What Motivates Men to Champion Gender Diversity?

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Final Words

Engage with SWE Magazine articles

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The Society of Women Engineers (SWE), founded in 1950, is a not-for-profit educational and service organization. SWE is the driving force that establishes engineering as a highly desirable career aspiration for women. SWE empowers women to succeed and advance in those aspirations and be recognized for their life-changing contributions and achievements as women engineers and leaders.

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Looking at the State of Women in Engineering

This marks our 17th annual review of the social science literature on women in engineering, and the third State of Women in Engineering special issue of SWE Magazine. The literature review is integral to the magazine and to arriving at clarity on the issues surrounding women in engineering, as well as other STEM fields, such as computer science and the physical sciences, where women are underrepresented.

This effort to examine what the research tells us has brought fruitful results and insights. Over time, we see that some consensus has emerged in certain areas, while disagreement and new research questions have been posed in others. We now know, for example, that math preparedness is not what prevents young women from entering or staying in engineering programs, as achievement gaps in math and science have closed. We also know that the perceived cultures of engineering and the tech sector — as being unwelcoming, male based, rigid, etc. — may contribute to many capable young women taking their talents elsewhere. For a grasp of the spectrum of research questions, study results, and their policy implications, I encourage you to engage with this year’s installment. For a compilation of all our reviews to date, please see https://research.swe.org/literature-reviews/.

TAKING INTO CONSIDERATION BOTH RECENT HEADLINES AND PERSONAL ANECDOTES, WE WERE COMPELLED TO ASK A NUMBER OF QUESTIONS ABOUT SOCIAL CHANGE, HUMAN BEHAVIOR, INTENTIONAL AND UNCONSCIOUS BIAS, AND RELATED MATTERS.

Inspiration for this year’s State of Women in Engineering issue was also found in discussions that took place during SWE’s annual conference, held last fall in Minneapolis. Those discussions covered many of today’s pressing topics in education, the workplace, and society overall. Taking into consideration both recent headlines and personal anecdotes, we were compelled to ask a number of questions about social change, human behavior, intentional and unconscious bias, and related matters. Our cover story, “What Motivates Men to Champion Gender Diversity?” and the companion piece reviewing the peer-reviewed literature on male allies, as well as the feature story, “What Research Tells Us About Diversity Training,” are tied together. They are our formal, research-based response to these discussions/questions.

Also in this issue, we report on results from SWE’s first overseas study, “Gender Bias in India,” which represents a unique examination of the real-world experiences of working engineers in India. And lastly, we provide an update to the Department of Education’s proposed changes to Title IX, the groundbreaking law that ensures protection against sex discrimination in education. See our story, “Title IX Still on the Brink,” to learn what is at stake.

The State of Women in Engineering issue represents a key element of SWE’s mission to support women as engineers and leaders, and to demonstrate the value of a diverse workforce. We hope readers will join us in this effort.

Anne M. Perusek
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Women in Engineering: A Review of the 2018 Literature

SWE’s assessment of the most significant research found in the past year’s social science literature on women engineers and women in STEM disciplines, plus recommendations for future analysis and study.

By Peter Meiksins, Ph.D., Cleveland State University
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SWE’s annual review of the literature summarizing scientific research on women in engineering is intended to promote a greater understanding among engineers of the challenges facing female engineers in what continues to be a male-dominated occupation. Each year, we review the most important research that explores the experiences of female engineers and offers insights into the continued underrepresentation of women in the profession. The hope is that this will help individual engineers recognize that their situation is not unique. We hope, as well, that a better understanding of the factors limiting the numbers of women in engineering and hindering progress toward gender equity will point to solutions that can be pursued, both individually and collectively, by women and men working in the field.

The issue of gender equity in engineering has become front-page news. The awarding of the Nobel Prize in Physics to Donna Strickland, Ph.D., in 2018 reminded the public of both the strides women have made in STEM fields and the continued underrepresentation and underrecognition of women in STEM (Dr. Strickland was only the third female recipient of the Nobel Prize in Physics in its more than 100-year history). Ongoing public controversies over sexual misconduct in tech companies and the apparent hostile culture that pervades those organizations has kept the issue of gender equity in the headlines. And, more and more, especially in the context of increasingly restrictive immigration policies, Americans are hearing that attracting more women into engineering and other STEM fields is a matter of national self-interest; more female engineers are needed to reduce the United States’ dependence on foreign technical workers who are becoming increasingly difficult to recruit as immigration policies tighten.

