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The Pipeline Still Leaks and More Than You Think: A Status Report on Gender Diversity in Biomedical Engineering

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Abstract—While the percentage of women in biomedical engineering is higher than in many other technical fields, it is far from being in proportion to the US population. The decrease in the proportion of women and underrepresented minorities in biomedical engineering from the bachelors to the masters to the doctoral levels is evidence of a still leaky pipeline in our discipline. In addition, the percentage of women faculty members at the assistant, associate and full professor levels remain disappointingly low even after years of improved recruitment of women into biomedical engineering at the undergraduate level. Worse, the percentage of women graduating with undergraduate degrees in biomedical engineering has been decreasing nationwide for the most recent three year span for which national data are available. Increasing diversity in biomedical engineering is predicted to have significant research and educational benefits. The barriers to women's success in biomedical engineering and strategies for overcoming these obstacles—and fixing the leaks in the pipeline—are reviewed.

Keywords—Women, Engineering, Barriers, Bias.

INTRODUCTION

The lack of diversity in engineering is a persistent and important problem. As Neal Lane, a former Assistant to the President for Science and Technology noted at the Summit on Women in Engineering,[21] "we simply need people with the best minds and skills, and many of those are women." Senator Ron Wyden echoed these sentiments in 2003[42] when he stated:

> America will not remain the power it is in the world today, nor will our people be as healthy, as educated or as prosperous as they should be, if we do not take the lead in scientific research and engineering development. To make our country better, to improve our national security and quality of life, we need to encourage people to go into these disciplines. Women are a largely untapped resource in achieving this vital goal.

Even more recently Arden Bement Jr., Director of the National Science Foundation urged working toward an even more inclusive workforce[4]:

> Year by year, the economic imperative grows for broadening, empowering and sharpening the skills of the entire US workforce—just to remain competitive in this global community. This fresh talent is our most potent mechanism for technology transfer to our systems of innovation. Fortunately, we have a fount of untapped talent in our women, underrepresented minorities and persons with disabilities. Our need to broaden participation and increase opportunity is critical, for both the science and education communities and the nation.

Indeed, the claim that a more inclusive workforce may be more innovative and more productive is supported by the literature on diversity.[19,24,26]

In academia, the educational benefits of diversity and inclusivity are concrete and significant.[15] First, experience with diverse peers early in the college years fosters more, and more positive, cross-racial interactions later.[14] Second, students with the most classroom experience with diversity and the most diverse friends and experiences on campus are more engaged in learning, and self-reported more gains in critical

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thinking, problem solving, and self-confidence.[15] Similar benefits of diversity have been found in graduate professional (medical and law) education.[27] Third, motivation to consider multiple perspectives, which is an important skill in team work as well as interdisciplinary research, has been shown to be related to classroom and campus experiences with diversity.[15,27] Finally, multiple lines of evidence suggest that experience with diversity reduces unconscious bias,[3,5,29,40] a topic we will return to below.

In biomedical engineering, we have unique opportunities and unique challenges. One opportunity is the wide appeal of our field to women, underrepresented minorities (URM), and people with disabilities. We are also a younger discipline, which implies fewer institutionalized impediments to diversity. In comparison to many other engineering disciplines, we are more connected to the relatively more diverse biological and medical sciences. Our unique challenges are the flip side of these opportunities. The inherent appeal of biomedical engineering to a diverse population can foster complacency about diversification and lack of attention to the real problems of attrition and, sometimes, discrimination. Second, as a younger discipline, we have fewer senior women and underrepresented minority role models. Third, the interdisciplinary nature of our discipline contributes to the leaky pipeline since at all levels—BS, MS, and PhD—highly trained women and URM may be recruited into medicine and the biological sciences where they perceive the intellectual challenges to be similar but the barriers to their success fewer.

