

Suggestions for improving invited speaker diversity to reflect trainee diversity

Running title: Suggestions for improving invited speaker diversity

Ada K. Hagan, Ph.D.^{*†}, Rebecca M. Pollet, Ph.D.¹, and Josie Libertucci, Ph.D.^{**1}

† To whom correspondence should be addressed: akhagan@alliancescc.com

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

*Current address: Alliance SciComm & Consulting, Linden, Michigan

**Current address: 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

29 **Conflict of Interest Notification Page**

30

31 All authors affirm that there are no conflicts of interest.

32

33 **Abstract**

34 Within the field of biomedical research in the United States, the proportion of
35 underrepresented minorities at the full professor level has remained consistently
36 low, even though trainee demographics are becoming more diverse.

37 Underrepresented groups face a complex set of barriers to achieving faculty status
38 including imposter syndrome, increased performance expectations, and patterns of
39 exclusion. Institutionalized racism and sexism have contributed to these barriers
40 and perpetuated policy that excludes underrepresented minorities. These barriers
41 can contribute to decreased feelings of belonging, which may result in decreased
42 retention of underrepresented minorities. Though some universities have altered
43 their hiring practices to increase the number of underrepresented minorities in the
44 applicant pool, these changes have not been sufficient. Here we argue that
45 departmental invited seminar series can be used to provide trainees with scientific
46 role-models and increase their sense of belonging, while institutions work towards
47 more inclusive policy. In this study, we investigated the demographics (gender and
48 race) of invited seminar speakers over 5 years to the Department of Microbiology
49 and Immunology at the University of Michigan. We also investigated current trainee
50 demographics and compared them to invited speaker demographics to gauge if our
51 trainees are being provided with representation of themselves. We found that
52 invited speaker demographics were skewed towards Caucasian men, and our
53 trainee demographics were not being represented. From these findings, we
54 proposed policy change within the department to address how speakers are being
55 invited with the goal of increasing speaker diversity to better reflect trainee

56 diversity. To facilitate this process, we developed a set of suggestions and a web-
57 based resource that allows scientists, committees, and moderators to identify
58 members of under-served groups. These resources can be easily adapted by other
59 fields or sub-fields to promote inclusion and diversity at seminar series',
60 conferences, and colloquia.

61

62

63 **Keywords**

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

65

66 **Background**

67 Long-standing systemic bias, sexism, and racism have contributed to the under-
68 representation of many racial and ethnic groups, as well as women, in science,
69 technology, engineering, and math (STEM) fields (1–4). Specifically, within the field
70 of biomedical research in the United States, the proportion of underrepresented
71 minorities at the full professor level has remained consistently low at 4% (survey
72 data taken from the NIH from 2001 to 2013) (5, 6). Similar discrepancies exist for
73 women in biomedical sciences as full professorships are currently held mostly by
74 men (7, 8). As demographics of faculty within the biomedical sciences remain
75 skewed towards Caucasian men, the demographics of trainees (graduate students
76 and postdocs) are becoming more diverse (5).

77 Policy changes are needed to support inclusion of all individuals, particularly in the
78 biomedical sciences, since underrepresented groups face a complex set of barriers
79 to achieving faculty status (9). For example, the dedication of women—who have
80 children—to their work is perceived to be less than that of their colleagues,
81 including men who also have children (10–12). Historically under-represented
82 minorities in the United States (HURM), Asian/Asian-Americans, and women are all
83 held to stricter competency standards and report having to work harder than
84 Caucasian men to be perceived as legitimate scholars (13, 14). Asian/Asian-
85 Americans suffer from imposter syndrome at greater rates than other marginalized
86 groups and Asian women report a lack of sponsors (15, 16). Increased performance
87 expectations and patterns of exclusions are consistent themes in studies

characterizing the HURM faculty experience (17, 18). While HURM and other marginalized groups share some experiences, differences including varying rates of hiring and tenure promotion mean that unique considerations are important for inclusion of each group (3).

Here, we argue that to support the retention of faculty from marginalized groups at the professor level, universities should provide trainees with visual representation of themselves as successful scientists. Recent studies show that women in STEM benefit from women role models through improved belonging and self-efficacy (19, 20). Predictably, a lack of active inclusion also decreases self-efficacy in URM, which can result in decreased feelings of belonging (21). However, as the demographics of trainees have become more diverse, those who are not Caucasian men are lacking role models. Institutionalized racism and sexism (22), defined as policies, societal norms, and ideologies that reinforce inequities, have played a large role in access to, inclusion in, and hiring policies at U.S. universities (23, 24).

Accordingly, faculty from marginalized groups are eliminated from the applicant pool and subsequent hires, leaving university policies and practices to be predominantly created by Caucasian men. Thus, institutionalized racism and sexism are perpetuated (25, 26). Universities have begun adjusting hiring practices and creating initiatives to address inequitable hiring practices, but have had limited results (27). Considering that most faculties within the U.S. are still skewed towards Caucasian men, invited seminar series are a possible tool to provide marginalized trainees with representation of themselves as successful scientists.

