Revisiting the Question of Diversity: Faculties and Ph.D. Programs

H. G. Grundman

The question is starting to feel old, yet with each repetition, it becomes even more perplexing. As we as mathematicians wonder how our schools, our students, our research, and even our jobs will fare in the downturned economy, we also can hardly avoid wondering: how can the United States have its first African American president and its third female secretary of state while our tenured mathematics faculty members are still overwhelmingly white and male?

From a CBMS survey in 2005, the full-time (tenure-track and non-tenure-track) faculty of mathematics departments awarding Ph.D. degrees are approximately 80% white and 82% male. The lack of diversity is even more striking when contrasted with the national undergraduate student population, which has been growing more and more diverse. As a result, notes Shirley Malcom of AAAS, mathematics faculty are looking less and less like the student bodies that they are teaching [6].

As many of us recall, there were some real changes in the 1960s and 1970s. A number of impressive women and minority mathematicians joined research faculties, breaking the metaphorical glass ceiling.

Karen Uhlenbeck [7], of the University of Texas, Austin, started what is now the Institute for Advanced Study’s Women and Mathematics Program after, in the 1990’s, she realized that she had been part of a wave of women mathematicians, but that it was a wave that was never followed by another.

Many of her peers who held the distinction of being the first women to hold tenure in their departments were also the last. And, somehow, that remains the case today: as these women approach retirement age, they are still the youngest women in their departments. The progress that had been made back when they were hired was not the leading edge of a sea-change that many had hoped for and even expected.

Uhlenbeck blames the lack of sustained change on many things, including her own complacency—she and her peers were doing their work, as were other mathematicians over the years. This leads us to the obvious question: what’s wrong with doing our jobs? Nothing, of course! But any of us who take part in hiring and in educating students need to accept that doing our jobs includes examining our policies and practices and fixing anything that is broken. In particular, we need to change those aspects that are contributing to the lack of diversity in our faculty and in the Ph.D.s we graduate.

A National Forum

One recent attempt to address these issues was a workshop held at the Mathematical Sciences Research Institute (MSRI) in November 2008: Promoting Diversity at the Graduate Level in Mathematics: A National Forum, organized by, among others, Sylvia Bozeman of Spelman College and Rhonda Hughes of Bryn Mawr College, the creators of EDGE (Enhancing Diversity in Graduate Education, http://www.edgeforwomen.org/). The goal of the three-day conference was to stimulate, identify, and disseminate successful models that improve retention of underrepresented groups in graduate programs in mathematics [3]. (For the purposes of the conference, these groups were
identified as women, African Americans, Latinos, Native Americans, and Asian Pacific Islanders.) Although the focus was on graduate education, there was also discussion concerning faculty diversity: how policies and practices regarding hiring, particularly those at research universities, have often acted to preserve the nearly homogeneous faculty that has become the norm—and how these practices might be changed.

The first day was devoted to graduate students: listening to them, learning from them, and asking them to propose new models for successful graduate programs. Part of the hope of the organizers was that these students could then go back and assist their departments in changing their departmental structures, policies, and practices. The remaining two days were for faculty from doctoral degree awarding departments and so-called supplier departments (those with a history of sending minority students to mathematics graduate school). Together these faculty worked to identify successful existing models, to evaluate and build on the ideas the students had generated the first day, and to develop plans for specific implementations within the attendees’ departments.

As noted by Malcom [6], evidence that we’re losing critical talent on the education system pathway—from bachelor’s degree to doctorate—is in great abundance. For example, in 2004, women earned 46% of B.S. degrees in mathematics and statistics, but women earned only 28.1% of the Ph.D. degrees in these subjects [6]. Although, of course, looking at these different degrees in one given year doesn’t describe what actually happened to the students who received B.S. degrees in that year, looking across years makes little difference: in 1994, women earned 47% of B.S. degrees in mathematics, while in 2000, women earned 27% of the mathematics Ph.D. degrees [4]. Similar patterns are seen in data for African American, Hispanic, and American Indian students [6], though with such low numbers, extensive analysis is more difficult.

The MSRI workshop was a packed three days of presentations, panel discussions, and working group sessions. Obviously, this article can provide at most a glimpse into the workshop, providing only a small fraction of the information and ideas examined. Luckily, most of the workshop was videotaped and can be viewed on the Internet [1]. For more statistics on women and minorities in mathematics presented at the workshop, as well as for more sources, see [4, 5, 6].

