Online Ethics Center
FOR ENGINEERING AND SCIENCE

Chapter 6: Underrepresented Groups in Physics

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Description

Chapter 6 of "An Instructor's Guide for Ethical Issues in Physics."

Body

Chapter 6: Underrepresented Groups in Physics

Section 6.1: Introduction — The need for diversity

Lack of diversity within a profession or organization is often, though not always, correlated with unfair treatment of some groups. For instance, there is very likely a lack of geographic diversity in the subscriber list to most orchestras--that is, it is unlikely that an orchestra in Maryland has many season ticket subscribers residing in Alaska—which is not problematic. On the other hand, a community orchestra that is drawing subscribers only from nearby upper class neighborhoods might want to

ask if its pricing structure poses too large a barrier for people from other neighborhoods to access this community resource. We should examine situations where diversity is lacking to determine if a root cause is a lack of fair treatment.

Because diversity can also be beneficial to a profession, it is important for the profession to make sure that there are not unnecessary barriers to the best people for the jobs being the ones who fill the positions. Diverse members will provide a wider range of perspectives on how to approach and solve problems. This issue was raised in a Supreme Court case involving the University of Texas.[1] A Letter to the Editor of Physics Today points out that diversity in physics is important in part because there is a cultural aspect to the physics community that necessarily goes beyond physics knowledge found in textbook.[2]

Issues of diversity can be described in various ways. At one time, the term “minorities” was used to refer to underrepresented groups, but that term clearly does not include women. It is also possible that certain minorities are appropriately represented in the profession. Currently, the most common phrasing is “women and underrepresented minorities.” This Instructor’s Guide uses “underrepresented groups” because it includes women and avoids getting into the potentially complicated issue of one group being a minority in one geographic location while being a majority in another.

It is interesting to note that, while programs addressing diversity in physics in this country deal with both women and ethnic minorities, such as African Americans, Hispanic Americans, and native Americans, recent literature seems to focus more on gender, especially in the area of bias. This imbalance in available literature is, unfortunately, reflected in the three sections on bias below.

Section 6.2: Statistics

The American Institute of Physics carries out numerous annual surveys as well as one-time surveys to probe the physics profession in the United States. The starting point for exploration is the Statistical Research Center.[3] Reports on this site analyze data acquired by the AIP as well as data acquired by other organizations. These reports do involve a time lag—for instance, the AIP surveys departments regarding enrollment data in the months following the completion of a given academic year, and time is then required to compile the data and write a report—so

the data you will find on this site is usually at least one year old. More narrowly defined topics are the subject of reports that are made every few years, so the most recent data may be two to four years old.

Among the reports that might be of particular interest are:

- African-American Participation among Bachelors in the Physical Sciences and Engineering,[4] which looks at data generated by the National Center for Education Statistics (NCES). This report shows some fluctuations but overall no growth in the number of bachelor's degrees awarded in physics to African-Americans during the 2005-2015 period. The report notes that the underlying data from the NCES is publically available.[5] This database could be useful to students interested in going deeper into the diversity issue.
- African American, Hispanic, and Native American Women among Bachelors in Physical Sciences & Engineering,[6] which uses 2003-2013 data from NCES. Among the observations was that the growth rate in bachelor's degrees in physics awarded in these demographics did not keep up with the overall growth rate of Bachelors awarded in physics.
- Native American Participation among Bachelors in the Physical Sciences and Engineering,[7] which likewise provides evidence for underrepresentation, but fluctuations in the data make it somewhat difficult to draw definitive conclusions.
- Women in Physics and Astronomy, 2019,[8] which draws mostly on AIP survey data from 2007-2017 to take a comprehensive look at gender differences in physics, starting from high school and extending through employment. The percentage of bachelor's degrees in physics awarded to women during this period stayed nearly constant at about 20, as did the corresponding percentage of PhDs. The report found some evidence for women in the physics workforce earning less than men.

Discussion Prompts

1. Discuss the trends in statistics related to underrepresented groups in physics. [Note to instructors: You may wish to postpone discussion of the causes of the trends until introducing some of the material in the following sections.]
2. In what ways does diminished diversity have a negative impact on the physics community and on society at large?