Invited seminar series are common within biomedical departments across the United States (28). Usually, seminar series' consist of faculty members selecting a scientist from another institution to visit their university and present their research, as well as meet with other faculty members and trainees. Named lectureships follow the same format but are decided by committee and are considered more prestigious because they are named in honor of prominent local scientists. These seminar series and lectureships provide an opportunity for trainees to be exposed to research outside of their department. Additionally, being an invited speaker provides the scientist with an opportunity to make future collaborations and build their own *curriculum vitae* (CV). Scientists invited to give seminars are widely regarded as successful and the top in their field, providing an opportunity for trainees to be exposed to successful scientists in that field. Some studies have examined the addition of more women speakers at conferences to promote inclusion (29–31), however, we have only identified one other study that has focused on invited speakers at universities (28). In their study, Nittrouer et al, examined 3,652 talks at 50 U.S. institutions in 2013 - 2014 and found that women faculty are less likely to be invited speakers (28). We have not been able to identify any publications examining scientific speaker diversity beyond gender or how department speaker series compares to trainee diversity in that department.

In this study, we examine and compare the demographics of invited speakers to Caucasian men in the Department of Microbiology and Immunology at the University of Michigan. Additionally, we compare invited-speaker demographics to the current trainee demographics to gauge if trainee demographics are being

represented throughout the seminar series. Following our investigation, we proposed a policy change to the Department of Microbiology and Immunology in how invited speakers are selected to promote inclusion in our department and reduce unconscious bias. In order to facilitate inviting a more diverse group of scientists, we developed a set of resources that allow scientists, within the fields of microbiology and immunology, to self-identify any under-represented or under-served identity including: HURM, non-Caucasian/non-HURM (NCNH), or a Caucasian woman. These resources will promote inclusion and diversity by providing greater representation of all scientists and will provide hosts an opportunity to invite a more diverse group of scientists.

Methods

Each academic year, each faculty member in the Department of Microbiology and Immunology at the University of Michigan has the opportunity to invite one speaker per year for a weekly seminar series. Some of these seminar slots are dedicated to named lectureships, which are decided by committee, and three trainee-invited speakers. We analyzed the demographics of invited speakers and faculty hosts for five academic years (Fall 2014 - Spring 2019), and compared them to the current trainees when the data were analyzed (Spring 2019). Each speaker was only counted once and those listed as departmental faculty members or as a “host” at any point could not also be considered “invited speakers”. The list of faculty hosts was used as a proxy for faculty demographics since as hosts, these faculty members are visible representatives of the department. There were a total of 142 invited speakers and paired hosts. The trainees were identified using departmental email

156 lists that included masters students, doctoral students, and post-doctoral fellows.
157 There were 44 students and 45 post-doctoral fellows.

158 This is a retrospective study, thus speakers were not asked for their identities at the
159 time of visit. Instead we hand-coded proxy demographics of the speakers, faculty
160 hosts and trainees using first names, publicly available photos, and CVs (32–36).
161 Information from CVs, such as undergraduate institutions and activity in HURM
162 groups helped inform our demographics by indicating identities that might be held
163 by that individual. For instance, an undergraduate at a Puerto Rican university and
164 activity in the non-profit Ciencia Puerto Rico suggests that even if the individual
165 appears Caucasian, they probably identify as Puerto Rican and qualify as a URM.
166 Because these data were collected from publicly available sources, this study was
167 not submitted to an IRB for consideration. The presenting gender of each individual
168 was inferred using a binary system (man/woman). Due to the low number of
169 individuals in the study, race/ethnicity demographics were only split into three
170 groups: Caucasian, Historically Under-represented Minority (HURM), and Non-
171 Caucasian/Non-HURM (NCNH), each with a binary (yes/no) possibility. Caucasian
172 was inferred using the current U.S. Census definition where those of Middle Eastern,
173 European, and Russian descent are included. URM individuals include those of
174 African-American, Indigenous American, Alaskan/Hawaiian Native, Latinx and/or
175 Hispanic heritage (20 U.S. Code § 1067k), we use the HURM designation to recognize
176 the history of enslavement and active oppression in the U.S.. The NCNH group
177 predominantly included Asian/Asian-Americans, but also African immigrants (37).

178 Data were compiled and figures generated in R Statistical Software, using relevant
179 packages (38–50).

180 **Results**

181 To understand the representation of women, we compared the proportion of
182 women in each academic role. At the trainee level, more than half of students and
183 postdoctoral fellows were women. That dropped to 46.77% of faculty hosts and
184 38.73% of the invited speakers (Fig. 1A). Of 27 lectureships over the five year
185 period, 37.04% were awarded to women.

186 Our analysis identified an over-representation of Caucasian individuals as hosting
187 faculty and invited speakers (80% each), relative to the proportion of Caucasian
188 trainees, which was 55% (Fig. 1B). We also observed declines in the representation
189 of HURM and NCNH faculty and speakers relative to the trainees (Fig 1B). HURM
190 trainees made up 11% of the department, on track with the 11% of U.S.
191 microbiology and immunology doctorates awarded in 2017 (51). However, only
192 8.5% of invited speakers, and none of the hosting faculty, were HURM scientists.
193 NCNH trainees were 34% of department students and postdocs (versus 22% of U.S.
194 microbiology and immunology doctorates in 2017), but only 19% of hosting faculty
195 and 10.5% of invited speakers (51).

196 The more prestigious invited speaker lectureships were also dominated by
197 Caucasian scientists, who comprised 81.48% of those awarded (Fig. 1C). HURM and
198 NCNH scientists were awarded 3 and 2 lectureships, respectively. Because the
199 intersection of identities can compound biases and outcomes, we further examined

the lectureships by gender and race/ethnicity status (52). Caucasian men and women accounted for 44.44% and 37.04% of the lectureships, respectively. Just 18.52% of lectureships were held by non-Caucasian men while none were held by non-Caucasian women (Fig. 1D).