Research on Education
Abbe H. Herzig, of the University of Albany, does research on equity and social justice in mathematics and science education at all levels. Recently, she has been more specifically studying women and students of color in the post-graduate mathematical sciences. Needless to say, her research was of great interest to the conference participants.

She began by noting that most studies of the “underparticipation of women and students of color” in mathematics have focused on the K–12 level. The good news is that this research has led to some interventions that have helped to greatly diminish performance and participation differences between gender groups and among various minority groups. The bad news, says Herzig, is that much of this research used a “deficit model”, which says that there’s something lacking with girls and minorities, something that needs to be fixed.

Making changes in mathematics participation at more advanced levels is more difficult, partly because of beliefs about the nature of mathematics, beliefs that this is a meritocracy in which measures of success are objective, that all one needs is talent and determination. Without entering into this debate, we might want to question just why it is that one should need “determination” and whether or not many graduate programs require more determination on the part of students from underrepresented groups. As observed by Karen Uhlenbeck [7], for the most part, women are not failing out of math graduate school, they are dropping out.

Herzig’s work has led her to promote what she calls the “apprentice metaphor” for mathematics education. Just as in apprenticeships historically, mathematics graduate students need to learn to do mathematics, to learn what mathematicians do, and to learn who they are as mathematicians. They need to learn not only the basic craft, but also how to think like, act like, and feel like a mathematician.

Mathematics education has been mostly about the first: the content of mathematics. Slowly, over time, undergraduate mathematics education has moved towards teaching more about the practice of mathematics: problem solving, writing and presenting mathematics, the basics of doing research, etc. At the graduate level, however, the standard model is very far from that of an apprenticeship, with students normally expected to find their own ways, at least until they get to the research phase. Even then the training is almost always narrowly focused on completing the dissertation, with little or no regard for other aspects of what it means to be a mathematician. Herzig also stressed the importance that students, like apprentices, be able to take part in authentic mathematical activities, not just course work, early in their graduate training.

Interestingly, research shows that at the doctoral level, feeling a part of the community is an important indicator of persistence and that students who have had a strong sense of community
As an undergraduate, or even a good REU experience, are more likely to succeed. Herzig explained these findings and noted their consistency with the theories that building students’ senses of belonging in mathematics is critical for an equitable K–12 education.

Herzig also reported on a 2006 workshop at the American Institute for Mathematics (AIM), “Finding and Keeping Graduate Students in the Mathematical Sciences”. She reported on the plethora of ideas and suggestions for both faculty and students generated at this conference. (See [4].)

Research on Intelligence

For many participants of the MSRI workshop, a high point came on the final day with a presentation by Joshua Aronson [2] of New York University. Aronson has done extensive research on the social and psychological influences on academic achievement. His talk focused on the effect on minorities by the theories that building students’ senses of belonging in mathematics is critical for an equitable K–12 education.

Herzig discussed numerous obstacles to completing a Ph.D. in mathematics, noting additional ones for many women and minorities: having a lack of role models; facing discrimination in finding mentors; being marginalized; confronting blatantly sexist and racist behavior; and constantly having to prove their worth. Each of these can threaten the needed sense of community and belonging. She also discussed some possible ways to work towards eliminating many obstacles: fostering community among the students, initiating a program of meaningful faculty mentoring, establishing policies allowing for flexible scheduling and for full lives, providing positive role models, and practicing zero tolerance for discriminatory behavior, among others. She noted that many of these practices have been found to improve retention of all graduate students, not just women and minorities.

Aronson gave the commonly used operational definition of intelligence: that which IQ scores measure, is indicated by performance in school, by verbal fluency, by scores on other standardized tests, etc. He noted that in the past, the prevailing theory was that an individual’s intelligence is mostly, if not completely, determined at birth and that this theory is now falling apart.

Rather than taking the expected path into the nature versus nurture debate, Aronson focused on the situations in which intelligence is measured. He argued that this is not simply a case of measuring some static quality of the brain, but is more of a transaction. Whether the subject is being tested or interviewed, the process of measuring is creating a psychological situation. This fact makes it obvious that the results can be affected by many things that we don’t usually think of as intelligence.