DATA ON GENDER DIVERSITY IN BME

Although gender diversity is poor in engineering as a whole, the BME discipline has attracted many women, at both undergraduate and graduate levels. The fraction of those receiving BS degrees in BME who are women is second only to environmental engineering according to the most recent data from the ASEE[2] (Fig. 1, top). BME also has the highest fraction of women receiving PhDs in engineering (35.6%; Fig. 1, bottom). Unfortunately, gender diversity of the faculty is not as good. A retrospective survey of 20 highly ranked departments shows that the fraction of women on the faculty is substantially lower than the fraction of women enrolled in undergraduate and doctoral programs ($38 \pm 9\%$ and $39 \pm 6\%$ for undergraduate and doctoral programs, respectively vs. $17 \pm 8\%$ for faculty; Fig. 2, top). The fraction of URM at the undergraduate, doctoral, and faculty levels are even lower ($9 \pm 7\%$, $8 \pm 8\%$ and $4 \pm 9\%$, respectively), with the majority of schools having no URM faculty members at all (Fig. 2, bottom). While the fraction of women faculty members may be higher at other institutions, the data from top tier institutions have important implications for the role models available to students who have the best chance of succeeding in the highest reaches of academia. In particular, according to Trower and Chait,[38] the "most accurate predictor of subsequent success for female undergraduates is the percentage of women among faculty members at their college." And, as suggested by Sandra Harding, "the presence of significant numbers of women in a field often increases its legitimacy and the value of its work in the public perception."[17]

It is tempting to think that the numbers of women and underrepresented minority faculty members will increase over time as the current BS and PhD level women and URM move up through the ranks. However, data from other fields of science and engineering suggest that this is not the case. In biology, women have obtained more than 50% of the BS degrees for over a decade (now earning >60% of the BS degrees), receive 50% of the PhDs today, yet still represent only 25% of faculty positions.[25] In Chemistry, women have received approximately 50% of the BS degrees since 2002, but represent only 13% of faculty today. In chemical engineering, women have received 30% of BS degrees and 25% of PhDs for more than a decade, but today just over 10% of faculty members are women. Current data from ASEE demonstrate that the percentage of BS degrees in BME earned by women reached a peak in 2004 and has declined for each of the last 3 years, effectively erasing gains from the last 5 years[1,2,25] (Fig. 3). Looking at the absolute numbers for the last 3 years (Table 1), two different reasons for the decreases in percentage are apparent. During the period 2005–2006, the numbers of men and women obtaining BS degrees increased, but the number of men increased more than the number of women. In contrast, during 2006–2007, the number of men earning degrees again increased but the number of women decreased. Thus, BME attracted more men but fewer women.

Given the perceived growth in our field over the last 3–5 years, this last statistic is perhaps the most disheartening. Why are fewer women graduating with BME undergraduate degrees now and how can we reverse the trend? Also, if a relatively stable increase in women obtaining PhDs in BME does not increase the number of women faculty in BME, then what will? Finally, while there are many possible explanations for the recent drop in BS degrees in BME earned by women, how can we sort out which is the dominant cause and thereby develop effective interventions? In part, we view this presentation of data as