Discussion

This study found that the proportion of HURM and NCNH invited speakers were under-representative of the trainee populations for each group. Additionally, within the last 5 years, no HURM or NCNH woman was awarded a lectureship, despite that in 2017 non-Caucasians were 30% of the professoriate (53). This means that the department is not providing non-Caucasian trainees with adequate representation of successful scientists and failing to support an inclusive environment in terms of visual faculty representation. We also found that the proportion of women as faculty hosts and speakers in our study population is equivalent to global estimates that 40% of microbiologists are women, though women only represent about 30% of academic biomedical faculty (7, 54). Women are also over-represented as graduate students and postdoctoral fellows in this department. Overall, Caucasian scientists are over-represented as host faculty and invited speakers, compared to their presence as trainees, particularly when lectureships were considered.

We have not been able to identify any publications examining scientific speaker diversity beyond gender (28). This seems to be the first, which is concerning since conclusions drawn from gender-based studies are often framed, and considered, to be applicable to other marginalized groups (e.g., HURM). For instance, that African-

222 American and Caucasian women benefit equally from the same policy change. This
223 is a flawed assumption (55). While there is no doubt some overlap, each group
224 remains marginalized due to a unique complex set of factors that cannot always be
225 solved by gender-based solutions. The historical exclusion of HURMs by U.S.
226 institutions means that they have a particular responsibility to improving the
227 academic experience for these populations (23). We therefore call on U.S.
228 institutions to apply intersectional framing to their discussions and research.

229 Departments have different processes and criteria for selecting invited speakers, but
230 it is a matter of pride to bring the best scientists possible. The barriers to achieving
231 faculty status for HURMs, Caucasian women, and NCNH may also impact their
232 speaking invitations. For instance, the perceived prioritization and commitments of
233 women to family over work may cause faculty to doubt their acceptance of a
234 speaking invitation, despite the prestigious nature of these invitations and evidence
235 that men and women accept at similar rates (28, 56). As a result, the faculty member
236 may invite a different colleague who they feel is more likely to agree (and is a man).
237 It may also be that the definition of “best” poses a problem to under-represented
238 and under-served groups (e.g., women, HURM, and Asian) who are held to stricter
239 competency standards (13, 14). Some departments may only invite tenured faculty,
240 which severely limits the number of potential speakers who are Caucasian women
241 or non-Caucasian. Yet, another scenario is that pre-tenure faculty members invite
242 prestigious, tenured faculty in their field to network and secure letters for their own
243 tenure package. The increased burden of women and non-Caucasian scientists to
244 prove competency decreases their likelihood to be considered for either tenure or

245 as possible source of tenure letters. In particular, the proportion of HURM faculty at
246 the Assistant and Associate Professor level is currently higher than at Full Professor
247 so it will be difficult to increase speaker diversity if early-career researchers are not
248 being considered (57). Even when HURM speaker rates match the proportion of
249 HURM faculty employment, HURM trainees will be represented at a significantly
250 higher proportion. We argue that inclusion of marginalized faculty in seminar series
251 is an important factor to increasing their representation among Associate and Full
252 Professors. It is just one aspect of larger institutional change that is needed, but one
253 that will benefit trainee experiences and the CVs of faculty from marginalized
254 groups (58).

255 We recognize that our proxy demographics are a limitation of the analysis and want
256 to acknowledge that biological sex (male/female) is not always equivalent to the
257 gender that an individual presents as (man/woman), which is also distinct from the
258 gender(s) that an individual self-identifies as. We also want to acknowledge that
259 there are many other identities that are not captured in this limited analysis and
260 that our personal implicit biases may have impacted our assignment of
261 demographics. While our pilot study combined 5 years worth of seminars, our n is
262 still quite low and we did not have other departments for comparison.

263 Consequently, our results can not be generalized to other departments, fields, or
264 universities. Another limitation to looking at a single department is that trainees
265 may interact with faculty from many other departments, depending on their
266 research and interests. Therefore, the individual experience of representation
267 would vary by trainee. Future research needs to consider multiple departments,

268 universities, and/or fields to bolster generalizability. There is a paucity of research
269 on speaker identities other than their gender, so this also needs to be addressed in
270 future studies. However, we caution that representation is a shallow metric on
271 which a single-minded focus can cause more harm than help (25). We recommend
272 that future research also survey trainee and speaker experiences and trainee
273 participation in seminar series to better understand the dynamics at play.

274 **Instituting Policy Change**

275 In an attempt to promote inclusion within the Department of Microbiology and
276 Immunology at the University of Michigan, these data were presented to faculty
277 members and the department chair. Since trainee demographics were not
278 represented by the seminar speaker demographics over the past 5 years, we
279 proposed a policy change as to how seminar speakers were being invited (Table 1).
280 One suggestion was to switch from faculty-invited to lab-invited speakers to allow
281 trainees to choose a speaker that best represented themselves. This is easy to
282 implement as it does not change the overall structure of the department's seminar
283 series; however, for this same reason it may not have a significant impact on the
284 diversity of invited speakers. Trainees may be pressured to invite the top
285 individuals in their sub-field or may be influenced by the same unconscious biases
286 as faculty members. This idea can be expanded by increasing the number of trainee-
287 invited speakers and varying the trainee group that extend invitations, for instance
288 by training program, career interest, and/or trainees and faculty in an identity-
289 affinity group. Invitations from trainees are often seen as an honor by potential

290 seminar speakers and nominating as a group may decrease the pressure to invite
291 particular sub-fields or ranks.

292 We also used this opportunity to begin a conversation about the purpose of seminar
293 speakers. Seminar speakers are sometimes invited to highlight their latest high-
294 impact paper or to share the arc of discoveries they have made over several years of
295 their career. While both are certainly worthwhile, there are other benefits to be
296 gained from interacting with seminar speakers such as how to apply new techniques
297 and how research is framed outside research-focused universities (Table 1).

