.0b013e31823be028.
- 253 9. **Coe IR, Wiley R, Bekker L-G.** 2019. Organisational best practices towards gender equality in science  
254 and medicine. *The Lancet* **393**:587–593. doi:10.1016/s0140-6736(18)33188-x.
- 255 10. **Eagly AH, Steffen VJ.** 1984. Gender stereotypes stem from the distribution of women and men into  
256 social roles. *Journal of Personality and Social Psychology* **46**:735–754. doi:10.1037/0022-3514.46.4.735.
- 257 11. **Carter AJ, Croft A, Lukas D, Sandstrom GM.** 2018. Women's visibility in academic seminars: Women  
258 ask fewer questions than men. *PLOS ONE* **13**:e0202743. doi:10.1371/journal.pone.0202743.
- 259 12. **Nittrouer CL, Hebl MR, Ashburn-Nardo L, Trump-Steele RCE, Lane DM, Valian V.** 2018. Gender  
260 disparities in colloquium speakers at top universities. *Proceedings of the National Academy of Sciences*

261 **115:104–108**. doi:10.1073/pnas.1708414115.

262 13. **Kalejta RF, Palmenberg AC**. 2017. Gender Parity Trends for Invited Speakers at Four Prominent  
263 Virology Conference Series. *Journal of Virology* **91**. doi:10.1128/JVI.00739-17.

264 14. **Casadevall A, Handelsman J**. 2014. The Presence of Female Conveners Correlates with a Higher  
265 Proportion of Female Speakers at Scientific Symposia. *mBio* **5**. doi:10.1128/mBio.00846-13.

266 15. **Klein RS, Voskuhl R, Segal BM, Dittel BN, Lane TE, Bethea JR, Carson MJ, Colton C, Rosi S,**  
267 **Anderson A, Piccio L, Goverman JM, Benveniste EN, Brown MA, Tiwari-Woodruff SK, Harris TH,**  
268 **Cross AH**. 2017. Speaking out about gender imbalance in invited speakers improves diversity. *Nature*  
269 *Immunology* **18:475–478**. doi:10.1038/ni.3707.

270 16. **R Core Team**. 2017. R: A language and environment for statistical computing. R Foundation for  
271 Statistical Computing, Vienna, Austria.

272 17. **Wickham H**. 2017. Tidyverse: Easily Install and Load the 'Tidyverse'.

273 18. **Wilke CO**. 2019. Cowplot: Streamlined plot theme and plot annotations for 'ggplot2'.

274 19. **Allaire J, Horner J, Xie Y, Marti V, Porte N**. 2018. Markdown: 'Markdown' rendering for r.

275 20. **Xie Y, Allaire J, Grolemond G**. 2018. R markdown: The definitive guide. Chapman; Hall/CRC, Boca  
276 Raton, Florida.

277 21. **Allaire J, Xie Y, McPherson J, Luraschi J, Ushey K, Atkins A, Wickham H, Cheng J, Chang W,**  
278 **Iannone R**. 2018. Rmarkdown: Dynamic documents for r.

279 22. **Xie Y**. 2014. Knitr: A comprehensive tool for reproducible research in R. *In* Stodden, V, Leisch, F, Peng,  
280 RD (eds.), *Implementing reproducible computational research*. Chapman; Hall/CRC.

281 23. **Xie Y**. 2018. Knitr: A general-purpose package for dynamic report generation in r.

282 24. **Grolemond G, Wickham H**. 2011. Dates and times made easy with lubridate. *Journal of Statistical*

283 Software **40**:1–25.

284 25. **Wickham H, Bryan J.** 2018. Readxl: Read excel files.

285 26. **Ooms J.** 2019. Pdftools: Text extraction, rendering and converting of pdf documents.

286 27. **Wickham H.** 2018. Scales: Scale Functions for Visualization.

287 28. **Neuwirth E.** 2014. RColorBrewer: ColorBrewer Palettes.

288 29. **National Center for Science and Engineering Statistics.** 2017. Survey of Doctorate Recipients,  
289 Survey Year 2017. National Science Foundation, Alexandria, VA.

290 30. **Crenshaw K.** 1989. Demarginalizing the Intersection of Race and Sex: A black feminist critique of  
291 antidiscrimination doctrine, feminist theory and antiracist politics. University of Chicago Legal Forum **1989**.  
292 doi:10.1007/s11162-008-9097-4.

