OPINION
Diversity in Neuroscience. We Know the Problem. Are We Really Still Debating the Solutions?

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The lack of racial and ethnic diversity in science, technology, engineering and mathematic or STEM fields requires immediate attention if the United States is to continue to compete in the global marketplace of ideas. Here, the argument is made for immediate action in four specific directions. First, we need to continue to recruit and incentivize the mentoring of a diverse pool of junior faculty. Second, we need to introduce Under-Represented Minority (URM) students to "science in practice" through our research labs as early as possible. Third, we need to provide the resources to allow URM students to succeed in STEM fields. Fourth and finally, we need to encourage students of all backgrounds to "reach back" and involve themselves in K-12 science education.

Key words: Science, Technology, Engineering and Mathematic (STEM) fields; Under-Represented Minorities (URM); Bridge Programs, mentoring.

It seems unnecessary to restate the problem, and yet it really cannot go without acknowledgement. The lack of racial and ethnic diversity at all levels of science, technology, engineering and mathematic or STEM fields including neuroscience remains a problem. To be stagnant in our addressing of these issues is to handicap the country from the contributions that a more diverse perspective could bring to bear on creativity and innovation in global scientific endeavors.

A "leaky pipeline" remains one obstacle to a more diverse participation in STEM fields (Turner and Myers, 2000; Myers and Turner, 2004). Just a few examples of the problem follow. While 46% of White and Asian American students completed their STEM major in 5 years, only 27% of URM students did the same (Huang Taddese et al., 2000). By URM, we refer to individuals who belong to one of the following groups: African Americans, Alaska natives, Hispanics, Native Americans, and Pacific Islanders. Furthermore, only 17% of URM students who demonstrate an interest in pursuing bachelor's degrees in STEM fields earn them, whereas 30% of white and Asian students demonstrating a similar interest earn them. This statistic is particularly problematic given that URM and White high school students report equivalent levels of interest in pursuing STEM fields in college (College Board, 2005). Furthermore, in 2009, during the same time period that African-Americans earned 1,041 STEM Ph.D.s, Hispanics earned 1,098 STEM Ph.D.s, and American Indian/Alaska Natives earned 120 STEM Ph.D.s., White students earned 14,552 STEM Ph.D.s (Nation Science Foundation, 2011). Furthermore, while the number of doctorate degrees awarded to underrepresented minorities has increased by 34% from 2001 to 2008 (McElroy & Ham, 2009), the number of URM in faculty positions in STEM fields remains between 3% and 5% (Beutel and Nelson, 2006).

The intersection between ethnicity and gender has also proven troublesome. As just one measure of this, female URM faculty have the lowest rates of successful tenure of all groups measured (Beutel and Nelson, 2006).

ENHANCING DIVERSITY AMONG FACULTY

Better access to both role models and effective mentoring for URM students is key to our mission as academics. As just one example of the importance of URM role models, Umbach (2006) noted that the percentage of students of color who enter a university is tied to the number of faculty of color on staff there. Furthermore, URM students have been found to be least likely to remain in URM fields when they lack role models and mentors (Nelson and Bramer, 2010). With regard to the need for better mentoring, the *Bayer Facts of Science Education Survey* (2011) reports that 40% of all URM in chemistry and chemical engineering were discouraged from pursuing science at least once in their academic career and that the most common time of discouragement was in college with the most common individual being a college professor. Furthermore, Bayer (2012) also interviewed STEM chairs from the top 200 research institutions and found that 83% of chairs believe that their faculty counsels some students against pursuing STEM studies and that 58% of chairs believe this is a common practice in their departments. Of course, taken at face value, counseling students based on their interests and aptitudes (whether this leads to encouragement or discouragement) may not be a problem itself, but when coupled with evidence suggesting that URM may be more likely to receive discouragement it becomes problematic.

In my own career as a neuropsychologist, I have been honored by extremely dedicated mentors across my entire training career. The vast majority of these mentors were not themselves members of URM groups. They were, instead, members of privileged groups who recognized the nature of their privilege and made concerted efforts to reach out. Yet, I recognize that my experience is not shared by everyone, and that those senior colleagues that do reach out often do so with little external incentive.

