

■ Participants' report

Improving participation by early stage researchers and women in conference seminars

J. Robert Logan, ORCID: [0000-0003-4359-0955](https://orcid.org/0000-0003-4359-0955)

W. K. Kellogg Biological Station, Michigan State University, Michigan, USA

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Introduction

Power hierarchies and gender biases are widespread and the science, technology, engineering, and mathematics (STEM) disciplines are not immune. Studies have repeatedly shown that double-blind reviews often lead to greater acceptance of publications by women, indicating biases against female authors (Knobloch-Westerwick et al. 2013; Roberts and Verhoef 2016). Across many STEM fields, women are less likely to be invited to give seminars (Schroeder et al. 2013), face greater levels of sexual harassment (Clancy et al. 2014), are interrupted more often during meetings (Kennedy and Camden 1984), and experience discrimination when their publications are reviewed by peers (Roberts and Verhoef 2016).

Although a growing body of literature has highlighted gender disparities in STEM, less research has been directed toward the role that academic hierarchies play in determining how individuals engage with one another professionally. For instance, students are less likely to participate in discussions at conferences and seminars oftentimes because they believe they do not have the expertise to speak up or feel that their contributions will not be taken as seriously as those of more senior researchers (pers. obs.). Identifying ways for early stage researchers to feel more confident and welcome to contribute to discussions is likely to lead to a more productive

exchange of ideas at conferences and workshops that are designed to promote collaboration among researchers.

There has been a strong push in recent years to increase participation by under-represented groups in STEM and academia generally. However, the mere presence of people from a group is insufficient if individuals are not able to contribute intellectually. If one of the goals of conferences is to teach and empower students and other early stage researchers, we should make efforts to ensure that everyone, including early stage researchers, is able to actively participate in a meaningful way. Recognizing barriers to inclusiveness during professional meetings is particularly important if we want to promote productive exchanges of ideas and equip students with the skills they need to succeed later on.

In order to determine how equally early stage researchers (ESRs) vs. faculty/principal investigators (PIs) and male vs. female researchers participate in conference discussions, I recorded the gender and career stage (ESR vs. PI) of each person asking a question following oral presentations at the Network Meeting of the International Association for Plant UV Research in Bled, Slovenia in April 2018. I report that there was a significant and large imbalance in the number of questions asked by certain groups and provide recommendations for improving participation at future meetings.

Methods

After each oral presentation, I recorded the gender and career stage of the presenter as well as the gender and career stage of each person asking a question during the discussion that followed. For confidentiality reasons, no identifying information was collected on anyone except career stage and gender. Students and post-doctoral fellows were classified as early stage researchers (ESRs) and researchers at later stages of their careers were classified as principal investigators (PIs). Because I did not know everyone's career stage at the start of the conference, several individuals were classified as "career stage unknown" during the first few talks. Since individual names were not recorded, it was impossible to retroactively assign career stages to these people so these "career stage unknowns" (7/100 questions) were removed from the analysis of career stage but still included for analyzing gender patterns. While this observational method runs the risk of misidentifying some individuals' genders, specifically asking people would have involved interaction in a way that would have likely affected people's behavior and lead to less informative results.

I used deviation as the metric used to describe the difference between the number of questions asked by members of a given group and the number expected based on their representation in the audience of the room. Deviation was calculated as:

$$\Delta = N_{\text{group}} - P \times N_{\text{total}}$$

where N_{group} is the number of questions asked by members of that group, P is the proportion of the audience made up by that group, and N_{total} is the total number of questions asked during that session by everyone in the audience. A value of zero means that on average, that group asked a number of questions proportional to their representation in the room. A positive deviation means that a group spoke more than expected and

a negative deviation means they spoke less. I calculated a deviation value for the four groups for each oral presentation at the meeting ($n = 21$). Finally, I conducted all analyses in R using base functions (t -tests and 2-way ANOVAs), using individual oral talks as the replicates. Since this study involved no subject interaction or intervention with regard to private information, Michigan State University's Human Research Protection Program determined that this work was not human subjects research (STUDY00001206).

Results

Who asks the questions

During the three-day meeting, 100 questions were asked following 21 talks. The average number of questions asked per talk was 4.7 (range 1--11) asked by 4.5 people (range 1--10). The gender and career stage of the presenter did not affect the number questions they received; male and female presenters and ESR and PI presenters received the same number of questions (gender $t = 1.5$, $p = 0.16$; career stage $t = 0.27$, $p = 0.79$).