Section 6.3: APS policy statements

The APS Guidelines on Ethics has a significant portion devoted to issues likely to affect the climate of the physics community, particularly as experienced by underrepresented groups.[9] Section III Treatment of Colleagues and Subordinates opens with a statement that APS values diversity and then discusses explicit, systemic, and implicit bias. Recommendations focus on awareness of the issues and working to ensure fairness in the workplace and in career-affecting decision-making processes. The following subsection focuses on harassment, giving examples of ways in which harassment may take place and stating the obligation of physicists to report it. The section on Treatment of Subordinates reminds members that power dynamics can allow various form of harassment to develop. Finally, there is a statement on the expectation that those who attend APS meetings will conduct themselves in a manner that shows respect for other attendees.

In addition to statements embedded in the Guidelines on Ethics, four other brief statements are worth reading: (1) the 1988 statement (revised in 2018) called Promoting an Inclusive Workplace,[10] (2) the 1994 Policy on Equal Opportunity,[11] (3) the 2008 Diversity Statement,[12] and (4) the 2015 Statement on the Status of Women in Physics.[13]

Discussion Prompts

1. Identify examples of bias that you are aware of from personal experience, anecdotes shared with you, or something you have read. Discuss whether these are examples of explicit, systemic, or implicit bias.
2. Does your institution have a Title IX office? If so, what is its role in addressing issues of gender bias?
3. Find and read your institution's policy on bias. How does it differ, if at all, from the APS policy?

Section 6.4: Explicit bias

Explicit bias is defined in the APS Guidelines on Ethics as occurring "when conscious attitudes or beliefs about a group of people manifest themselves in discriminatory speech or action."[9] It can take many forms, but recent study has focused on

harassment, and in particular gender harassment, in the physics community. Aycock et al. published a paper on gender harassment that provides a solid introduction to the topic as well as an analysis of a survey of undergraduate women in physics.[14] They found that about ¾ of the respondents had experienced some form of sexual harassment in a physics-related context at some point during the previous two years. Although students may be unfamiliar with some of the statistical methods discussed, they will still be able to grasp the paper's central message. For a broader look at sexual harassment in the STEM fields, see the National Academies study, Sexual Harassment of Women: Climate, Culture, and Consequences in Academic Sciences, Engineering, and Medicine.[15] While the report is lengthy, the twelve-page summary at the beginning makes for a readily manageable reading assignment. It discusses environmental factors that tend to foster harassment and makes a series of recommendations to address these factors.

Briefer introductions to the topic of harassment can be found in a handful of pieces in ***Physics Today.*** Three items from 2016 focus on the field of astronomy. A news report uses a case involving an astronomy faculty member as a springboard for a discussion of what professional societies are doing to address the harassment issue.[16] Another news report discusses the formation of the Astronomy Allies, a group that makes itself available to astronomers who have been harassed and are trying to decide what to do.[17] An open letter to the community calls on senior members in the field of astronomy to take the lead in addressing harassment.[18] At the time this letter was published in ***Physics Today***, it had 393 signers. A 2018 commentary by Chapman, an astrophysicist, describes her personal experiences of being harassed.[19]

Discussion Prompts

1. If a harassment survey were taken in your institution, how do you think the results would compare to those found in the Aycock paper?
2. What factors might someone at your institution consider in deciding whether or not to report harassment that they have experienced?
3. What factors might someone at your institution consider consider in deciding whether or not to report harassment that they have observed?
4. Based on the APS Guidelines on Ethics, how likely do you think it will be that cases of harassment will be reported by victims or by observers when they take place at APS meetings?

Section 6.5: Systemic bias

From the APS Guidelines on Ethics,[9] “Systemic bias occurs when policies, procedures, and practices of an institution result in the exclusion of some groups, and the promotion of others.“ Sometimes the existence of systemic bias can be determined through looking at written procedures, but other times it is apparent more through its impact on a group of people. In addition, early bias in areas like establishing starting salaries can bake into the system a bias toward reproducing the inequities in the future.