293 31. **Allagnat L, Berghmans S, Falk-Krzesinski HJ, Hanafi S, Herbert R, Huggett S, Tobin S.** 2017.  
294 Gender in the global research landscape.

295 32. **Blair-Loy M, Rogers L, Glaser D, Wong Y, Abraham D, Cosman P.** 2017. Gender in engineering  
296 departments: Are there gender differences in interruptions of academic job talks? Social Sciences **6**:29.  
297 doi:10.3390/socsci6010029.

298 33. **National Research Council Policy and Global Affairs, Committee on Women in Science,**  
299 **Engineering, and Medicine, Committee on Advancing Institutional Transformation for Minority**  
300 **Women in Academia, Rapporteur KM.** 2013. Seeking Solutions: Maximizing American Talent by  
301 Advancing Women of Color in Academia: Summary of a Conference. National Academies Press,  
302 Washington, D.C.

303 34. **Firth M.** 1982. Sex discrimination in job opportunities for women. Sex Roles **8**:891–901.  
304 doi:10.1007/bf00287858.

305 35. **Correll SJ, Benard S, Paik I.** 2007. Getting a job: Is there a motherhood penalty? American Journal  
306 of Sociology **112**:1297–1339. doi:10.1086/511799.

307 36. **Fuegen K, Biernat M, Haines E, Deaux K.** 2004. Mothers and fathers in the workplace: How gender  
308 and parental status influence judgments of job-related competence. Journal of Social Issues **60**:737–754.



309 doi:10.1111/j.0022-4537.2004.00383.x.

310 37. **Xu YJ**. 2008. Gender Disparity in STEM Disciplines: A Study of Faculty Attrition and Turnover  
311 Intentions. *Research in Higher Education* **49**:607–624. doi:10.1007/s11162-008-9097-4.

312 38. **Hwang W-C, Goto S**. 2008. The impact of perceived racial discrimination on the mental health of  
313 asian american and latino college students. *Cultural Diversity and Ethnic Minority Psychology* **14**:326–335.  
314 doi:10.1037/1099-9809.14.4.326.

315 39. **Tran VC, Lee J, Huang TJ**. 2019. Revisiting the asian second-generation advantage. *Ethnic and*  
316 *Racial Studies* **42**:2248–2269. doi:10.1080/01419870.2019.1579920.

317 40. **Gibbs KD, Basson J, Xierali IM, Broniatowski DA**. 2016. Decoupling of the minority PhD talent  
318 pool and assistant professor hiring in medical school basic science departments in the US. *eLife* **5**.  
319 doi:10.7554/elife.21393.

320 41. **Whittaker JA, Montgomery BL, Martinez Acosta VG**. 2015. Retention of Underrepresented Minority  
321 Faculty: Strategic Initiatives for Institutional Value Proposition Based on Perspectives from a Range of  
322 Academic Institutions. *Journal of undergraduate neuroscience education: JUNE: a publication of FUN,*  
323 *Faculty for Undergraduate Neuroscience* **13**:A136–145.

324 42. **Pololi L, Cooper LA, Carr P**. 2010. Race, Disadvantage and Faculty Experiences in Academic  
325 Medicine. *Journal of General Internal Medicine* **25**:1363–1369. doi:10.1007/s11606-010-1478-7.

326 43. **Hassouneh D, Lutz KF, Beckett AK, Junkins EP, Horton LL**. 2014. The experiences of  
327 underrepresented minority faculty in schools of medicine. *Medical Education Online* **19**:24768.  
328 doi:10.3402/meo.v19.24768.

329 44. **Johnson MDL**. 2019. mSphere of Influence: Hiring of Underrepresented Minority Assistant  
330 Professors in Medical School Basic Science Departments Has a Long Way To Go. *mSphere* **4**.  
331 doi:10.1128/mSphere.00599-19.

332 45. **Baucom R, Duffy M**. 2019. DiversifyEEB. <https://diversifyeeb.com>.

333 46. **Duffy M, McNeil AJ**. 2019. DiversifyChemistry. <https://diversifychemistry.com>.

334 47. **Hagan AK, Pollet RM**. 2019. DiversifyMicrobiology. GitHub repository. <https://github.com/>

335 [diversifymicrobiology.github.io](https://github.com/diversifymicrobiology); GitHub.

336 48. **Hagan AK, Pollet RM.** 2019. DiversifyImmunology. GitHub repository. <https://github.com/>

337 [diversifyimmunology.github.io](https://github.com/diversifyimmunology); GitHub.