Okay, so this isn’t exactly news to anyone in academics. We know that test scores can be affected by various things. We also know that women and minorities do not perform as highly as men do on many standardized tests and have heard a variety of explanations for this. Aronson listed many of the common explanations, some of them credible, some of them basically disproven. He then noted that these explanations, taken as a group (doing a careful regression analysis), cannot account for a performance gap of the size observed.

This led Aronson to develop the theory of stereotype threat. According to the theory, the awareness of a stereotype implying that the subject is less intelligent and so will do comparatively poorly on a test acts to increase the subject’s stress level, leading to a lower test score.

Aronson tested his theories with various groups of subjects and a variety of academic tests. He discovered that simply telling minority students that the goal of the experiment was to study the psychology of achievement and test-taking, that the intelligence of individuals was not being measured, resulted in much higher test scores than those of the minority students who had been told that the goal was to test each individual’s intelligence.

In a related experiment, one group was asked to fill out a demographic survey, including a question about race, at the beginning of a test. In this group, the white subjects did about twice as well as the African Americans. Another group took the same test without the survey (but with a question about race at the end of the test). In this second group, there was virtually no difference between the scores of the different racial groups. Apparently, drawing the African Americans’ attention to their own demographic information prior to the test led them to do less well.

Concerning math and gender, two groups of students were given a difficult math test. One group was told that it is known that there are no gender differences in performance on the test. The women in this group did significantly better than women in the control group and, interestingly, the men in this group did worse than the men in the control group. In fact, for this group, there was...
virtually no difference in average test scores by gender.

It should be noted that stereotype threat can have negative effects on virtually anyone. For example, Aronson described an experiment in which white male students who were particularly strong in mathematics were given a very hard math test. One group was told that the goal of the test was to see why Asians are so good at math. This group scored almost a full standard deviation (.93 SD) below the other group on the test.

Many of these experiments have been carried out "in the field". Most notably, one year the Educational Testing Service altered the procedure for its advanced placement AB Calculus test so that half of the test-takers were asked to identify their genders after taking the test instead of beforehand. The women in this group scored much higher than the women in the control group. In fact, on average, in the group asked to indicate their genders before the test, men scored higher than women; and in the other group, women scored higher than men.

Aronson noted that there are over 350 published replications of these studies. They involve different stereotyped groups and different skills, but the results are all consistent with Aronson's theories.

Additional research has indicated that there are a variety of ways in which this effect can be mitigated. Aronson describes a number of experiments demonstrating the effectiveness of, even briefly, teaching students about stereotype threat in order to diminish its effects. Similarly, informing students that intelligence is malleable and can be improved, that it is not determined at birth, leads to improved test scores for all groups of students, though more so for racial minorities than for whites. He explained how exposure to role models, particularly highly qualified ones, can virtually eliminate the effects of stereotype threat. It also helps to normalize struggle, that is, to let students know that it is normal to have trouble in whatever level of school they are in, and to help them avoid social isolation.

Aronson's presentation generated a lot of excitement at the workshop as participants saw ways they could immediately apply the lessons learned from his work.

Ongoing Efforts
Some of the most inspiring parts of the workshop were those in which attendees learned about graduate programs that are successful in improving their diversity and their retention rates among women and minorities. Hearing from both faculty and students about their experiences with such graduate programs along with effective summer programs like EDGE and the IAS's Women and Mathematics Program [http://www.math.ias.edu/wam](http://www.math.ias.edu/wam) was both encouraging and informative.

The workshop itself was certainly not meant to be the final word on diversity in graduate mathematics. The organizers and MSRI sponsored a list-serve for conference participants which saw a great deal of activity in the following weeks, as information was exchanged and faculty of graduate programs sought to improve their recruitment of women and minority graduate students from the institutions represented at the workshop.

Continuing in the theme of this workshop, three of the participants have organized a workshop at AIM, with the goal of improving recruitment and retention of all mathematics graduate students, with a particular emphasis on women and under-represented minorities. The AIM workshop, which at the time of this writing is scheduled for August 2009, will build on the 2006 AIM workshop, the 2008 MSRI workshop, and the myriad efforts by groups and individuals in the mathematics community that have resulted in the improvements made thus far.

References


Note: All videos can be accessed from the URL given in [1].