298 Thinking more broadly about what material is valuable during a seminar series may
299 lead to more speakers from under-represented and under-served backgrounds, as
300 well as more diversity of career paths. For some institutions, these suggestions
301 represent more of a structural change to the departmental seminar series as
302 speakers focusing on techniques or from non-research-intensive universities are
303 usually invited as part of a professional development series. If these changes are to
304 be implemented, many members of the department must agree to the value of
305 including these seminars in the main departmental seminar series and these
306 expectations must be clearly communicated by the leadership (Table 1).

307 Departmental leadership can also ask individuals and groups to consider the
308 unconscious biases that may be impacting their own speaker nominee lists to
309 combat some of the barriers to inviting diverse speakers.

310 Presented with these ideas, several members of the Department of Microbiology and
311 Immunology at the University of Michigan expressed interest in specific resources

312 they might use to identify individuals from diverse identities, careers, and
313 institutions. One suggestion is to use resources that are being organized by
314 professional societies such as the American Society for Microbiology (ASM) and the
315 Society for Advancing Chicanos/Hispanics & Native Americans in Science (SACNAS)
316 (Table 1). We also chose to develop “Diversify” resources for the microbiology and
317 immunology fields that provide a list of scientists from under-represented and
318 under-served groups, that is not associated with a specific professional society.
319 More information on the type of resources and how to establish a Diversify list is
320 below. Using list resources like those available from professional societies as well as
321 our “Diversify” resources are particularly useful as social science research has
322 shown that the human brain is much better at recognizing and using information
323 (such as a strong scientific speaker) from a list than it is at recalling the same
324 information from memory (59, 60).

325 We caution, however, that it is not enough to invite speakers from diverse identities.
326 An inclusive environment must be built within the department. Start by inviting all
327 speakers to spend a few minutes describing their personal science journey and
328 providing time for trainees to engage with the speaker. Trainee-speaker interactions
329 can be encouraged by ensuring that trainees are the first to ask questions at the
330 seminar’s conclusion and by scheduling a dedicated meeting time for trainees. As
331 speaker schedules are being designed, departments should consider how they can
332 foster an inclusive atmosphere during the speaker visits. Speakers should be asked
333 prior to their visit if they have any dietary, movement, or other restrictions that
334 should be accommodated during the visit. The identities of individuals the speaker

is meeting with during their visit may also need to be considered; this is not to say that all identities of a speaker should be matched on their schedule or that a HURM speaker must have a meeting a HURM faculty member, but take care to ensure that speakers are meeting with faculty that reflect the diversity of thought and identity in the department. If a portion of the department is consistently not represented on speakers' schedules (or extending invitations) this may reflect an opportunity for increased inclusivity in the department. Finally, speakers should be provided with ample opportunity to request meetings, not only with faculty but also with student groups or campus administrators who share similar interests. Through these steps departments can increase the diversity of speakers invited to their seminars while also increasing the impact of the seminar speakers.

Building Diversify

Motivated by a lack of resources to identify scientists who are members of marginalized and/or historically under-served groups, and inspired by resources in other fields–DiversifyEEB and DiversifyChemistry–we created DiversifyMicrobiology and DiversifyImmunology (61–64). These resources are a tool for symposium organizers, award committees, search committees, and other scientists to identify individuals to diversify their pools. Additionally, we have built these as a template to be used by other fields and organizations that wish to create their own lists. Since these lists are compiled by self-nomination, we can ensure that only scientists comfortable revealing their marginalized identities are included.

356 The self-nomination form is a Google Form with entries logged in a private Google
357 Sheet. This form is embedded within the website and can be linked to directly. The
358 use of a Google Forms allows us to maintain this database at no cost and gives us the
359 flexibility to add questions or change response options without disrupting previous
360 responses. Entries are logged in a private spreadsheet so that entries can be
361 screened before being added to the public database. This screening includes two
362 steps: confirming that each person is listed in the database only once and that any
363 submitted website is a personal, professional website. If both criteria are met, a new
364 entry is added to the public database spreadsheet. If a person is already listed in the
365 database, their information is updated to the most recent submission.

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

374 The website provides an interface to the Google forms and spreadsheets with
375 template pages for viewing the list, adding a name to the list, and finding additional
376 resources. Importantly, our website creation tool is hosted for free by GitHub, which
377 provides a free website for each GitHub organization. Basic tools and skills required

378 to set up a Diversify site include knowledge of, or experience with, the version
379 control tool git, the web-tool GitHub, and a text editor. A tutorial in the
380 DiversifyMicrobiology repository on GitHub provides links to these resources and
381 instructions for adapting the tool to your own field (Table 1) (63). We caution
382 creators of Diversify lists that the data voluntarily submitted to these lists is not
383 eligible for study. IRB approval must be obtained prior to launching the list if that is
384 a goal.

385 **Conclusion**

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

391 **Acknowledgments**

392 We thank Drs. Beth Moore and Harry Mobley and the Department of Microbiology &
393 Immunology, University of Michigan for their input and financial support that
394 enabled publication of our manuscript. We thank Bonnie Krey and former speaker
395 series coordinators Drs. Nicole Koropatkin and Kathy Spindler for providing
396 compiled invited speaker data. We would also like to acknowledge and thank Nick
397 Lesniak and Dr. Ariangela Kozick for their comments and suggestions.