A recent commentary in The Chronicle of Higher Education by the CEO of AAAS, Alan Leshner (2011) makes the point clear. Until mentoring a diverse student body in STEM fields is better rewarded as part of the metric of faculty success for faculty of all backgrounds, little is likely to change. Therefore, I think it is critical to increase the number of faculty from disadvantaged groups, but I also think it is myopic to assume that these faculty should be the only ones who have a responsibility to mentor students from diverse backgrounds. All faculty need to be encouraged, and indeed incentivized, to mentor a diverse group of potential scientists. For example, faculty who choose to mentor URM students in STEM fields and show success in doing so might be paid extra for this mentoring, given credit for this mentoring during promotion, or receive course credit towards a reduced load.

ENHANCING ACCESS TO RESEARCH EXPERIENCES AND INCORPORATING ISSUES OF SOCIAL JUSTICE IN OUR RESEARCH LABS

One way to maintain URM student interest in STEM fields is to expose them as early as possible to our research labs. Indeed while previous literature has demonstrated the positive impact of undergraduate research on attracting and attaining students of all backgrounds in the sciences, the effects on URM students appear to be particularly strong (see Lopratto, 2004, 2007 and Russell et al., 2007). Programs like SOMAS-URM (http://www.somasprogram.org) provide funding for undergraduate students to work in junior faculty research labs providing mentoring to both student and faculty. Similarly, the University of Washington-Howard Hughes Medical Science Institute's (UW-HHMI) Biology Fellows Program introduces students to research laboratories as early as their first year in college as well as provides tutorial services for excelling in first year science courses (Dirks and Cunningham, 2006). Such programs have proven highly effective and clearly need to be supported and expanded.

I have also noticed an exciting trend in the research questions that neuroscientists are tackling in their laboratories. Part of this trend is directly related to the enhanced interest in social neuroscience. That is, more of our research projects seem to be addressing issues that may be of particular interest to students from disadvantaged groups. For example, I have two colleagues who have been investigating the instantiation of cultural differences (e.g., individualism and collectivism) onto brain activity. I have another colleague who is looking for biological markers of homosexuality and atypical patterns in gender identity. Finally, one of my own projects investigates discrimination stress in African American students and the impact of such stress on cardiovascular activity, stress hormones and immune markers. At least in my case, the original project was actually proposed by a student of color several years ago and now has become a popular project that has recruited more students of color to my research interests.

BUILDING BRIDGES

Bridge programs differ in terms of the targeted year in high school (usually sophomore or junior), the curriculum (hands-on research or classroom curriculum), whether they are targeted academically or socially, and, when targeted academically, whether proficiency in a specific academic field is highlighted (science, writing or broader based academic exposure). Intended to help transition students who may have had fewer opportunities to experience college preparation, finding statistics on the effectiveness of bridge programs is more difficult than might be expected.

One clear success story is that of Grinnell's "Science Project" where students from under-represented groups (URM, first generation college students, and women in computer science and engineering) participate in a week-long pre-enrollment week as well as revised introductory science courses, mentoring and research opportunities throughout their undergraduate education. Between 1994 (when the program began) and 2008 (the last year when data are available), Grinnell has witnessed a 114% increase in women science majors and a 164% in URM science majors.

I think we need to ask the difficult question of who can succeed in college given the resources they bring to the table and (if you will) the table at which they have been placed. I think we need to be honest about the fact that some students (students of all racial and ethnic groups) will simply not be able to succeed at our institutions. To accept them and then watch them fail is egregious. It sends the wrong message to everyone in the academic community. I wonder why we have not made greater progress in determining what level of achievement is necessary in order to increase the likelihood of success for all of our students. If there is a good reason to think that the markers of such achievement are different for different groups, make the argument, use those markers, and let's get going. If it is the case that those who society has disadvantaged could reach appropriate achievement levels to succeed in college if we simply provided them with further resources (for example, a number of different types of bridge programs), what is the argument for not doing so?

CAN WE REALLY MOVE FORWARD WITHOUT REACHING BACK?