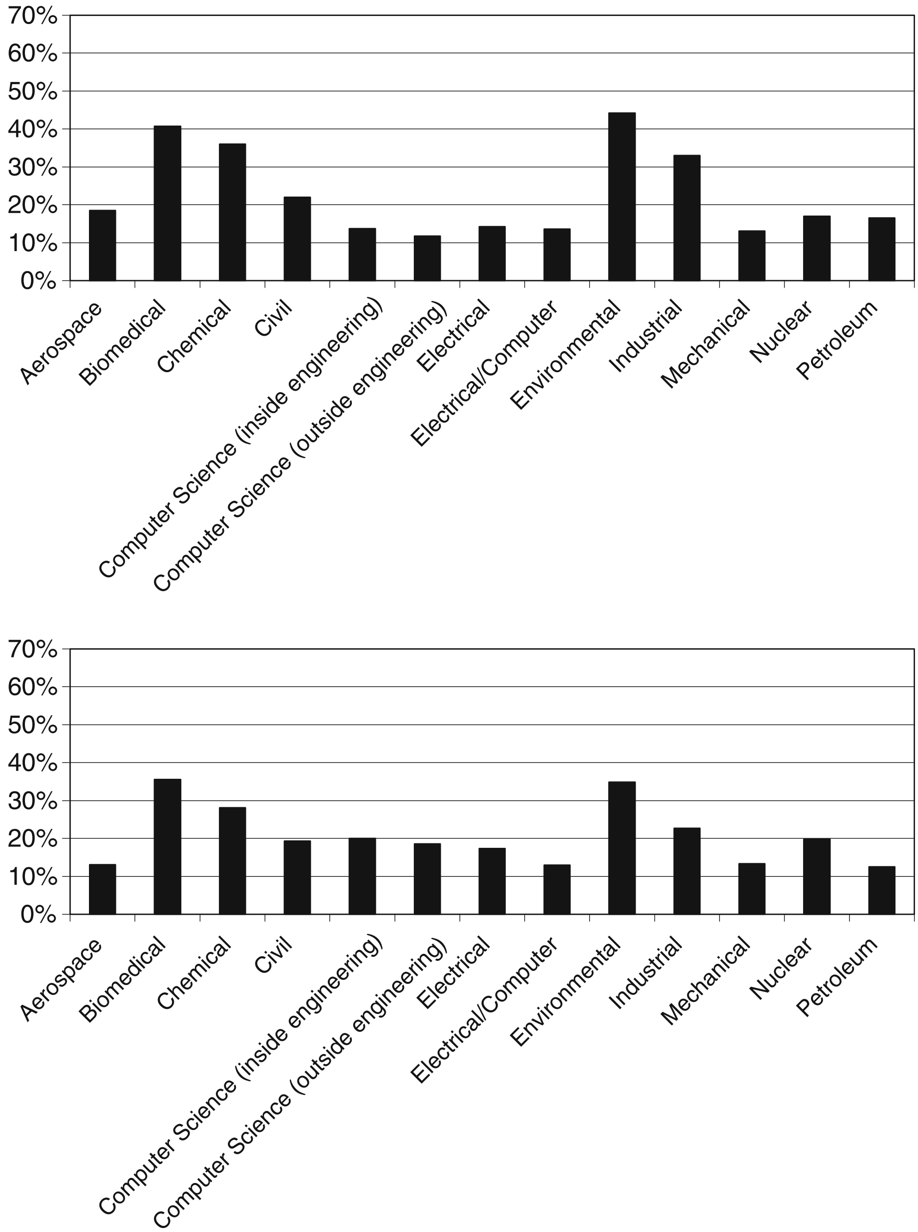

FIGURE 1. Percent of bachelors (top) and doctoral (bottom) degrees awarded to women in engineering disciplines in 2005–2006 from American Society of Engineering Education.[2]

a call to action to investigate the trends identified here with carefully designed studies that clearly establish why the BME pipeline is leaking. Only by careful analysis of the root causes, can we then hope to develop effective solutions. In the absence of data on the BME-specific barriers to the retention and advancement of women and people of color, here we provide a review of previously identified barriers in STEM disciplines and suggest strategies for improving diversity in BME.

BARRIERS AND STRATEGIES FOR IMPROVING DIVERSITY

As succinctly reviewed by Handelsman *et al.*,[16] the barriers to women in science in engineering are (1) the pipeline, (2) the departmental climate, (3) difficulties balancing family and work and (4) unconscious bias. Note that we focus here on the barriers to, and strategies for, increasing *gender* diversity in BME. We acknowledge that this approach minimizes the