398 **Author Contributions**

399 A.K.H. collected the data, inferred demographics, analyzed the data, created the
400 website, and wrote the methods and results. R.M.P. created the Google lists, forms,
401 and website content and the description of their maintenance. J.L. wrote the
402 introduction and provided conceptual advice. A.K.H. and J.L facilitated the policy
403 change to the UM Department of Microbiology and Immunology. All authors
404 contributed to preparing the final manuscript.

405 **Code and data availability**

406 The anonymized data, code for all analysis steps, and an Rmarkdown version of this
407 manuscript is available at
408 https://github.com/akhagan/Hagan_SpeakerDiversity_JMBE_2019. Template and
409 complete instructions for generating a field-specific Diversity website are available
410 at <https://github.com/diversifymicrobiology/DiversifyMicrobiology.github.io/>.

References

1. **Martinez LR, Boucaud DW, Casadevall A, August A.** 2018. Factors contributing to the success of NIH-designated underrepresented minorities in academic and nonacademic research positions. *CBELife Sciences Education* **17**:ar32. doi:[10.1187/cbe.16-09-0287](https://doi.org/10.1187/cbe.16-09-0287).
2. **Allen-Ramdial S-AA, Campbell AG.** 2014. Reimagining the pipeline: Advancing STEM diversity, persistence, and success. *BioScience* **64**:612–618. doi:[10.1093/biosci/biu076](https://doi.org/10.1093/biosci/biu076).
3. **Fang D.** 2000. Racial and ethnic disparities in faculty promotion in academic medicine. *JAMA* **284**:1085. doi:[10.1001/jama.284.9.1085](https://doi.org/10.1001/jama.284.9.1085).
4. **Gibbs KD, McGready J, Bennett JC, Griffin K.** 2014. Biomedical science ph.D. career interest patterns by race/ethnicity and gender. *PLoS ONE* **9**:e114736. doi:[10.1371/journal.pone.0114736](https://doi.org/10.1371/journal.pone.0114736).
5. **Meyers LC, Brown AM, Moneta-Koehler L, Chalkley R.** 2018. Survey of checkpoints along the pathway to diverse biomedical research faculty. *PLOS ONE* **13**:e0190606. doi:[10.1371/journal.pone.0190606](https://doi.org/10.1371/journal.pone.0190606).
6. **National Center for Science and Engineering Statistics.** 2014. Women, minorities, and persons with disabilities in science and engineering. National Science Foundation, Alexandria, VA.

- 430 7. **Jena AB, Khullar D, Ho O, Olenski AR, Blumenthal DM.** 2015. Sex differences in
431 academic rank in US medical schools in 2014. *JAMA* **314**:1149.
432 doi:[10.1001/jama.2015.10680](https://doi.org/10.1001/jama.2015.10680).
- 433 8. **Rotbart HA, McMillen D, Taussig H, Daniels SR.** 2012. Assessing gender equity
434 in a large academic department of pediatrics. *Academic Medicine* **87**:98–104.
435 doi:[10.1097/acm.0b013e31823be028](https://doi.org/10.1097/acm.0b013e31823be028).
- 436 9. **Coe IR, Wiley R, Bekker L-G.** 2019. Organisational best practices towards gender
437 equality in science and medicine. *The Lancet* **393**:587–593. doi:[10.1016/s0140-](https://doi.org/10.1016/s0140-6736(18)33188-x)
438 [6736\(18\)33188-x](https://doi.org/10.1016/s0140-6736(18)33188-x).
- 439 10. **Firth M.** 1982. Sex discrimination in job opportunities for women. *Sex Roles*
440 **8**:891–901. doi:[10.1007/bf00287858](https://doi.org/10.1007/bf00287858).
- 441 11. **Correll SJ, Benard S, Paik I.** 2007. Getting a job: Is there a motherhood penalty?
442 *American Journal of Sociology* **112**:1297–1339. doi:[10.1086/511799](https://doi.org/10.1086/511799).
- 443 12. **Fuegen K, Biernat M, Haines E, Deaux K.** 2004. Mothers and fathers in the
444 workplace: How gender and parental status influence judgments of job-related
445 competence. *Journal of Social Issues* **60**:737–754. doi:[10.1111/j.0022-](https://doi.org/10.1111/j.0022-4537.2004.00383.x)
446 [4537.2004.00383.x](https://doi.org/10.1111/j.0022-4537.2004.00383.x).
- 447 13. **Blair-Loy M, Rogers L, Glaser D, Wong Y, Abraham D, Cosman P.** 2017.
448 Gender in engineering departments: Are there gender differences in interruptions of
449 academic job talks? *Social Sciences* **6**:29. doi:[10.3390/socsci6010029](https://doi.org/10.3390/socsci6010029).