There was however a large difference in who was asking the questions, with PIs and men asking more questions than would be expected based on their representation in the audience (Figure 8.1). However, the effect was purely additive with no significant interaction between career stage and gender (Table 8.2); male ESRs asked fewer questions than male PIs and female ESRs asked fewer questions than female PIs. Overall, the effect of career stage was considerably larger than that of gender (Figure 8.2, Table 8.1).

Despite making up only 45% of the audience, PIs asked 89% of the questions, twice as many questions as expected if everyone had participated equally (Table 8.1). ESRs on the other hand asked one fifth of the questions expected based on their representation in the room. Also of note, all but one presentation

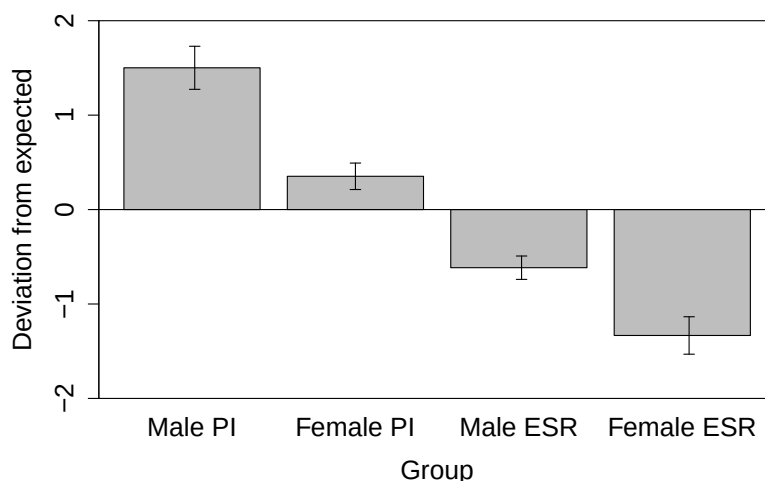


Figure 8.1: Deviations from expected number of questions asked by male and female PIs and early stage researchers. Positive values mean that group asked disproportionately more questions than would be expected based on their makeup in the audience and negative values mean they spoke less. All groups are significantly different from each other (Table 8.2). Bars represent ± 1 S.E.

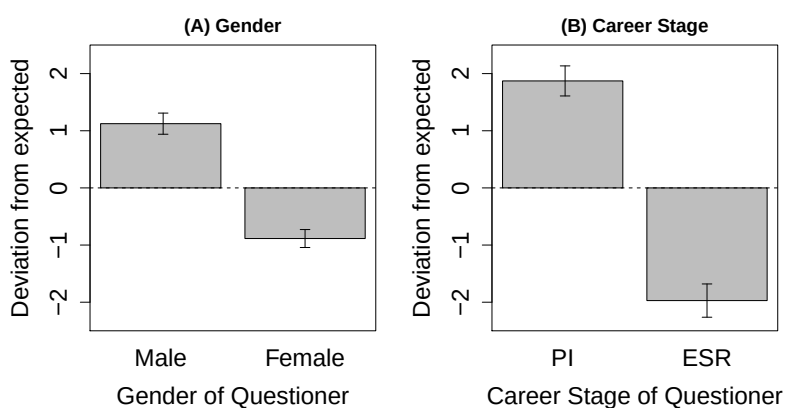


Figure 8.2: Deviation from expected number of questions asked based on the gender (A) and career stage (B) of the questioner (PI versus early stage researcher). Positive values mean that group asked disproportionately more questions than expected based on their makeup in the audience and negative values mean they spoke less. Bars represent ± 1 S.E.

Table 8.1: Participation in discussions by members from different groups. Conference attendance numbers, number of questions asked by members of different groups, same number of questions expressed relative to that expected assuming equal participation, talks with at least one question by a member of the group, and talks where a member of the group asked the first question. The number of questions included in the career-stage descriptions is 93 (instead of 100) because I did not know the stage of seven questioners early in the conference and was only able to assign gender to them. The same is true for the last column indicating how many people asked the first question following talks (during one talk I didn't know the career stage of the first questioner so there are only 20 talks included for career-stage comparisons).