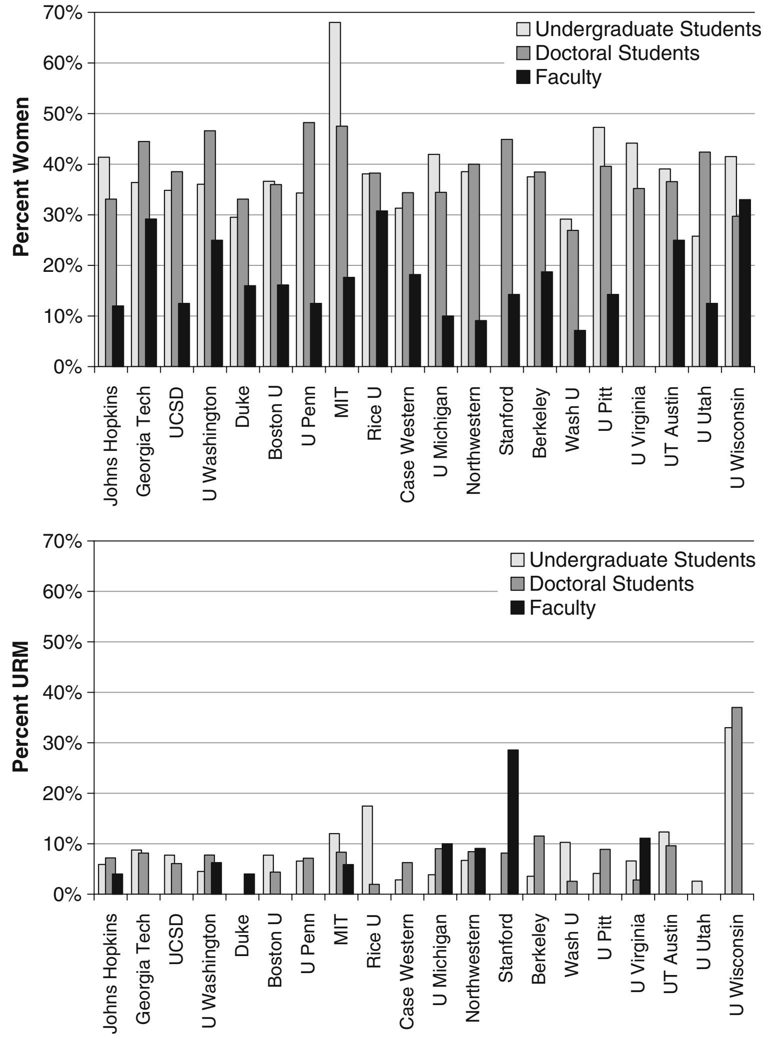

FIGURE 2. Percent of women (top) and underrepresented minorities (URM) (bottom) undergraduate students, doctoral students and faculty in highly ranked Biomedical (or Biological) Engineering Departments in 2005–2006 from American Society of Engineering Education.[2] Note that a missing bar indicates 0% by self-report from that institution in 2005–2006.

situation of all people of color—especially men of color—and does not address the unique barriers faced by women of color.

Pipeline

Increasing the number of young women who seek to obtain undergraduate engineering degrees is a critical first step to increasing gender diversity in BME. Many institutions, departments, faculty members, and even graduate and undergraduate students are actively working toward this goal with a variety of K-12 outreach initiatives, too numerous to review here. Once recruited into engineering programs, curricular reform[7] and mentoring programs[8] may be successful at increasing advancement and retention. Unfortunately, these and similar initiatives are likely not being pursued as avidly in BME as in other engineering disciplines because of the perception of gender parity in BME. The data showing declining graduation rates recently should serve as a call to action in our field to actively recruit, encourage, and promote women in our field.

At the doctoral level and beyond, workshops and programs geared specifically for women can have high impact; one example is the Negotiating the Ideal Faculty Position Workshop held at Rice University and supported by the NSF ADVANCE program,[31] which was recently modified for presentation at the 2007 BMES Annual Meeting and the 2009 ASME Summer Bioengineering Conference. New assistant professors who successfully negotiate for the resources