The National Report Card from the US Department of Education provides figures for 2009 for the number of high school students from different ethnic groups who do not attain standard curricular criteria because of a lack of different requirements. While 31% of Asian/Pacific Islanders and 34% of white students are missing science, 50% of Hispanic students and 52% of Black students are missing science. Furthermore, while the average grade point average (GPA) for Asian/Pacific Islander students was 3.26 and for White students was 3.09, the average GPA for Hispanic students was 2.84 and for Black students was 2.69. Furthermore, the OECD Programme for International Student Assessment (PISA) report ranks 15-year old students in the United States 17th in science and 25th in mathematics of the 34 countries to which it is compared.

I think we have to start engaging in the K-12 debates. Certainly, you may argue that that is not our mission. Yet, I believe that our mission is threatened if we do not address the path our students take to reach us. One way we can better engage in this challenge is by encouraging our students of every background to participate in outreach programs. I have a current student who decided to start a program to provide free music lessons to elementary students in a surrounding school district. He and a cadre of his classmates go to the children's homes or have them coming to our college campus (thereby providing them with greater familiarity to a college setting) once a week and provide them with music lessons on any one of multiple instruments. The donated instruments are then left with the participant during the week so that they will have access to them for practice purposes. Because he collected IQ measures in those who received such lessons and others in a waitlist control, he is currently writing up this intervention into a scholarly article as part of his neuroscience senior thesis. Future programs might focus on hands-on science interventions provided by talented and diverse undergraduate students over the summer and investigate how these might help retain students in K-12 education and further into college education. To me, such projects represent the perfect intersect between community outreach and research training.

CONCLUSIONS

So, we know the problem. The pipeline is leaky and though progress has been made over the last decade or two, the fundamental problems persist. Might I suggest then that we move forward on concrete solutions? First, if we truly care about the mentoring of URM in STEM, we need to incentivize it through faculty promotion criteria. Second, we need to introduce students to "science in practice" through our research labs as early as possible. Third, if we are accepting students who have had fewer opportunities to succeed in STEM fields, we need to provide the resources to allow these less-advantaged students to succeed. Fourth and finally, we need to acknowledge that we can play a role in the quality of the resources to which our students have access before arriving at college by encouraging our college students of all backgrounds to "reach back" and involve themselves in K-12 science education. If we cannot convince our colleagues across the sciences of the need for such reforms, surely Neuroscience is again willing to lead, are we not?

REFERENCES

Bayer (2011) Bayer facts of science education survey. Media, PA: International Communications Research.

Beutel A, Nelson DJ (2006) The gender and race-ethnicity of faculty in top social science research departments. Soc Sci J 43:111-125.

College Board (2005) 2005 College-bound seniors: total group profile report. http://www.collegeboard.com/prod_downloads/about/news_info/cbsenior/yr2005/2005-college-bound-seniors.pdf.

Dirks C, Cunningham M (2006) Enhancing diversity in science: is teaching science process skills the answer? CBE Life Sci Educ 5:218-226.

Huang G, Taddese N, Walter E (2000) Entry and persistence of women and minorities in college science and engineering education (No. NCES 2000601). Washington, D.C.: National Center for Education Statistics.

Lopatto D (2004) Survey of Undergraduate Research Experiences (SURE): first findings. Cell Biol Educ 3:270-277.

Lopatto D (2007) Undergraduate research experiences support science career decisions and active learning. CBE Life Sci Educ 6:297-306.

Leshner A (2011) We need to reward those who nurture a diversity of ideas in science. Chron High Educ.

McElroy M, Ham, B (2009) Dramatic rise in minority science Ph.D.s detailed in new report. Science 24:480.

Myers SL, Turner C (2004) The effects of Ph.D. supply on minority faculty representation. Am Econc Rev 94:296-301.

National Science Foundation, Division of Science Resources Statistics. 2011. Women, minorities, and persons with disabilities in science and engineering: 2011. special report NSF- 309. Arlington, VA. Available at http://www.nsf.gov/statistics/wmpd.

Nelson DJ, Brammer CN (2010) A national analysis of minorities in science and engineering faculties and research universities (2nd ed). Norman, OK:Diversity in Science Association.

Russell SH, Hancock MP, McCullough J (2007) The pipeline. benefits of undergraduate research experiences. Science 316:548-549.

Turner C, Myers SL (2000) Faculty of color in academe: bittersweet success. Upper Saddle River, NJ: Allyn and Bacon.

Umbach PD (2006) The contribution of faculty of color to undergraduate education. Res High Educ 47:317-345.

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