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REFLECTIONS IN DIVERSITY

What Does Gender Have to Do with Physics?

A physics professor and expert in gender equity and equal opportunity advises abandoning a purely objective view of science to address bias.

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The question posed in the title implicitly raises a "positivistic paradox." Physics is grounded in an objective, genderless description of reality. Yet the history, classrooms and especially the decision making in physics is dominated by men. How is a subject that seems inherently independent of sex and gender so gendered in its culture?

Londa Schiebinger from Stanford University, USA, author of the book *Has Feminism Changed Science?*, offers a three-pronged approach to tackling this question: numbers, culture and knowledge. These dimensions are clearly intertwined, not the least in physics, in which culture defines what knowledge is worth searching for—even in "curiosity-driven," basic science (simply ask *whose* curiosity drives the research).

Cold, hard numbers

When looking at the numbers, it is clear that physics, more than most other subjects, suffers from both horizontal

and vertical segregation. The former means that women and men gravitate to different fields when choosing their careers. Usually, attempts to counter horizontal segregation consist of trying to convince women outside academia that "physics is fun," or that they should take more math courses in high school and similar measures. Without belittling these efforts, the "change the women" mentality is an inherent flaw.

Far more important, however, is vertical segregation—the fact that men are promoted at the expense of women, in academia in general and in physics in particular—which resides in the system itself. An often-used metaphor for such segregation is the "leaky pipeline," but this has been questioned recently. First, the term implies that there is only one pipe to funnel through toward a successful career. In reality, things are more complex, and different people need different pipelines to thrive and stay in academia.

Second, the pipeline analogy implies that people who leave academia have failed, yet these people end up in successful careers in other circles. The drain of talent is therefore a problem for academia, not for those who leave. Something within the academic culture of physics seems to repel women.

Debunking Hercules

The culture of physics has been studied in many fields. For example, in a 1992 anthropological study of major American and Japanese science labs, Sharon Traweek discusses how the society within physics is formed, how excellence is defined and how young scientists are groomed. Her claim that "physicists consider their labs as a 'Culture without Culture'" summarizes her findings perfectly—physicists are so convinced

Tomas Brage, editor of Lund University's report "Core values work in academia" with his coeditor Inger Lövkrona.

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of the objectivity of positivistic science that they believe it also defines the way they interact.

More than a decade later, the UPGEM project, a 2008 sociological study of five countries in Europe, investigated and assessed the reasons underlying the stark country-to-country disparities in the percentages of physics professors who are women—23 percent in Italy and 3 percent in Denmark. After ruling out a number of possible explanations linked to the culture of the countries without full correlation, the researchers found a correlation between the lack of women at the highest levels and how strongly "Herculean" the institutional cultures were. The Herculean idea of a single, strong leader who advances science in his success defines this culture. The result is that the culture doesn't benefit anyone who doesn't fit that reductive stereotype.

It is time to redefine the idea of excellence, and abandon the model of a brilliant, single scientist, since it fails in modern physics, where problem-solving groups are the norm. Moreover, considering diversity in building these groups is necessary and key to excellence.

The meritocracy myth

At the heart of the issue of retaining women in physics is implicit bias. (If you are not convinced, look at Harvard's Project Implicit.) Many studies show that women are not measured by the same standards as men due to preconceived ideas about excellence and abilities. Women get smaller research grants, fewer citations, worse grades, worse student evaluations, fewer contributions to conferences and inferior letters of recommendation.

Such bias is a threat to the principle of meritocracy—even as research shows that the idea of meritocratic universities itself might be a myth. In a recent study of Aarhus University in Denmark, it was found that 20–30 percent of professorships were appointed in closed processes, and around 40 percent of the rest had only one applicant. At the same time, the fraction of women employed was twice as large in open as in closed processes.

Clearly, our biases, compounded by the meritocratic myth, throw a wrench into the machinery of a proper physics career path. In fact, the more convinced a group is that it follows meritocratic principles, the more it is affected by bias.

Changing the system

Here are a few actions that institutions can take to support diversity and gender equity:

- Tackle institutional culture by introducing bias-awareness training, bias observers, anti-discrimination workshops and by supporting teamwork over a "Herculean" culture.
- Create gender- and diversity-integrated leadership and career programs for women and men.
- Find out why people leave, and take actions to counteract them leaving.
- Introduce "counter-spaces," such as conferences and networks, where minorities can become the "norm" for a while.
- Investigate the effects of awards and certifications (such as Juno, Athena Swan and Gender Certification).
- Counteract horizontal segregation in STEM, but avoid approaches that aim to "change the women."

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Members of Lund University's gender-integrated leadership program (AKKA).

Particularly threatening to diversity is harassment and discrimination. A study from Uppsala University, Sweden, labeled Dandelion Physicists, interviewed physics Ph.D. students and found that around one-third of women had experienced sexual harassment at work and at conferences. In a recent study at Chalmers University of Technology in Gothenburg, Sweden, 53 percent of women interviewed had experienced harassment on the grounds of their sex or gender. An important, more subtle part of the problem comes in the form of "micro-violence"—everyday actions in the form of being ignored, made invisible, ridiculed or withheld information.

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Beyond the "objectivity" defense

Finally we reach Schiebinger's third dimension—knowledge, particularly of "the subject." Instead of holding fast to the idea that physics is purely objective, she suggests that there are aspects of science that can be improved by embracing a gender perspective. We can hide behind a definition of physics that only includes logical discussions, equations and formal mathematics—after all, it's true that electrons and equations have no sex. But, in real life, physics bleeds into other fields and deserves a broader definition.

Physics research does not happen in a vacuum; it must be contextualized—how is it performed, what is the purpose, who does it benefit? Similarly, a physics teacher needs to use examples and metaphors and select which topics are interesting and important to teach. Clearly, the subject of all physics is affected by the background of the researcher, teacher and student, and it follows that a gender perspective is needed. OPN

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To learn about OSA's efforts to advance diversity and inclusiveness in STEM, please visit **www.osa.org/diversity**.