Group	attendance	number of questions	relative to expected	talks with a question by	talks with first question by
Male PI	27% (15/56)	61% (57/ 93)	2.3	95% (20/21)	40% (8/20)
Female PI	20% (11/56)	28% (26/ 93)	1.4	81% (17/21)	30% (6/20)
Male ESR	18% (10/56)	4% (4/ 93)	0.24	19% (4/21)	20% (4/20)
Female ESR	36% (20/56)	6% (6/ 93)	0.18	24% (5/21)	10% (2/20)
Male	46% (26/56)	66% (66/100)	1.4	100% (21/21)	62% (13/21)
Female	54% (30/56)	44% (44/100)	0.83	86% (18/21)	38% (8/21)
PI	45% (25/56)	89% (83/ 93)	2.0	95% (20/21)	70% (14/20)
ESR	55% (31/56)	11% (10/ 93)	0.20	38% (8/21)	30% (6/20)

Table 8.2: The effect of gender (male vs. female) and career stage (early stage researcher vs. principal investigator) on numbers of questions asked. Results of two-way Analysis of Variance testing the effect of gender and career stage of speakers on deviations from expectation of equal participation.

Source	d.f.	F	P-value
Gender	1	27.6	<0.001
Career stage	1	114.6	<0.001
Gender $\times$ C. stage	1	1.5	0.228
Residuals	80		

received a question from a PI (95%), whereas ESRs only asked questions after 38% (8/21) of the presentations (Table 8.1). PIs were also considerably more likely than ESRs to ask the first question ($X^2 = 5.2$, $df = 1$, $p = 0.02$).

While gender of the questioner did play a role, the effect was smaller than for career stage. Men made up 46% of conference attendees but asked 66% of the questions (Table 8.1). While every presentation

received at least one question from a male researcher, female researchers asked a question following 86% (18/21) of presentations. Neither male nor female researchers were more likely to ask the first question ($X^2 = 2.0$, $df = 1$, $p = 0.16$).

Does it matter who asks the first question?

To determine whether people were more likely to speak when the first question was asked by a member of their group, I calculated the number of questions asked by women and ESRs when the first question was asked by another woman or ESR. Since the goal here was to determine whether the gender or career stage of the first questioner affects how likely other people from that group are to ask subsequent questions, I excluded the first question from the calculated deviations. The gender of the first person to ask a question had no effect on whether female researchers were more likely to ask follow-up questions ($p = 0.21$). However,

when the first question was asked by an ESR, other ESRs asked follow-up questions somewhat more often ($p = 0.08$), suggesting a possible "first question" effect based on career stage.

Discussion and recommendations

While there was a strong gender imbalance in how many questions were asked, the effect of career stage was much larger. Early stage researchers asked fewer questions, participated in fewer discussion sessions, and were considerably less likely to be the first ones to ask a question. While it might be expected that students are less likely to participate in discussions at conferences, the magnitude of the career stage effect was large. Male and female early stage researchers asked one quarter and one sixth of the questions they were expected to ask based on their attendance numbers. This shows that there are strong barriers preventing early stage researchers from fully participating in conference discussions.

I did not find a significant interaction between gender and career stage, as the effects were additive, leading to particular disenfranchisement of female students and post-docs. This is consistent with other studies that have also found that even among younger researchers, men ask more questions than women (Hinsley et al. 2017). Overall, while the magnitude of the effects were different, similar strategies may be used to encourage more equitable participation by both early stage and female researchers.

Although I only looked at two variables (gender and career stage), many identities may be relevant in determining how often an individual participates in a discussion, including race, ethnicity, nationality, native language, and field of study, among others. Especially for students at international meetings, whether an individual is a native speaker of the language used at the conference may play a large role in how confident

they are in speaking up. While these may all have played a role, the relatively small sample size here as well as logistical constraints (being able to quickly classify people in real time) limited the scope of this study to just these two identity groupings.

One limitation of this study is that these data only reflect the total number of questions that were asked following oral presentations. As such, there is no way to know to what extent these imbalances were driven by decisions made by audience members (choosing whether to raise one's hand or not) versus decisions made by the presenter and moderator (deciding who to call on), though both of these may likely have played a role. A survey of 600 academics in 20 countries found that women were more likely to report that they wouldn't speak up because of internal factors (e.g. they couldn't "work up the nerve" to ask a question or they felt intimidated by the speaker) (Carter et al. 2017). People also reported that speakers would call on people they know more often, suggesting that decisions other than those made by audience members may also play a role in the observed imbalance. Regardless of the specific mechanism, the disparities I report here highlight the fact that early career researchers and women have less access to presenters than do faculty and men.