- 450 14. **National Research Council Policy and Global Affairs, Committee on Women**
451 **in Science, Engineering, and Medicine, Committee on Advancing Institutional**
452 **Transformation for Minority Women in Academia, Rapporteur KM.** 2013.
453 Seeking Solutions: Maximizing American Talent by Advancing Women of Color in
454 Academia: Summary of a Conference. National Academies Press, Washington, D.C.
- 455 15. **McGee E.** 2018. Black genius, asian fail: The detriment of stereotype lift and
456 stereotype threat in high-achieving asian and black STEM students. AERA Open
457 4:233285841881665. doi:[10.1177/2332858418816658](https://doi.org/10.1177/2332858418816658).
- 458 16. **Joan C. Williams RR Su Li, Finn P.** 2016. Climate control: Gender and racial bias
459 in engineering. University of California Hastings College of the Law, San Francisco,
460 CA.
- 461 17. **Pololi L, Cooper LA, Carr P.** 2010. Race, Disadvantage and Faculty Experiences
462 in Academic Medicine. Journal of General Internal Medicine **25**:1363–1369.
463 doi:[10.1007/s11606-010-1478-7](https://doi.org/10.1007/s11606-010-1478-7).
- 464 18. **Hassouneh D, Lutz KF, Beckett AK, Junkins EP, Horton LL.** 2014. The
465 experiences of underrepresented minority faculty in schools of medicine. Medical
466 Education Online **19**:24768. doi:[10.3402/meo.v19.24768](https://doi.org/10.3402/meo.v19.24768).
- 467 19. **Herrmann SD, Adelman RM, Bodford JE, Graudejus O, Okun MA, Kwan VSY.**
468 2016. The effects of a female role model on academic performance and persistence
469 of women in STEM courses. Basic and Applied Social Psychology **38**:258–268.
470 doi:[10.1080/01973533.2016.1209757](https://doi.org/10.1080/01973533.2016.1209757).

- 471 20. **Drury BJ, Siy JO, Cheryan S.** 2011. When do female role models benefit women?
472 The importance of differentiating recruitment from retention in STEM.
473 *Psychological Inquiry* **22**:265–269. doi:[10.1080/1047840x.2011.620935](https://doi.org/10.1080/1047840x.2011.620935).
- 474 21. **Lambert WM, Wells MT, Cipriano MF, Sneva JN, Morris JA, Golightly LM.**
475 2020. Career choices of underrepresented and female postdocs in the biomedical
476 sciences. *eLife* **9**. doi:[10.7554/elife.48774](https://doi.org/10.7554/elife.48774).
- 477 22. **Hardeman RR, Murphy KA, Karbeah J, Kozhimannil KB.** 2018. Naming
478 institutionalized racism in the public health literature: A systematic literature
479 review. *Public Health Reports* **133**:240–249. doi:[10.1177/0033354918760574](https://doi.org/10.1177/0033354918760574).
- 480 23. **Harvey WB.** 2011. Higher education and diversity: Ethical and practical
481 responsibility in the academy.
- 482 24. **Stack M.** 2019. Academic stars and university rankings in higher education:
483 Impacts on policy and practice. *Policy Reviews in Higher Education* **4**:4–24.
484 doi:[10.1080/23322969.2019.1667859](https://doi.org/10.1080/23322969.2019.1667859).
- 485 25. **Iverson SV.** 2007. Camouflaging power and privilege: A critical race analysis of
486 university diversity policies. *Educational Administration Quarterly* **43**:586–611.
487 doi:[10.1177/0013161x07307794](https://doi.org/10.1177/0013161x07307794).
- 488 26. **Tate SA, Bagguley P.** 2016. Building the anti-racist university: Next steps. *Race*
489 *Ethnicity and Education* **20**:289–299. doi:[10.1080/13613324.2016.1260227](https://doi.org/10.1080/13613324.2016.1260227).

- 490 27. **Gibbs KD, Basson J, Xierali IM, Broniatowski DA.** 2016. Decoupling of the
491 minority PhD talent pool and assistant professor hiring in medical school basic
492 science departments in the US. *eLife* **5**. doi:[10.7554/elife.21393](https://doi.org/10.7554/elife.21393).
- 493 28. **Nittrouer CL, Hebl MR, Ashburn-Nardo L, Trump-Steele RCE, Lane DM,**
494 **Valian V.** 2018. Gender disparities in colloquium speakers at top universities.
495 *Proceedings of the National Academy of Sciences* **115**:104–108.
496 doi:[10.1073/pnas.1708414115](https://doi.org/10.1073/pnas.1708414115).
- 497 29. **Kalejta RF, Palmenberg AC.** 2017. Gender Parity Trends for Invited Speakers at
498 Four Prominent Virology Conference Series. *Journal of Virology* **91**.
499 doi:[10.1128/JVI.00739-17](https://doi.org/10.1128/JVI.00739-17).
- 500 30. **Casadevall A, Handelsman J.** 2014. The Presence of Female Conveners
501 Correlates with a Higher Proportion of Female Speakers at Scientific Symposia.
502 *mBio* **5**. doi:[10.1128/mBio.00846-13](https://doi.org/10.1128/mBio.00846-13).
- 503 31. **Klein RS, Voskuhl R, Segal BM, Dittel BN, Lane TE, Bethea JR, Carson MJ,**
504 **Colton C, Rosi S, Anderson A, Piccio L, Goverman JM, Benveniste EN, Brown MA,**
505 **Tiwari-Woodruff SK, Harris TH, Cross AH.** 2017. Speaking out about gender
506 imbalance in invited speakers improves diversity. *Nature Immunology* **18**:475–478.
507 doi:[10.1038/ni.3707](https://doi.org/10.1038/ni.3707).
- 508 32. **Broderick NA, Casadevall A.** 2019. Gender inequalities among authors who
509 contributed equally. *eLife* **8**. doi:[10.7554/elife.36399](https://doi.org/10.7554/elife.36399).