An AIP international survey of physicists in 2010 reported on by Ivie and Tesfaye indicates that women on average have less access than men to critical resources such as funding, space, and equipment.[20] They also have fewer career-advancing opportunities in the physics community, such as attending conferences abroad or serving on grant review panels. Another AIP study raised a note of caution in how we interpret data, particularly when small numbers are involved.[21] In particular, the study observes that since only 13% of physics faculty members are women, then statistics suggest that there will be a lot of physics departments without any women on their faculty. Their conclusion, then, is that the lack of women on the faculty of a small department is not by itself evidence that the department is biased in its hiring. It may be worth pointing out to students that the applicant pool for physics faculty positions is drawn primarily from those who have a PhD in physics. Women account for 15-20% of those degrees according to AIP data.

A commentary by Rudolph argues for a more careful look at admissions policies in order to reduce implicit bias in the process.[22] A specific example highlighted is that GRE scores are often relied on in a significant way for graduate school admissions, despite the fact that there are known biases in their structure that put already underrepresented groups at a disadvantage. Moreover, the commentary cites a study showing little to no predictive value in the GRE as far as determining which admitted students are more likely to complete their PhD.

Discussion Prompts

1. In what sense, if at all, can the lack of role models from underrepresented groups be viewed as systemic bias?

2. Are you aware of examples of systemic bias commonly present on university campuses?
3. How might procedures for resource allocation be structured to minimize systemic bias?
4. Based on Rudolph's commentary, would the use of GRE scores in admissions decisions be an example of systemic bias as well as implicit bias?

Section 6.6: Implicit bias

From the APS Guidelines on Ethics,[9] "Implicit bias occurs when an individual has a preference for, or aversion to, a group of people, or a member of the group, without conscious knowledge."

Nelson wrote a lengthy commentary in ***Physics Today*** discussing explicit and implicit bias in the context of underrepresented groups in physics.[23] She ends with recommendations for actions available to many physicists to address the biases.

A group of three short pieces in ***Physics Today*** address implicit bias in physics textbooks. Trefil and Swartz describe how some textbook problems may be harder for women to connect to than for men due to the nature of the prior knowledge they assume.[24] A few months later, Wolfson had a letter in Physics Today commenting on the irony of that article appearing in the magazine in the same month that a review of a quantum physics textbook appeared.[25] That textbook, Wolfson noted, repeatedly used an analogy in which the reader was asked to imagine peering into the window of a Victoria's Secret shop, and Wolfson suggested that analogy would not sit well with women in the classroom. The textbook authors responded, arguing their experience has been that women do not object to the analogy and that in fact they can connect with it.[26]

A 2017 article in ***Physics Today*** focuses on salary data showing female physics faculty on average are paid less than male physics faculty.[27] The article examines possible root causes involving both systemic bias and implicit bias.

An article by Ecklund and Di proposes an interesting source of implicit bias in the physics community.[28] Some physicists interviewed in their study indicated that women were more likely to behave in an ethical way, and because competition in science has an inherently unethical component, this puts them at a competitive

disadvantage. While it was beyond the scope of this study to draw a connection between this perspective and on the careers of women in physics and the authors do not propose a remedy to this situation, it is nevertheless useful to consider what the consequences of this perspective are for the physics community.

For a broader look at issues related to systemic and implicit bias, consider reading the ***Physics Today*** article by Blue et al.[29] It provides both sufficient information to launch classroom discussions about what the problems are, as well as how we might address them, and a number of useful references for students who want to dig deeper. Some points in the article are amplified in Letters to the Editor by Kane[30] and Feingold[31].

The Only Woman in the Room: Why Science is Still a Boys' Club by Eileen Pollack offers both personal insight into the author's experience as a physics student at Yale in the 1970s and analysis of interviews and research into why physics remains so dominated by males.[32] A book review in ***Physics Today*** offers a summary of this work.[33]

For a briefer look at personal experiences with all three forms of bias, see this collection of seven short interviews of physicists in the LGBT community.[34]

Finally, Volume 16 Issue 2 (2016) of ***Physical Review Physics Education Research***, has a large collection of research papers, for the most part with sharply defined topics related to gender bias. An instructor looking to highlight a particular aspect of gender bias may well find that aspect addressed by one of these papers.