In the review that follows, we summarize and discuss the most significant scientific research on women in engineering and STEM published in the past year. We identified close to 200 articles, conference papers, and books in a variety of disciplines for review. As in the past, we were not able to discuss all of the materials we read in the review; we have tried to focus attention on the most rigorous studies that used the best scientific methods and on studies that offered new and important insights. We have also attempted to draw attention to areas of disagreement that future research needs to resolve and/or to neglected areas of inquiry where more research is needed.

Regular readers of the SWE annual literature review, and those familiar with the literature on women in engineering and STEM, will know that several familiar themes form the focus of much research each year and that a degree of knowledge has been generated around these themes; in some cases, even consensus has emerged. We begin our review with a look at some of these more familiar themes and findings, then shift to consider research in newer areas of inquiry or in which there continues to be disagreement and debate.
THE LEAKY PIPELINE

Over the years, there has been a great deal of research, much of it reviewed in these pages, focused on the experiences of young women who enter undergraduate engineering programs. Do they have negative experiences in those programs and, if so, does this create a leak in the “pipeline” as some women react to their bad experiences by leaving the field for other majors?

This year was no exception, as we reviewed several articles focused on understanding women’s experiences in undergraduate engineering programs and/or on evaluating programs designed to improve their retention. Patrick, Borrego, and Prybutok (2018), for example, reported on a study of 563 students in 12 undergraduate engineering programs at a large public university in which they examine the effects of various factors hypothesized to predict persistence in an engineering program. To their surprise, they found that, for both women and men, the strength with which respondents identified with being an engineer did not predict persistence. What did, however, was interest, again, for both women and men. The one gender difference they found was that female students tended to see themselves as less competent, and that this interacted with their sense of engineering identity and level of interest in the discipline they were studying. They speculate that this may be a gender-specific factor in some women’s decision to shift to other majors.

Dell et al. (2018) conducted research on a program at the Rochester Institute of Technology designed to promote increased retention of female students in an undergraduate program in engineering technology. The program sought to provide students with professional skills development and academic and social support, to offer faculty mentoring to participants, and to connect them to the existing support services at the university. Dell et al. found that the program did increase retention (although the small sample size — only a few dozen students — made the results statistically insignificant) because it increased students’ feelings of “relatedness” (being connected to faculty and other students), competence (feeling supported and having the confidence to combat microaggressions), and autonomy (not feeling the negative effects of stereotype threat).

Underlying this, and much of the earlier research on retention in undergraduate programs, is the belief that women leave engineering programs at higher rates than men. Dell et al. state this explicitly, referencing several earlier studies. Patrick, Borrego, and Prybutok are confusing on this issue. At one point (p. 351), they make a more complex claim, arguing that women leave engineering programs earlier than men, but at similar rates over the course of their undergraduate programs; at another, they appear to say that women’s lower feelings of competence explain why they leave engineering programs in larger numbers (p. 360).

As we have noted in previous literature reviews, however, there is a growing body of evidence indicating that women do not leave engineering programs at rates higher than those of men, a point first argued by Frehill (2010) a number of years ago. A review, published this year, of articles in the Journal of Engineering Education (Waychal, Henderson, and Collier, 2018) found that there was no real evidence that the retention or graduation rates of women in engineering programs are lower than those of men and that female retention appears to be increasing. We also reviewed one study this year that addresses this question explicitly. Shi (2018) examined data on a very large sample that included all students in public schools in the state of North Carolina between 2009 and 2014. The study examined whether students followed through on their “intended” majors after graduating from high school and entering postsecondary institutions. Shi found no evidence that there is higher attrition among female than male engineering students in university.

In short, while there is value in continuing to refine our understanding of what promotes the retention of female students in engineering programs (and, for that matter, what promotes the retention of male students!), the underrepresentation of women in engineering is not being caused primarily by women’s switching out of engineering majors at higher rates than men. However, as we discuss below, students’ experiences in engineering programs may have an effect on attrition from the field in postgraduation decisions. In other words, similar retention rates cannot be taken as evidence that men and women students are having similar experiences in their engineering programs.
WHY AREN'T YOUNG WOMEN MORE INTERESTED IN ENGINEERING?