- 510 33. **Kimery KM, Mellon MJ, Rinehart SM.** 2011. Publishing in the accounting
511 journals: Is there a gender bias? *Journal of Business & Economics Research (JBER)* **2**.
512 doi:[10.19030/jber.v2i4.2872](https://doi.org/10.19030/jber.v2i4.2872).
- 513 34. **Helmer M, Schottdorf M, Neef A, Battaglia D.** 2017. Gender bias in scholarly
514 peer review. *eLife* **6**. doi:[10.7554/elife.21718](https://doi.org/10.7554/elife.21718).
- 515 35. **Fox CW, Paine CET.** 2019. Gender differences in peer review outcomes and
516 manuscript impact at six journals of ecology and evolution. *Ecology and Evolution*
517 **9**:3599–3619. doi:[10.1002/ece3.4993](https://doi.org/10.1002/ece3.4993).
- 518 36. **Gilbert JR.** 1994. Is there gender bias in JAMAs peer review process? *JAMA: The*
519 *Journal of the American Medical Association* **272**:139.
520 doi:[10.1001/jama.1994.03520020065018](https://doi.org/10.1001/jama.1994.03520020065018).
- 521 37. **Okonofua BA.** 2013. I am blacker than you. *SAGE Open* **3**:215824401349916.
522 doi:[10.1177/2158244013499162](https://doi.org/10.1177/2158244013499162).
- 523 38. **R Core Team.** 2017. R: A language and environment for statistical computing. R
524 Foundation for Statistical Computing, Vienna, Austria.
- 525 39. **Wickham H.** 2017. Tidyverse: Easily Install and Load the 'Tidyverse'.
- 526 40. **Wilke CO.** 2019. Cowplot: Streamlined plot theme and plot annotations for
527 'ggplot2'.
- 528 41. **Allaire J, Horner J, Xie Y, Marti V, Porte N.** 2018. Markdown: 'Markdown'
529 rendering for r.

530 42. **Xie Y, Allaire J, Golemund G**. 2018. R markdown: The definitive guide.
531 Chapman; Hall/CRC, Boca Raton, Florida.

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

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

537 45. **Xie Y**. 2018. Knitr: A general-purpose package for dynamic report generation in
538 r.

539 46. **Golemund G, Wickham H**. 2011. Dates and times made easy with lubridate.
540 Journal of Statistical Software **40**:1–25.

541 47. **Wickham H, Bryan J**. 2018. Readxl: Read excel files.

542 48. **Ooms J**. 2019. Pdftools: Text extraction, rendering and converting of pdf
543 documents.

544 49. **Wickham H**. 2018. Scales: Scale Functions for Visualization.

545 50. **Neuwirth E**. 2014. RColorBrewer: ColorBrewer Palettes.

546 51. **National Center for Science and Engineering Statistics**. 2017. Survey of
547 Doctorate Recipients, Survey Year 2017. National Science Foundation, Alexandria,
548 VA.

549 52. **Crenshaw K.** 1989. Demarginalizing the Intersection of Race and Sex: A black
550 feminist critique of antidiscrimination doctrine, feminist theory and antiracist
551 politics. University of Chicago Legal Forum **1989**. doi:[10.1007/s11162-008-9097-4](https://doi.org/10.1007/s11162-008-9097-4).

552 53. **National Center for Science and Engineering Statistics Directorate for**
553 **Social, Behavioral, and Economic Sciences.** 2019. Women, minorities, and
554 persons with disabilities in science and engineering. National Science Foundation,
555 Alexandria, VA.

556 54. **Allagnat L, Berghmans S, Falk-Krzesinski HJ, Hanafi S, Herbert R, Huggett S,**
557 **Tobin S.** 2017. Gender in the global research landscape. Elsevier.

558 55. **Armstrong MA, Jovanovic J.** 2015. STARTING AT THE CROSSROADS:
559 INTERSECTIONAL APPROACHES TO INSTITUTIONALLY SUPPORTING
560 UNDERREPRESENTED MINORITY WOMEN STEM FACULTY. Journal of Women and
561 Minorities in Science and Engineering **21**:141–157.
562 doi:[10.1615/jwomenminorscieneng.2015011275](https://doi.org/10.1615/jwomenminorscieneng.2015011275).

563 56. **Xu YJ.** 2008. Gender Disparity in STEM Disciplines: A Study of Faculty Attrition
564 and Turnover Intentions. Research in Higher Education **49**:607–624.
565 doi:[10.1007/s11162-008-9097-4](https://doi.org/10.1007/s11162-008-9097-4).

566 57. **Whittaker JA, Montgomery BL, Martinez Acosta VG.** 2015. Retention of
567 Underrepresented Minority Faculty: Strategic Initiatives for Institutional Value
568 Proposition Based on Perspectives from a Range of Academic Institutions. Journal of

569 undergraduate neuroscience education: JUNE: a publication of FUN, Faculty for
570 Undergraduate Neuroscience **13**:A136–145.

571 58. **Johnson MDL**. 2019. mSphere of Influence: Hiring of Underrepresented
572 Minority Assistant Professors in Medical School Basic Science Departments Has a
573 Long Way To Go. mSphere **4**. doi:[10.1128/mSphere.00599-19](https://doi.org/10.1128/mSphere.00599-19).

574 59. **Loftus GR**. 1971. Comparison of recognition and recall in a continuous memory
575 task. Journal of Experimental Psychology **91**:220–226. doi:[10.1037/h0031841](https://doi.org/10.1037/h0031841).

576 60. **Johnson J**. 2014. Recognition is easy; recall is hard, pp. 121–129. *In* Designing
577 with the mind in mind. Elsevier.

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

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

580 63. **Hagan AK, Pollet RM**. 2019. DiversifyMicrobiology. GitHub repository.
581 <https://github.com/diversifymicrobiology.github.io>; GitHub.

582 64. **Hagan AK, Pollet RM**. 2019. DiversifyImmunology. GitHub repository.
583 <https://github.com/diversifyimmunology.github.io>; GitHub.