Discussion Prompts

1. What criteria would you use in deciding whether or not the textbook problems discussed by Trefil and Swartz are examples of implicit bias?
2. What criteria would you use in deciding whether or not the Victoria's Secret analogy discussed by Wolfson is an example of implicit bias?
3. Ecklund and Di report that some physicists believe that competitive behavior has an intrinsically unethical component. Do you agree with this perspective?
4. Have you observed examples of explicit, systemic, or implicit bias, whether or not they are related to the physics community?

Section 6.7: Programs of the American Physical Society and other organizations

The American Physical Society website has pages addressing issues of women, minorities, and members of the LGBT community in physics. Some information on these pages overlaps.

The Women in Physics page[35] is overseen in part by the Committee on the Status of Women in Physics (CSWP). The page provides a good overview of APS efforts in addressing the underrepresentation of women in physics and includes a number of valuable links, including one to the CSWP-generated set of Effective Practices for Recruiting and Retaining Women in Physics.[36]

The Minorities in Physics page[37] includes links to pages for the Committee on Minorities in Physics and the APS Bridge Program. A news article in ***Physics Today*** describes the efforts of the APS Bridge Program to increase the number of Physics PhDs received by minority students by providing support to those students in gaining admission to and succeeding in PhD programs.[38] For a look at an alternative approach, see the more recent ***Physics Today*** article describing the Cal-Bridge program aimed at boosting minority representation in PhD programs across all STEM fields in California.[39] In that same issue is a news article on programs aimed at increasing participation by underrepresented groups in PhD programs, with an emphasis on the Significant Opportunities in Atmospheric Research and Science (SOARS) program at the National Center for Atmospheric Research.[40] One of the distinctive features of SOARS is its emphasis on mentorship for each student over a span of several years.

The LGBT+ page on the APS website[41] is newer and hence not as filled out as the pages on women or minorities. The LGBT+ Climate in Physics Report, however, provides a good springboard for classroom discussion of these issues.[42]

Discussion Prompts

1. Several programs that address underrepresented groups in physics focus on a small number of departments or institutions. Will it be sufficient to view these points of focus as incubators of a new, more diverse population in physics, or are they better viewed as model programs that will need to be replicated much more broadly?
2. Are there features common to most or all of the programs designed to reduce the problem of underrepresentation in physics?
3. Are there elements that you would recommend adding to the Bridge programs?
4. Would you participate in a Bridge program if you were eligible to do so?

Section 6.8: Role models

Role models who are members of underrepresented groups in physics can be helpful to early career members of underrepresented groups. The role models not only demonstrate that success in the field is possible but can also acknowledge the challenges they have faced and how they dealt with them.

A collection of about two dozen short profiles of minority physicists can be found on the APS website.[43] The National Society of Black Physicists has a large collection of profiles of African Americans in STEM.[44]

Physics Today has a number of resources. A commentary by an astronomy graduate student gives insight into her trajectory as well as gender-related issues such as the influence of role models.[45] A full length article details the life of Mary Sullivan, who wrote some high profile science-related books in the early 1800s.[46] The article spends a fair amount of time setting the historical stage, but it also discusses gender issues directly. An article about Maria Goeppert-Mayer provides both a history of her scientific contributions in the mid 1900s and a history of the variety of part time positions she cobbled together (some uncompensated) before she landed a regular full time position late in her career.[47] A brief interview with Mary K. Gaillard offers her reflections on the status of women in physics and how that is influenced not only by actions within the physics community but also by gender-related messages in the media.[48]

Discussion Prompts

1. What role models stand out as people who have been able to accomplish a lot despite the biases they faced?
2. What role models seem to have a big impact on changing attitudes in the physics community?
3. Is there enough value in simply reading about role models that you think all physics students should be encouraged to do so, or does the primary value come through personal interaction with role models?
4. Compare the experiences of Mary Sullivan, Maria Goeppert-Mayer, and Mary K. Gaillard. How, if at all, are the experiences of present day, early career women in physics different?

Continue to Chapter 7: Physics and Military Research

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Rights

Resource Type

Instructor Materials

Topics

Diversity
Workplace Ethics
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Discipline(s)

Physics
Computer, Math, and Physical Sciences
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