Another familiar stream in research on women in engineering asks, “Why aren’t more young women attracted to engineering in the first place?” There is a very large (and growing) body of literature showing that young women display less interest than young men in entering engineering programs, an obvious, powerful contributor to the underrepresentation of women in engineering, especially since relatively few students switch their majors to engineering after starting on a different major. Much of this research explores the various possible reasons for women’s relative lack of interest in engineering.

Research reviewed in previous years emphasized that gendered differences in interest in various fields of study begins very early (as early as elementary school) and that efforts to increase girls’ interest in STEM in general, and engineering in particular, need to begin with younger children. Surprisingly, then, we found little new research this year that explored the development of children’s interests that might lead to a later interest in an engineering career. In contrast, this year’s review identified several studies examining why older girls and young women have relatively low levels of interest in studying engineering. We review several of these here, but note the need for additional research exploring the early childhood origins of these gender-specific preferences.

Shi’s (2018) study of students in North Carolina provides a useful starting point for a review of this research focus. Her analysis identifies four factors that contribute to women’s lower interest in engineering:

- Academic preparation
- Beliefs about ability
- Female prosocial orientation
- Family influence

Brotopia: Breaking Up the Boys’ Club of Silicon Valley

Portfolio/Penguin, New York, 2018
ISBN-10: 0735213534

By Emily Chang

A number of exposés of the high-technology industry have made Americans aware of its being dominated by a “bro culture” that is hostile to women and is a powerful reason for the small numbers of female engineers and scientists in the sector. In Brotopia: Breaking Up the Boys’ Club of Silicon Valley, Emily Chang, journalist and host of “Bloomberg Technology,” describes the various aspects of this culture, provides an explanation of its origins, and underlines its resiliency, even in the face of widespread criticism both from within and outside the industry.

Like many, she notes that male domination of the computer industry is a relatively recent development. Early on, programmers were often female, and programming was seen as women’s work, relatively routine, and associated with other “typically” female jobs such as running a telephone switchboard or typing. This began to change in the 1960s as the demand for computer personnel grew. In the absence of an established pipeline of new computer employees, employers turned to personality tests to identify people who had the qualities that would make them good programmers. From these tests emerged the stereotype of computer programmers as antisocial men who were good at solving puzzles. Gradually, this turned into the view that programmers ought to be like this, and employers actively recruited employees with these characteristics.

As the sector became male dominated, the “bro culture” began to emerge. Chang points to the role of Trilogy in the ‘90s in helping to foster that culture — the company deliberately employed attractive female recruiters to attract inexperienced young men, and it encouraged a work hard/party hard ethos. Later, an important role in perpetuating male domination of the tech sector was played by the “PayPal Mafia,” a group of early leaders of PayPal who went on to play key roles in other Silicon Valley firms. Many of these men were politically conservative antifeminists (e.g., co-founder
Shi finds that only about 5 to 7 percent of the gendered difference in interest in engineering is explained by differences in SAT scores or high school GPAs, while a somewhat larger percentage (8 percent) is explained by beliefs about academic ability (as opposed to actual ability). Young women also are much more likely to show a preference for prosocial responsibilities and for contributing to the arts, rather than the sciences, which accounts for 14 percent of the gap. Finally, Shi analyzes a subsample of fraternal twins within her larger sample and finds that boys in opposite sex pairs are more likely to choose engineering as a major than girls. She hypothesizes that this is the result of families’ influencing boys toward gender-stereotypical roles, although she does not attempt to assess how much of the overall difference in gendered attitudes toward engineering is explained by this. Overall, while Shi’s study does not account for all of the differences between boys’ and girls’ interest in engineering, she identifies several important factors that clearly contribute to those differences.

Other studies we reviewed provide additional, albeit partial support for several of Shi’s conclusions. Justman and Mendez (2018) used administrative data on a cohort of students in Victoria, Australia, to examine the factors shaping students’ interest in STEM subjects. Their study shows that boys in Victoria had a significant advantage over girls in mathematics in grades 7 and 9, while girls had a significant advantage in reading. However, as in Shi’s study, these differences accounted for only a small portion of the gendered differences in STEM interest. Justman and Mendez argue that “female students require stronger prior signals of mathematical ability” to choose subjects such as physics or information technology. Those who do choose these subjects outperform their male counterparts, perhaps because only the very strongest girls choose to pursue them, implying that there is a

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Peter Thiel, J.D.) who hired one another and saw no problem in hiring an overwhelmingly male workforce (this was the result of “merit,” in their view).