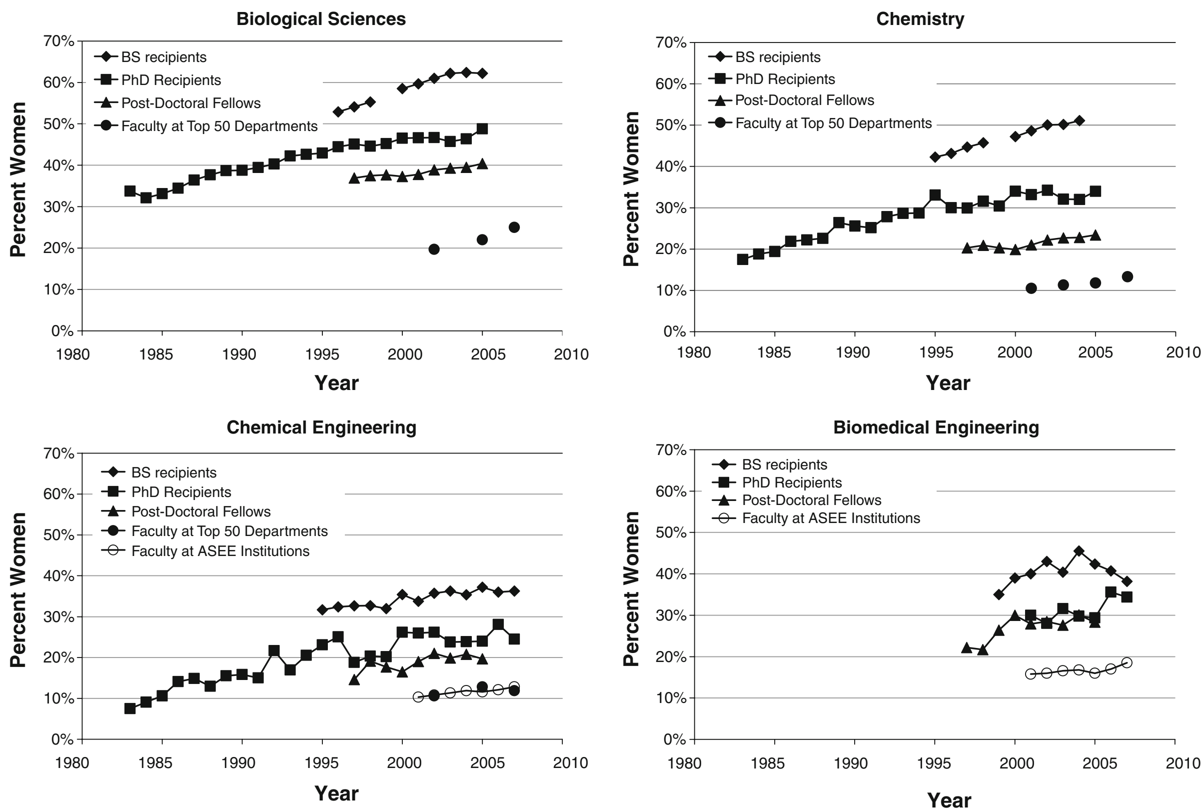

FIGURE 3. Number of women at various levels in biological sciences, chemistry, chemical engineering and biomedical engineering from 1983 to 2006 from A National Analysis of Diversity in Science and Engineering Faculties at Research Universities,[1] American Society of Engineering Education,[2] and National Science Foundation.[25]

TABLE 1. Numbers of bachelors and doctoral degrees awarded to women and men in biomedical engineering from 2005 to 2007 from American Society of Engineering Education.[2]

	2005	2006	2007
BS			
Women	1022	1187	1134
Men	1388	1730	1835
PhD			
Women	98	155	184
Men	235	281	352

that will make them successful and who can recognize environments where they are likely to be successful are more likely to be promoted and tenured. The NSF ADVANCE Cross-Disciplinary Initiative for Minority Women Faculty is a post-doctorate example that targets minority women and supports their socialization into an academic career.[32] Other highly recognized efforts include the Committee on the Advancement of Women Chemists (COACh)[33] led by senior women faculty in the chemical sciences and best known for national workshops designed to transform the careers of women scientists and engineers, and the National Institutes of Health (NIH) Working Group on Women in Biomedical Careers created in response to the National Academies *Beyond Bias and Barriers: Fulfilling the Potential of Women in Academic Science and Engineering* Report.[12]

Increasing the number and visibility of women role models at high levels in both academia and industry could also increase the number of women who advance from the BS to the MS and PhD levels, and eventually into successful careers in academia and industry. As noted above, the number of women faculty members at an institution has a direct impact on the success of women students.[38] Women who leave the field after obtaining a PhD represent a significant financial loss for the academic institutions and federal agencies that supported their training, one that the US economy can ill afford. Interestingly, new research from the National Academy of Sciences[11] indicates that at Research I institutions, in select fields including civil and electrical engineering, the women who applied for faculty positions fared quite well in receiving interviews as well as job offers. However, the time to tenure was longer for women, their success in receiving grants was more dependent on having a mentor, and, while women were more likely to receive tenure than men when they came up for review, in some fields, the percentage of women who came up for review was lower than the percentage of women assistant professors.[11] Thus, mentoring programs and workshops for women faculty members that reduce attrition and improve tenure and promotion rates could also have a significant impact.

Climate

A ''chilly'' climate at the departmental and institutional levels is often responsible for the loss of women from academic positions pre and post-tenure.[35] In industry as well, women leave the STEM workforce in much higher numbers than men; according to a recent study, 52% of highly qualified women working for science, engineering, and technology-related companies leave mid-career due in part to hostile ''macho'' cultures and isolation.[18]

Professional societies such as BMES can provide a venue for reducing isolation of women in BME. More and more often, informal networking events are being held at national conferences to provide professional connections and access to senior role models. Networking events and mentoring programs that cross disciplinary boundaries can also reduce isolation and provide technical, informational, and psychosocial support.[10] However, while programs at the national level may be useful, the highest impact changes are likely to occur through institutional transformation.[9] For example, institutions at the vanguard of equity in STEM, such as the Universities of Washington, Wisconsin, and Michigan, have institutionally supported mentoring initiatives that both combat isolation and provide mentoring, campus-wide programs to educate the community about subtle discriminatory practices in hiring and promotion, and internal funding opportunities to support faculty facing significant life cycle challenges at critical junctions in their careers. In combination, these programs make it clear to all faculty members that the institution as a whole is committed to diversity and inclusivity, and retention and advancement of women faculty members.