Encouragingly, these results and previous observations suggest ways to build a more equal participation at conferences. Although PIs were more likely to ask the first question following a talk, early stage researchers tended to ask more questions when another student or post-doc asked the first question. This is consistent with previous findings, albeit most other studies have focused on gender imbalance rather than career stage imbalances. After observing the gender of questioners at almost 250 seminars, (Carter et al. 2017) found that when a female researcher is called on first, the gender imbalance of who asks questions disappears.

Similarly, a study that looked at who

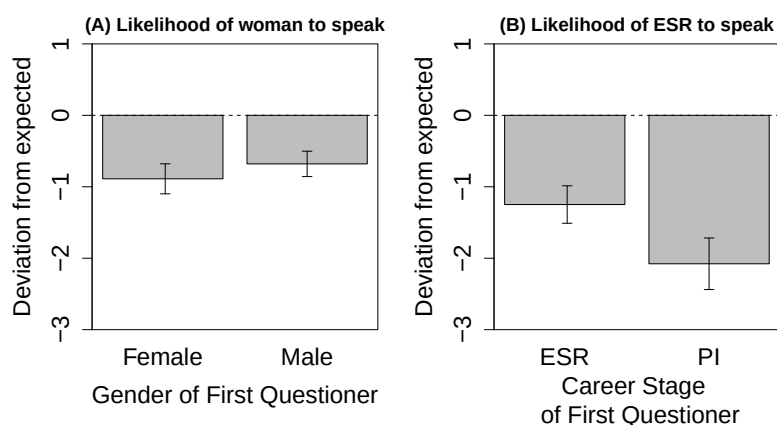


Figure 8.3: Likelihood of female researchers and early stage researchers to ask questions given the identity of the first questioner. (a) The likelihood of female researchers to ask a follow up question did not differ significantly based on the gender of the first person to ask a question ($t = 1.3$, $p = 0.21$). (b) The likelihood of ESRs to ask a follow up question was somewhat greater when the first question was asked by an ESR rather than a PI ($t = 1.9$, $p = 0.08$). Bars represent ± 1 S.E.

was invited to give talks at a series of research conferences found that the number of female speakers at research symposia increases when women have leadership roles organizing the meetings (Sardelis and Drew 2016)). Although the effect here was driven by career stage and not by gender, these studies highlight that implementing simple structural changes (increasing leadership roles or implementing a rule about who may ask questions first) can have tangible effects on participation by individuals from groups that are traditionally excluded from the table, either because of bias by organizers or from internalized self-doubts. Developing structures to help amplify the voices and leadership responsibilities of individuals from disempowered groups can lead to more equitable participation and ultimately, a more productive exchange of ideas.

Based on observations from this meeting and suggestions from some of the studies cited above, I make several recommendations for improving participation at future meetings:

- Implement a rule that the first question following a talk must be asked by a stu-

dent or post-doc. Similarly, moderators should make a point to call on female researchers first. Many departments have rules that faculty are only allowed to ask questions once several students have had an opportunity to speak and faculty feel this leads to an increase in participation by students (K. Jacobson, pers. comm.). This not only guarantees that more ESRs will be able to participate in discussions but also makes it more likely that others will ask more questions later on, further increasing participation.

- Designate early stage researchers as session chairs and moderators. Although students and post-docs made up 55% of conference attendees, none of the seven sessions was chaired by a student and only one was chaired by a post-doc. Since ESRs tend to be more likely to ask questions when another ESR “breaks the ice” with the first question, assigning students and post-docs to positions as session chairs will likely increase participation by other ESRs in discussions.
- Encourage more participation by early

stage researchers in oral presentations instead of only posters. While ESRs were very well represented in oral talks at the 2018 Network Meeting (they made up 55% of attendees and 52% of oral presenters), 73% of posters were presented by ESRs compared to only 27% by PIs. This shows that although students and post-docs are proportionally well represented as oral presenters, ESRs are more likely to request/be accepted for poster presentations and/or PIs are more likely to request/be accepted for oral presentations. Balancing the number of poster and oral presentations by ESRs and PIs could provide more opportunities for ESRs to present their work to the broader audiences of oral talks.

Diversity and inclusion efforts will only succeed if we recognize existing barriers to inclusion in academia and work to change existing structures to actively promote the success and participation of individuals who are not already at the table. While this is a long-term process that will include challenging individual biases and implementing changes to institutions, doing so will ultimately lead to more supportive, open, and productive research programs.

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