A few technology companies, such as Google, did make a good-faith effort to break out of the pattern and recruit more women. But, Chang finds that, while Google deserves an “A for effort,” the results were not impressive. Google remained at best average in its gender balance, and, over time, promoted far more men into leadership roles. The company did recruit or develop several female leaders (Susan Wojcicki, Marissa Mayer, and Sheryl Sandberg), but Chang notes that they have been either overlooked (in the case of Wojcicki) or become the objects of criticism (Mayer for her later tenure at Yahoo, Sandberg for her alleged failure to understand the problems of “ordinary” women). Within Google, Chang finds that a male culture has grown stronger and that efforts to increase the number of women encountered resistance from men who saw this as compromising “high standards.”

Chang argues that “... Silicon Valley companies have largely been created in the image of their mostly young, mostly male, mostly childless founders” (207), resulting in a context that is at best unwelcoming, at worst hostile, to women. It is this overwhelmingly young, male environment that makes possible work-related trips to strip clubs and Silicon Valley sex parties that place women in no-win situations (if you don’t go, you’re excluded from social networks; if you do, your reputation is tarnished). It also fosters the now depressingly familiar pattern of sexual harassment that pervades the industry (as revealed by the “Elephant in the Valley” study and accounts of misconduct at Uber, Google, and other technology companies).

Chang also notes that the high-tech world of young, childless men creates other conditions that push women out. The expectation that tech workers must work heroic hours makes it hard for women with families to thrive. And, despite the fact that many tech companies offer generous perks and benefits, they typically do not include provisions to facilitate work/family balance. In fact, the work hard/play hard ethos causes many in the sector to question whether work/family balance is something to be desired at all!
significant waste of potential STEM talent among the slightly less well-qualified, less-confident girls who choose to avoid STEM subjects in school.

Research conducted at the Stanford Center for Education Policy Analysis (Reardon et al., 2018) examines state accountability test data from third-through eighth-grade students in the U.S. from 2008-9 to 2014-15. The study finds that there is no gender achievement gap in math in the “average school district” examined, while girls typically outperform boys in English language arts (ELA). However, intersectional patterns also emerge here. The pattern is not the same for all districts; some have more male-favoring gaps and some more female-favoring gaps. Math gaps tended to favor males in more socioeconomically advantaged school districts and in districts where there are significant socioeconomic disparities among parents. There was no relationship between the ELA gender gap and these variables. The data about math gaps suggest that, to the extent that math proficiency predicts an eventual interest in engineering or STEM, the pattern of male dominance of these subjects is likely to be particularly pronounced for more affluent students.

Justman and Mendez (2018) also note that low-income boys are less likely than more affluent boys to choose subjects such as physics or advanced mathematics, so the effects of boys’ math advantage on subject choice are likely concentrated among the more affluent. Dekhtyar et al. (2018) analyzed data drawn from a large sample of men and women in Sweden. They identified more than 167,000 adults born in Sweden between 1977 and 1979 and analyzed longitudinal data on their test scores in school and subsequent occupational choices. They found differences between men’s and women’s abilities in various areas, with more boys than girls being stronger in technical/numerical skills, while the reverse was true for verbal/language skills. This is important, they argue, because the people in their study tended to choose educations and occupations that matched the skills areas in which they were strongest, which would partially explain the underrepresentation of women in technical/numerical fields such as engineering. This pattern was weaker for women, however, as women with technical/numerical strengths still largely avoided careers demanding those abilities. So, factors other than ability appear to be driving women’s occupational interests.

Barth et al. (2018) conducted a study of 526 U.S. students, ranging in grade level from fifth grade to university (this is one of the few studies we reviewed that actually did have at least partial focus on young children). They found that ability beliefs were a powerful predictor of occupational interests and that there were gendered differences in both interest in STEM subjects and sense of STEM efficacy. However, this did not appear to be
true of the university students in the sample.