Balancing Work and Family

Multiple studies show that family caretaking responsibilities continue to fall disproportionately on women.[30] Institutions can provide support for women faculty members balancing work and family by implementing dual-career hiring programs; tenure clock extensions for childbirth, adoption, and elder care; on-campus lactation rooms; and access to high quality child care facilities. Also, as noted above, the institution can make funding available to support a faculty member's research program when he or she is facing significant life cycle challenges, such as the birth of a special needs child or illness of a parent.[34] The University of California system recently issued a report on creating ''family friendly'' departments in science in engineering[23] and is disseminating best practices in this area.[39] In addition to the benefits above, which are becoming standard, the UC system report suggests providing (1) a flexible part-time option for tenure-track faculty with caregiving responsibilities, (2) a relocation counselor for new faculty recruits and their families, (3) more university-sponsored infant and child care, (4) emergency backup child care, (5) adoption benefits and tuition reimbursement for faculty and family members, and (6) covering a portion of childcare expenses related to travel through university funds[23]—all of which could make a difference to young women faculty especially. Interestingly, conferences at which attendance is predominantly female, such as the Grace Hopper Celebration for Women in Computer (approximately 95%[20]), provide child care on site. Providing child care at meetings and conferences related to BME could increase participation of women and men scientists and engineers with primary caretaking responsibilities for young children.

Unconscious Bias

Throughout their advancement in technical fields such as BME, women face accumulated disadvantages due to gender schemas and unconscious bias.[40] Malone and Barabino revealed that biases combined with subtle interactions can adversely influence identity formation as a scientist or engineer and have lingering unhelpful implications for career advancement.[22] Further, it has been shown multiple ways in multiple studies that even men and women who espouse egalitarianism nevertheless do not evaluate men and women equitably in professional capacities.[13,40,41] Substantial research shows that resumes and journal articles were rated lower by male and female reviewers when they were told the author was a woman[28,36]; similarly, a study of postdoctoral fellowships awarded showed that female awardees needed substantially more publications to achieve the same competency rating as male awardees.[41] Thorough reviews of this literature are available in Valian.[40] Critical to overcoming the accumulated disadvantages to women due to unconscious bias is education of men and women about gender schemas. However, despite the overwhelming data provided by well-respected social scientists in this area, the idea of unconscious bias is often met with skepticism,[37] and so the message must be supported at the highest levels in institutions, departments, and BME societies.

Another strategy for overcoming unconscious bias is being blinded to the gender when evaluating materials and accomplishments. In the field of ecology, a recent initiative to make reviews double-blind (and consequently gender blind) significantly increased the representation of female authors.[6] A similar impact could occur in BME, which could significantly enhance retention and advancement of female researchers. In terms of disseminating best practices in this area, various institutions with programs to promote the advancement of women in science and engineering (those with NSF ADVANCE programs noted above) are creating educational materials for Deans and Chairs with recruiting and mentoring responsibilities. Modifying these documents for other professionals and dissemination at national meetings could increase their reach and impact.

CONCLUSIONS

While the percentages of women obtaining BS, MS, and PhD degrees in biomedical engineering are higher than nearly any other engineering discipline, graduation rates are not monotonically increasing over time, and past increases in graduation rates have not led to significant increases in the percent of women in faculty positions in our field. Thus, the pipeline is leaky, continues to leak, and does so perhaps more than many of us think.

The obstacles to reaching gender equity in STEM disciplines are daunting and likely to play a role in the continuing relative absence of women at all levels in BME. However, the benefits of diversity are substantial—both for students in BME and society at large. Furthermore, the potential ramifications of not addressing the recent decline in percent of women obtaining BS degrees are significant. If left alone, this trend will likely appear at the PhD and post-doctoral fellow levels in a few years, and then the faculty level a few years after that, decreasing the percentage of women in the professoriate below the already low current level of 17%. At some point, the loss of critical mass of women in the professoriate may in turn decrease the percent of women obtaining BS degrees so that we enter a vicious cycle of declining diversity.

Instead, by promoting and encouraging women and URM in the field of BME, we can begin to address and arrest these leaks in the pipeline. We can improve the climate in our departments, institutions, and national societies with more mentoring programs and workshops and by working together to support the diversity and inclusivity of the student body, faculty, and membership. By providing access to high profile role models who are successfully balancing work and family and promoting best practices, we can help all the faculty members more successfully strike a balance between work and family demands. And, finally, by educating leaders in BME about unconscious bias, we can begin to lessen the consequences of gender schemas for women in BME. These strategies may help us address the barriers to women's success in BME, and thereby promote a more diverse workforce in BME disciplines.

