FORUM

Women Count

PAGES 402–403

I am a counter by nature. I count things as an effective way to occupy my mind. How many people are in this room? How many are women? How many are wearing glasses? How many people are using a Mac versus a PC?

Once, sitting in a science team meeting as a graduate student, I noticed that I was the only woman in the group of about 15. At that time, it did not really bother me, but the scientist in me kicked into gear. I began gathering data. Was this situation unusual?

To learn more, I routinely calculated female to male ratios in various populations of scientists. At conferences, I counted the fraction of audience members who were female to establish a base statistic of the population of scientists. I compared that to the ratio of women giving oral presentations in that session, or the list of awardees, or the names of co-investigators listed on a mission overview talk.

This carried over to evaluating research groups. Which professors never seemed to have female graduate students in their labs? Which ones had multiple female students? I began looking for correlations. Were female to male ratios higher when the leadership was female? Yes, they were.

The scientist in you is probably curious about my sample size, my accuracy in distinguishing women from men in a crowd or in an author list. While important, they are likely minuscule compared to the trend I saw.

Over time, the trend bothered me. The gender imbalance that exists in science is easily perpetuated and is harmful to our community as a whole.

The Root of the Problem: Selectors Chose Candidates Most Like Them

The problem begins not when institutions select who will be faculty, or who gets what award, or who will be in the next cadre of graduate students. The problem begins well before this, when there are plenty of qualified individuals for a small number of positions that aren't advertised but are instead assigned. In these cases, the person selecting candidates does not have an exhaustive list of who would be appropriate, nor does he or she have a set criteria of experience needed to fill that position.

Who will the selector choose? Psychology suggests that selectors focus on people who are most like them. This can happen deliberately—overt bias—but it can also happen subconsciously or unconsciously, a phenomenon called homophily [*McPherson et al.,* 2001].

By corollary, people who are less like us are not foremost in our minds. For example, if the selector is male, the list of qualified candidates might be front-loaded with males, although qualified female candidates exist. The failure here is that although a perfectly valid team could be assembled based on the people who spring to the selector's mind, an equally valid but more diverse team could also have been selected.

We all subconsciously or unconsciously prefer people who remind us of our self-identified characteristics—it's human nature. The only way to overcome this is if selectors make a deliberate attempt at establishing diversity.

Homogeneity Spawns Homogeneity—How to Break the Cycle?

"Like calling to like" perpetuates imbalance. In the example above, where the selector is seeking to quickly assign people to leadership positions, the resulting "formative group"—influenced by the same psychology of like craving like—may inadvertently filter future populations into one that mirrors them.

Formative groups may include science teams, assessment groups, society officers, conference organizing committees, search committees, review panels, etc. Search committees identify candidates for faculty positions, and those faculty members select students and postdocs for their labs. Review panels influence who gets funding for their research and who does not. Science team members seek one another out for future science teams. Conference organizers assign who gives oral presentations; this affects how much exposure a person's research will get, which helps with future proposals, job applications, and collaborations. Assessment groups evaluate programs and prioritize objectives, which influence future directions for the field.

Each formative group has a role in shaping who is successful in our community. In science, so much opportunity comes from networking and from non-competed opportunities. Visibility is a key aspect to succeeding as a scientist. Thus, having diversity at the formative group level means that if the formative group just acts naturally, that is, thinking foremost of people like themselves, representatives will advocate for many different populations as a natural consequence.

In short, diversity in formative group membership perpetuates diversity.

An In-Depth Look at Space Missions

Spacecraft missions are the bread and butter of scientific work in space science and represent a great deal of opportunity. However, membership on the science team is often non-competed, and females are routinely underrepresented.

I saw this after conducting an informal survey of the science teams listed on the website of seven recent male-led NASA planetary science missions with fewer than 45 science team members (excluding participating scientists and guest investigators who are chosen through a competitive process). I found that only one had a ratio consistent with the female population of planetary scientists, which is 27%, according to the American Astronomical Society's Division of Planetary Sciences (see http://dps.aas.org/files/dps/publications/survey_2010/SurveyResultsBusinessMeeting.pdf).

Six of the seven missions had 5%–18% females on the non-competed science team. The statistical anomaly is demonstrated when you compile the data from all of the missions. The missions had a total of 28 women out of 193 listed science team members, or 14.5%, far less than 27%, which would be 52 women. In fact, randomly selecting exactly 28 women from 193 planetary scientists is a far outlier—the value is 4 standard deviations away from the mean. This is clearly anomalous and demonstrates that women are routinely underrepresented on planetary mission science teams.