Ehrlinger et al. (2018) conducted experimental studies of small samples of undergraduate students at a southeastern university in the U.S. (sample sizes were 96 and 178, respectively). Respondents were asked to evaluate whether computer scientists (study 1) or engineers (study 2) possessed stereotypical abilities (including intellectual abilities) and to indicate whether they felt they had those abilities themselves. Women offered less-positive estimates of their own intellectual abilities than men, and were more likely to endorse the view that engineers and computer scientists possessed stereotypical (strong) intellectual abilities, which predicted lower female interest in these disciplines. Other studies, reviewed in previous years, have emphasized women’s lower sense of efficacy in math and science, even when their performance suggests otherwise, so there is reason to believe that Shi is on solid ground in emphasizing the role of ability beliefs in shaping occupational interests.

Research reviewed this year examined additional factors that might play a role in shaping the relatively low levels of interest in engineering careers among young women entering university. Several studies examined the influence of stereotypes on young people’s interests and choice of major, but the results that emerge from this research are far from clear-cut. Barth et al. (2018), in the study already discussed, found that occupational gender stereotypes played an important secondary role in shaping occupational interests. The younger children in their sample displayed the clearest pattern, endorsing gendered stereotypes of STEM occupations and applying them to both themselves and others in determining who would be interested in those fields. The university students in the sample responded differently, however. While they endorsed gendered stereotypes of STEM occupations, they did not show gender differences in STEM career interest. Barth et al. speculate that this may be the result of the students’ having been selected from advanced STEM courses, so that their own success in STEM disciplines may counteract the effect of stereotypes.

Kelley and Bryan’s (2018) study of incoming undergraduate engineering students at a large Midwestern university (their study is based on 353 completed surveys) found that the women in the sample viewed the typical engineer as stereotypically masculine (although, interestingly, this was less true of international students, suggesting a strong cultural element in these stereotypes — see the discussion of comparative research below). Since they were engineering majors, it is obvious this stereotype did not prevent the female respondents from being interested in engineering; one might suspect that other women did respond negatively to engineering because of these stereotypes, but Kelley and Bryan’s study does not attempt to examine whether this was the case. Interestingly, gendered stereotypes did not affect female respondents’ choice of specialty within engineering. Although they were aware of the gender composition of the various fields, some chose to “defy” these stereotypes and enter stereotypically male majors.

Bian et al. (2018) conducted a series of experiments to explore the effect of messages about “brilliance” on women’s interest in educational and professional opportunities. This research is related to the studies of stereotypes discussed above, since one of the stereotypes often associated with success in STEM disciplines is that successful scientists and engineers are “brilliant.” Bian et al. found that messages indicating that a university major, internship, or position involved brilliance lowered women’s interest in those opportunities and were less likely to see themselves as similar to the typical person in those roles. Here, then, is evidence that occupational stereotypes do influence women’s interest in entering STEM disciplines such as engineering.

The perception that a field is gender biased, not just that it is gendered, also may be a factor shaping women’s interest in that field. Ganley et al. (2018) surveyed a group of undergraduate students to determine whether they had a gender-based aversion to STEM majors. They found that this was not the case. Rather, respondents perceived different fields as being gender biased to different degrees, with fields such as engineering, computer science, and the physical sciences being the most gender biased. This was a strong predictor of their choice of major, indicating that female students avoided majors and fields in which they perceived
significant gender discrimination. Moss-Racusin et al. (2018) also examined the effect of gender bias in a set of experimental studies with a sample of U.S. adults (322 in study 1; 429 in study 2). In the first experiment, some respondents read a news article describing the existence of gender bias in STEM, while others read an article describing its absence; a third group was given no article at all to read. Results indicated that women who read the article describing bias expressed less desire to participate in STEM than men; this was not the case for those who read the “no bias” article. Women who received no article were less inclined toward STEM than men, a result the authors speculate may reflect prevailing cultural beliefs about the existence of gender bias in STEM disciplines. Study 2 presented participants with an article about the accreditation of a chemistry department; some respondents received a report indicating that gender bias had been found, while others received a report indicating no bias. Women who read the gender bias report reacted more negatively to the department than men, expecting more discrimination and lower levels of trust and comfort, while those who read the “no bias” report did not. Interestingly, whether or not the department was reported to have completed gender training had no effect on the results.