In conclusion, we offer the following "top five" list of things that you can do to promote gender diversity in biomedical engineering:

"Top five" list of things you can do to improve gender diversity in biomedical engineering:

1. Address the leaky pipeline by supporting and getting involved in mentoring programs, outreach, and promoting positive role models.
2. Warm a "chilly climate" through workshops, networking activities, and raising awareness.
3. Promote best practices for balancing between work and family by not scheduling meetings before 8 am or after 5 pm and developing family-friendly leave policies.
4. Educate your community on unconscious bias and strategies to overcome "schemas."
5. Use the data provided here to educate your colleagues. It is not just a matter of time before things improve, it is a matter of effort.

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REFERENCES

[1] A National Analysis of Diversity in Science and Engineering Faculties at Research Universities. Dr. Donna J. Nelson, Norman, OK, January, 2005. Available at http://chem.ou.edu/~djn/diversity/briefings/Diversity%20Report%20Final.pdf.

[2] American Society of Engineering Education. Profiles of Engineering and Engineering Technology Colleges, Washington, DC, 2008. Available at http://profiles.asee.org/.

[3] Banaji, M., K. Lemm, and S. Carpenter. The social unconscious. In: Blackwell Handbook of Social Psychology: Intraindividual Processes, edited by N. Schwarz and A. Tesser. Malden, MA: Blackwell Publishers Ltd, 2001, pp. 134–158.

[4] Bement, A. L., Jr. Remarks, Setting the Agenda for 21st Century Science. Presented at the Meeting of the Council of Scientific Society Presidents. December 5, 2005. Remarks available at http://www.nsf.gov/news/speeches/bement/05/alb051205_societypres.jsp.