I believe the reason for this is that predominately male leaders at the principle investigator (PI) and instrument PI levels select from a mental list that is front-loaded with men. There's a subtlety here in that the typical instrument team size is small enough that each instrument team would expect to have 0, 1, or 2 women if the selector chooses based on the DPS ratio of females. In-group bias appears to weight these numbers to the low side. So when a larger team is aggregated from smaller groups of 3, 4, or 5, the cumulative team will have fewer women than what is found in the entire population.

In this example, picking 3 men for a team of 3 is not a statistical anomaly. However, when the entire science team was assembled from several small instrument teams, it ended up with a clearly anomalous composition with less than 20% women.

So how can this underrepresentation be avoided? One idea is that all spacecraft missions include a competed participating scientist program, where selections are likely to be more proportional to the gender ratio in the community. Another is that NASA could move to a paradigm where a large fraction of science teams is competitively selected.

We Are All Susceptible to Propagating Homogeneity

I want to be clear that I am not condemning my male colleagues, nor am I accusing anyone of sexism. Sure, active discrimination exists and is intolerable. Fortunately, it is rare and usually pretty easy to spot. In general, we are good, fair-minded people with the best intentions. Instead, I'm calling for us all to be proactive on diversity issues.

Recently, I co-chaired the science organizing committee (SOC) for a conference. Interestingly, the director of sponsoring group is a woman, and it might not be a coincidence that the two co-chairs of the SOC are women. My co-chair and I chose a SOC with a mix of men and women. The distribution of women in each of the presentation categories was roughly equal to the proportion of woman-authored abstracts. The categories of invited/plenary talks, contributed talks, and posters had ratios of 32%, 30%, and 29% women, respectively.

This shows that when selections were from a diverse formative group and based on a complete set of submitted abstracts, the results may be in proportion.

It takes a conscious act to assemble a diverse team. As attuned to gender issues as I am, I am not immune to neglecting diversity. In fact, although I was initially quite pleased that the program set up by the SOC was balanced, I failed at establishing a racial balance in this committee. As a white woman, it never crossed my mind, so the SOC had very little racial diversity. In retrospect I wish I had considered other types of diversity when selecting SOC members.

A Call to Action

Especially in our community of analytic thinkers, I suspect many of us analyze populations. So this is a notification to all of my colleagues in science. I count. Other women count, too. We will be counting and evaluating how many women you include in the team you are assembling. And we are going to ask you about it.

So I'm asking you to count, too, particularly when it comes to formative groups. As the leader of a formative group, please go the extra step of asking, "Are there candidates for this team who are female/early career/international/minority?" (Hint: the answer often is "yes.") If so, then bring them onto your team.

When you are a member of a formative group, look at the composition of the rest of your team. Ask your leadership, "Where are the minorities on this assessment group?" Then follow up by looking at diversity in your formative actions: "Are there female candidates on the short list for this faculty position?"

Even outside of a team, evaluate team composition when you see someone post the names of team members in a presentation or a website, or the list of invited speakers at a conference, or the list of award winners. If the list is homogeneous, ask those in charge, "Why are all of the co-investigators male? Why are there no minorities among the speakers on the agenda?" Don't do so in an accusatory manor. But do so to bring diversity up to the level of conscious thinking.

The Long Term Goal

As long as we follow our subconscious tendencies to pick people like ourselves, gender imbalance—or any imbalance, for that matter—will persist.

Nonetheless, I feel confident that most people, if consciously evaluating teams for diversity, will be able to assemble well-qualified, diverse teams. My hope is that eventually, by making a conscious effort to be more diverse in our selections, early-career women scientists will see a thriving community of established women scientists and feel included, and the population of women scientists will rally.

Then maybe, when you get that dreaded question from the audience, "Why are there no women on your team?," the answer will be, "They all turned me down because they are overcommitted."

Reference

McPherson, M., L. Smith-Lovin, and J. M. Cook (2001) Birds of a feather: Homophily in social networks, *Ann Rev. Sociol.* (*27*), 414–444, DOI:10.1146/annurev.soc.27.1.415.

—Dana M. Hurley, Johns Hopkins University Applied Physics Laboratory, Laurel, Md.; email: dana.hurley@jhuapl.edu