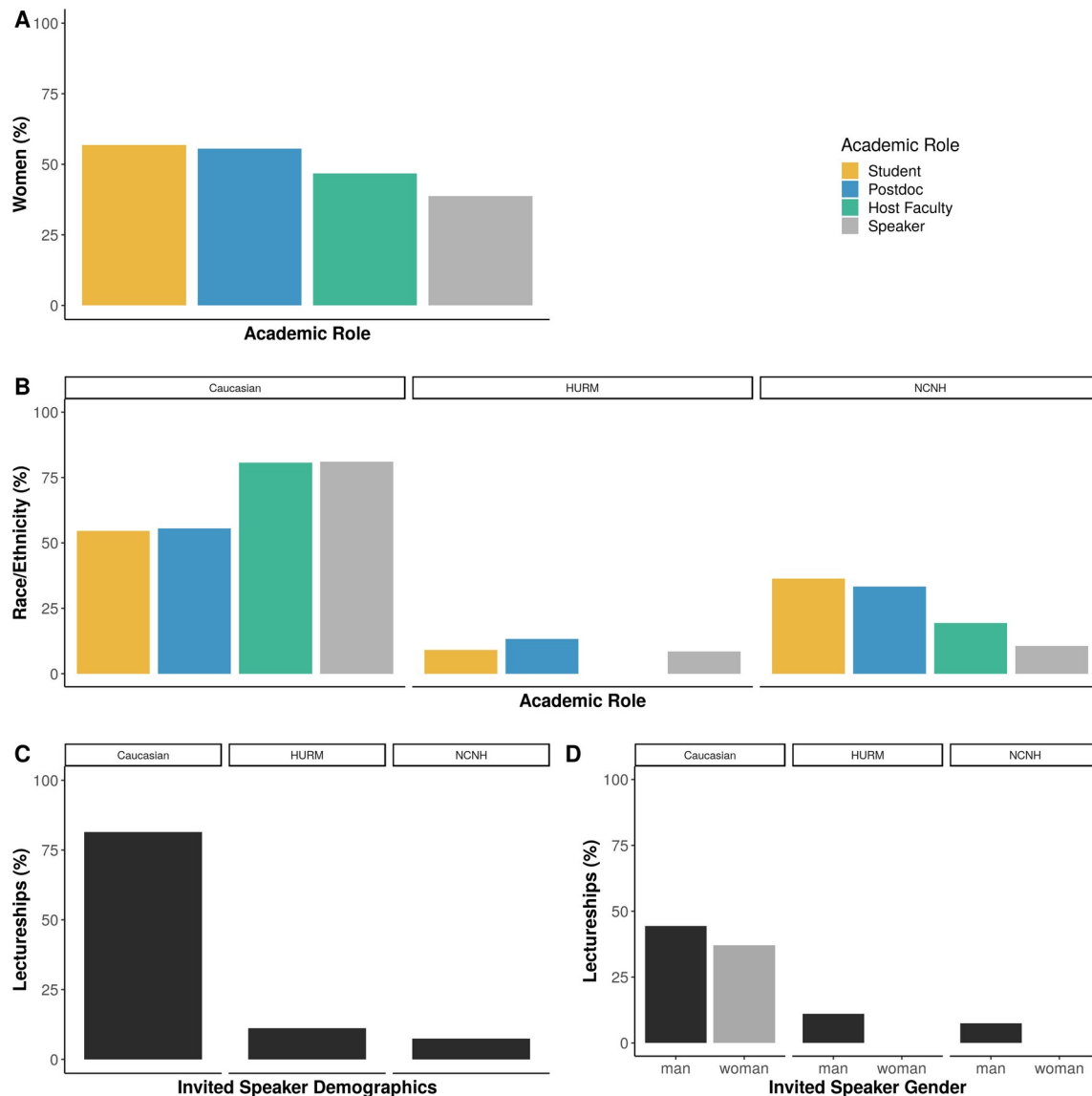


Figure 1. The demographics of invited speakers, hosting faculty, and trainees.
A) The proportion of women in each academic role. B) The proportion of each academic role represented by individuals that are Caucasian (left), Historically Underrepresented Minorities (HURM, center) or Non-Caucasian/Non-HURM (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.

Table 1: Suggestions and resources to increase invited speaker diversity.

Suggestion	Description	Resource
Trainee-invited speakers	Request suggestions from trainees, increase number of trainee-group-invited speakers	
Use a list	Lists of scientists from under-represented and under-served groups are available in several fields	https://DiversifyMicrobiology.github.io/resources
Create a list	Use the GitHub template to create a self-nomination list and resource for your field	Template can be found at https://github.com/diversifymicrobiology/DiversifyMicrobiology.github.io
Use resources from professional societies	Many scientific societies have a committee focused on serving individuals from under-represented and underserved backgrounds. Other societies (e.g., SACNAS) are dedicated to these issues.	SACNAS, ABRCMS, AISES, ASM Subcommittee on Minority Education
Think outside your sub-discipline	Speakers may introduce you to a technique that is not used in your sub-discipline	
Consider scientists outside research-focused universities	Scientists from industry, teaching-focused institutions, and non-profit orgs have different approaches to their research	
Communicate invitation expectations	Unit leadership should explicitly communicate expectations about who is invited to speak and the desired atmosphere	
Encourage trainees to engage	When a talk is over, ensure that trainees are the first to ask questions	
Foster an inclusive atmosphere	Consider the identities of individuals the speaker is meeting with. Ask if the speaker would like to meet a particular student group	
Highlight the journey	Invite speakers to spend a few moments describing their personal science journey	