[5]Blair, I. The malleability of automatic sterotypes and prejudice. *Pers. Soc. Psychol. Rev*. 6(3):242–261, 2002.
[6]Budden, A. E., T. Tregenza, L. W. Aarssen, J. Koricheva, R. Leimu, and C. J. Lortie. Double-blind review favours increased representation of female authors. *Trends Ecol. Evol*. 23(1):4–6, 2008.
[7]Busch-Vishniac, I. J., and J. P. Jarosz. Can diversity in the undergraduate engineering population be enhanced through curricular change? *J. Women Minor. Sci. Eng*. 10:255–282, 2004.
[8]Chesler, N. C., and M. A. Chesler. Mentoring undergraduate women in engineering: lessons learned from the sociology of gender. In: American Society of Engineering Education National Conference Proceedings, Albuquerque, NM, 2001.
[9]Chesler, N. C., and M. A. Chesler. Gender-informed mentoring strategies for women in engineering: on establishing a caring community. *J. Eng. Educ*. 91(1):49–56, 2002.
[10]Chesler, N. C., P. B. Single, and B. Mikic. On belay: peer-mentoring and adventure education for women faculty in engineering. *J. Eng. Educ*. 92(3):257–262, 2003.
[11]Committee on Gender Differences in the Careers of Science, Engineering, and Mathematics Faculty; Committee on Women in Science, Engineering, and Medicine; National Research Council. Gender Differences at Critical Transitions in the Careers of Science, Engineering, and Mathematics Faculty. The National Academies Press, 2009.
[12]Committee on Maximizing the Potential of Women in Academic Science and Engineering, National Academy of Sciences, National Academy of Engineering, and Institute of Medicine. Beyond Bias and Barriers: Fulfilling the Potential of Women in Academic Science and Engineering. The National Academies Press, 2007.
[13]Dovidio, J. F., and S. L. Gaertner. Aversive racism and selection decisions: 1989 and 1999. *Psychol. Sci*. 11(4):315–319, 2000.
[14]Duncan, G., J. Boisjoly, D. Levy, M. Kremer, and J. Eccles. Empathy or Antipathy? The Consequences of Racially and Socially Diverse Peers on Attitudes and Behaviors. Institute for Policy Research, Northwestern University, 2003.
[15]Gurin, P., E. Dey, S. Hurtado, and G. Gurin. Diversity in higher education: theory and impact on educational outcomes. *Harv. Educ. Rev*. 72(3):330–366, 2002.
[16]Handelsman, J., N. Cantor, M. Carnes, D. Denton, E. Fine, B. Grosz, V. Hinshaw, C. Marrett, S. Rosser, D. Shalala, and J. Sheridan. Careers in science. More women in science. *Science* 309(5738):1190–1191, 2005.
[17]Harding, S. Women, science and society. *Science* 281:1599–1600, 1998.
[18]Hewlett, S., C. Luce, L. Servon, L. Sherbin, P. Shiller, E. Sosnovich, and K. Sumberg. The Athena Factor: Reversing the Brain Drain in Science, Engineering and Technology. Cambridge, MA: Harvard Business Review, Center for Work-Life Policy, Harvard University, 2008.
[19]Hong, L., and S. E. Page. Groups of diverse problem solvers can outperform groups of high-ability problem solvers. *Proc. Natl Acad. Sci*. 101(46):16385–16389, 2004.
[20]Kosaraju, D. Vice President of Programs. Anita Borg Institute for Women and Technology, Personal Communication, 2008.
[21]Lane, N. Why are there so few women in science? *Nat. Debates*, 1999.
[22]Malone, K. R., and G. A. Barabino. Narrations of race in stem research settings: identity formation and its discontents. *Sci. Educ*. 93:485–510, 2009.
[23]Mason, M., A. Stacy, M. Goulden, C. Hoffman, and K. Frasch. Faculty Family Friendly Edge: An Initative for Tenure Track Faculty at the University of California. University of California, 2005.
[24]McLeod, P., S. Lobel, and T. Cox, Jr. Ethnic diversity and creativity in small groups. *Small Group Res*. 27(2):248–264, 1996.
[25]National Science Foundation, Division of Science Resources Statistics. Women, Minorities, and Persons with Disabilities in Science and Engineering: 2009, NSF 09-305, Arlington, VA, January 2009. Available at http://www.nsf.gov/statistics/wmpd/.
[26]Nemeth, C. Dissent, group process, and creativity. *Adv. Group Process*. 2:57–75, 1985.
[27]Orfield, G., and D. Whitla. Diversity and legal education: student experiences in leading law schools. In: Diversity Challenged: Evidence on the Impact of Affirmative Action, edited by G. Orfield, and M. Kurlaender. Cambridge, MA: Harvard Publishing Group and The Civil Rights Project, Harvard University, 2001.
[28]Paludi, M. A., and W. D. Bauer. Goldberg revisited: what's in an author's name. *Sex Roles* 9(1):387–390, 1983.
[29]Pettigrew, T., and L. Tropp. Does intergroup contact reduce prejudice? Recent meta-analytic findings. In: Reducing Prejudice and Discrimination, edited by S. Oskamp. Mahwah, NJ: Lawrence Erlbaum Associates, 2000, pp. 93–114.
[30]Related Resources. Women in Science and Engineering Leadership Institute (WISELI), University of Wisconsin. Available at http://wiseli.engr.wisc.edu/subject.php#balance and http://wiseli.engr.wisc.edu/subject.php#bias.
[31]See http://www.advance.rice.edu/negotiatingtheidealfacultyposition.
[32]See http://www.bme.gatech.edu/advance.
[33]See http://www.COACh.uoregon.edu.
[34]See http://wiseli.engr.wisc.edu/vilas.php.
[35]Seymour, N., and N. Hewitt. Talking About Leaving: Why Undergraduates Leave the Sciences. Boulder, CO: Westview Press, 1997.
[36]Steinpreis, R., K. A. Anders, and D. Ritzke. The impact of gender on the review of the curricula vitae of job applicants and tenure candidates: a national empirical study. *Sex Roles* 41(7):509–528, 1999.
[37]Tierney, J. A New Frontier for Title IX: Science Section, New York Times, New York, July 15, 2008. Available at http://www.nytimes.com/2008/07/15/science/15tier.html.
[38]Trower, C., and R. Chait. Faculty diversity. *Harv. Mag*. 33–37, 98, 2002.
[39]University of California. Creating a Family Friendly Department: Chairs and Deans Toolkit. Available at http://ucfamilyedge.berkeley.edu/toolkit.html.
[40]Valian, V. Why So Slow? The Advancement of Women. Cambridge, MA: MIT Press, 1998.
[41]Wenneras, C., and A. Wold. Nepotism and sexism in peer-review. *Nature* 387(6631):341–343, 1997.
[42]Wyden, R. Title ix and women in academics. *Comput. Res. News* 15(4):1–8, 2003.