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An open letter on diversity in education

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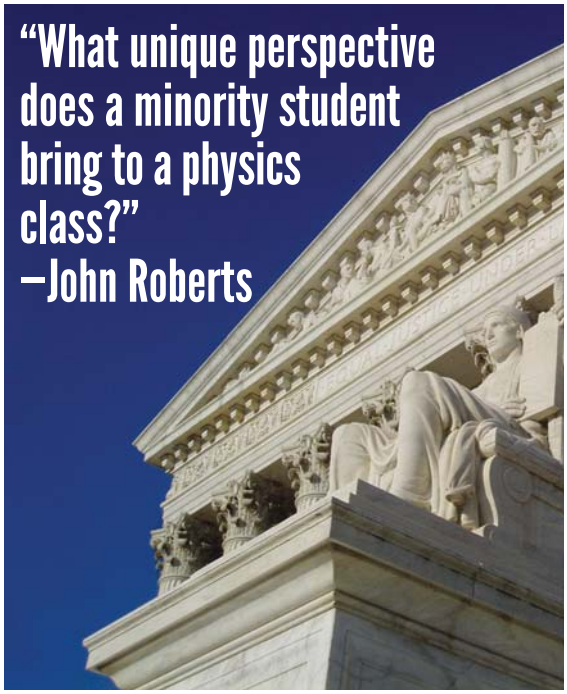

Dear Justice Roberts,

In recent oral arguments, you wondered skeptically what a black person's perspective could possibly bring to a physics course.

I am a white male physics professor who has taught at state-sponsored educational institutions and, for 11 years, in a historically black college for women (Spelman College, specifically). Allow me to enlighten you. The term used in cognitive science and social psychology is "stereotype threat."

When people talk about role models, they are using a common layman's term related to stereotype threat. The simple idea is that if you never see people who are like you in a discipline, you are far less likely to see that discipline as part of yourself. In fact, experiments have been done to trigger stereotype threat. Students' behavior in performing a given task will change if they are reminded of the stereotype of people like them. If they are reminded of being women, or ethnic minorities, they will be more likely to behave like the cultural stereotype of that group, and their performance will correspondingly decline.

I've been a physicist for more than 30 years, and in that time I have only known two black female physicists. My black female students had stereotype threat on a regular basis. People like them are conspicuous in physics largely by their absence.

Physics is a European invention and an adopted child of Asian culture. My black female students could not see themselves in the world of physics. I learned that there is a way to address that, but I had to radically alter my conception of my job. Instead of teaching the conceptual structure and logic of physics, I really needed to help students to see a physicist in themselves.

I no longer see myself as teaching physics. Instead, I see myself helping people become physicists, even if only briefly. And that means a great deal more than just the dry body of facts and concepts that you, Chief Justice Roberts, seem to have in mind. Physics is a culture, with norms of behavior, practice, communication, legitimate argument, and rational critique. One learns to inhabit that culture the same way one learned to inhabit American culture: developmentally, in practice with and gathering feedback from a more expert practitioner, whether parent or professor. You did exactly the same thing in law school. How much of the practice of law is contained in the statutes? Or even in the Constitution? If I teach someone only the dry facts of the statutes, will that person be an expert lawyer, or does that expertise come from collision with real life and divergent opinions?

That perspective in turn has profound effects. In the 19th and early 20th centuries, the only way to get a professional position in physics was to be closely associated with someone who was already there. The profession was closed. That is partly why Albert Einstein ended up in a patent office. And people on the inside viewed physics as basically a solved problem, with maybe a little tidying up needed around the edges.

It was a group of outsiders who blew physics open again, people who were not part of the establishment: Einstein, Ludwig Boltzmann, Werner Heisenberg, and Paul Dirac. They were the creators of quantum mechanics and relativity.

Today, in my opinion, physics is stuck in a similar rut. There has been no truly new idea since electroweak unification in 1972. String theory has been wandering around in search of something to describe, but it is now held together by politics. It failed its first big observational test—by getting the effect of dark energy exactly backwards from what it actually is. And in any case, string theory is not essentially new, just a continuation of a line of thought that began in the 1930s.

Some confirmation of the idea that the relative lack of diversity of physicists limits physics comes from the work of Kevin Dunbar.[1] As part of his studies on expertise in science, Dunbar has shown that the most productive and innovative research by far comes out of the most heterogeneous groups, those with the most diverse backgrounds. That diversity provides a broader range of ways of thinking about a problem, not just multiple copies of the same way. Physics now is largely composed of a bunch of people with the same backgrounds. I've no doubt that a dose of "outsiderness" would help crack open the groupthink again.

You should think about that. You have too damn many Harvard alums on the court.

But even if physics doesn't get blown open again, having to really think carefully about stereotype threat and how to navigate around it has radically changed my little corner of physics. And you won't find any mention of physics culture in the physics textbooks. They don't mention how physics is done, only what it is. Physics is seen as a thing, not as a process. The perspective I adopted—that I am not teaching physics but rather enabling the development of physicists and helping people to see "physicist" as part

of their identity—is not just applicable to reaching black women, and it is a perspective I continue to keep foremost in mind after having left Spelman (for the record, because the administrators no longer value perspectives such as mine). It has become a part of my view of the culture of physics.

You may regard this as a friend-of-the-court brief, though obviously I have no idea how to do that properly.

Reference

1. K. Dunbar, in *The Nature of Insight*, R. J. Sternberg, J. E. Davidson, eds., MIT Press (1995), p. 365; *J. App. Dev. Psychol.* **21**, 49 (2000).

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The "alien spirit" of relativity

The Supreme Court case *Fisher v. University of Texas at Austin* has once again exposed the unresolved problem of race in America. Particularly telling were the comments of Chief Justice John Roberts and Justice Antonin Scalia. Roberts asked, "What unique perspective does a minority student bring to a physics class?" And Scalia said, "Most of the black scientists in this country don't come from schools like the University of Texas." In case that was not sufficiently inflammatory, he continued unfazed: "They come from lesser schools where they do not feel that they're . . . being pushed ahead in . . . classes that are too . . . fast for them."

What Roberts has overlooked is that many of the most brilliant physicists, particularly the theorists, have been outsiders, at least in thought. Their "minority" perspective played a critical role in their success. In physics research, being an outsider can be an advantage when seeking answers to unsolved problems. Of course, being an ethnic or racial minority does not automatically make one a minority thinker. But it does come with unique experiences that could yield remarkable success in research.

The value of outsider thinking is quite clear when one considers how physics advances. For the most part, undergraduate physics education focuses on a codified set of solved problems. Research, on the other hand, exposes students to the unknown. The skills to excel at the latter have little to do with those required for whizzing through the former. Physics departments are replete with examples of problem-set whizzes who floundered in research. The ability to come up with new ideas that inform unsolved problems is a key factor in determining success in research.

The building blocks of modern physics as we know it—quantum mechanics, field theory, and general relativity, for example—all arose from individuals who stepped outside the established line of reasoning. That spirit is exemplified by Howard Georgi and Sheldon Glashow in their immensely influential 1974 grand unification paper, which contains the disclaimer, "Our hypotheses may be wrong and our speculations idle, but the uniqueness and simplicity of our scheme are reasons enough that it