WOMEN IN ACADEMIC ENGINEERING

As we have noted in previous reviews, there is a very large body of research on women in academic engineering and STEM departments, in no small part because of the influence of the National Science Foundation (NSF) ADVANCE program and assessment of its effects. The result is that quite a lot is already known about the (sometimes negative) experiences of women in academic STEM and engineering programs and about interventions designed to improve the situation. Researchers this year continued to add to the body of knowledge about female engineers and scientists in academic settings.

Griffith and Dasgupta (2018) report on a survey of 383 STEM faculty members at a public research university in the northeastern U.S. They found that female STEM faculty were less satisfied than their male colleagues where women were a minority, particularly in departments where women represented less than 25 percent of the department. In departments with more balance (close to 50 percent women), these differences in satisfaction disappeared. In departments where women were a minority, the differences in satisfaction found by the study were mediated by women’s perception that the culture and climate were less collegial, faculty governance was not transparent, and that men and women were not treated equally.
One familiar theme in analysis of female academics in general, and STEM faculty specifically, is the greater burden of service work that falls on women. Research by Pedersen and Minnotte (2018) contributes to this ongoing discussion. They surveyed 114 STEM faculty at a midsize university in the Midwest and conducted focus groups with small groups of women STEM faculty, finding that they viewed service obligations as onerous, isolating, a hindrance to research, and detrimental to family responsibilities and their own health. Women who had already achieved tenure resented being asked to take on additional service responsibilities to shelter junior colleagues, since no such protection had been extended to them. Overall, female faculty saw much more injustice in service work than men and this perceived injustice was associated with lower job satisfaction, scholarly isolation, workplace conflict, and job stress. The researchers also conducted a focus group with male department chairs, who generally saw service work for women as positive, not burdensome, so there is little reason to suppose that, at this university at least, the distribution of service work obligations is likely to become more equitable.

Rosser (2018) conducted a survey of 175 female scientists (including a number of engineers) who had received NSF Professional Opportunities for Women in Research and Education (POWRE) grants between 1997 and 2000. This was a 2011-12 follow-up to the survey administered when respondents originally received their grants to determine whether and how their situations had changed. A few things had changed: inability to get funding had become a more significant challenge (perhaps because of tight funding environments, rather than gender alone), and “low numbers” and “isolation” were less frequently identified as an obstacle. But, on the whole, the survey revealed that most of the challenges female scientists and engineers faced in 2000 were still challenges more than a decade later, a discouraging finding indicating that knowing what the problems are does not always lead to their quick resolution.

Many previous studies of women in STEM fields (with the second M representing medicine) have found that women are less well represented in published research. Holman, Stuart-Fox, and Hauser’s (2018) analysis of more than 10 million scientific academic papers published since 2002 and indexed in the PubMed® and arXiv® databases finds that while many disciplines are now close to having equal numbers of men and women authors, and others are making good progress, a number (including computer science, physics, and math) continue to make much slower strides. Since engineering publications are not indexed consistently and comprehensively, it would be difficult to duplicate this analysis for engineering, but the pattern for neighboring disciplines such as physics and computer science is concerning.

The underrepresentation of women in published science may simply reflect the low numbers of women in certain disciplines, but earlier researchers have argued that part of the difference is the result of lower rates of publication for female faculty (Aiston and Yung, 2015). One study we reviewed this year adds to existing research showing that the size and nature of academic networks have a significant impact on research productivity. Gaughan, Melkers, and Welch (2018) analyzed data on more than 3,000 academic faculty in four disciplines (biology, biochemistry, civil engineering, and mathematics), finding that women published at a rate about 10 percent lower than men, and that nonwhites publish at a rate 13 percent lower than whites. Their analysis concludes that networks are a major cause of these differences. While women’s networks tend to be slightly larger than men’s, their networks tend to have more “advice” resources and fewer “instrumental” resources. Having a larger network is generally positively associated with research productivity, but instrumental research network resources are more significant, particularly for men. Advice resources actually are negatively associated with scholarly productivity, although less so for women. Gaughan, Melkers, and Welch conclude that strengthening networks, especially those that provide instrumental resources, will help to promote greater equality in publication rates; at the same time, one should not assume that female or minority group scientists’ networks will or should look precisely like white men’s.

Interestingly, a small study of 23 engineering faculty at two U.S. land-grant universities in the
northwest produced a finding that links both the issue of scholarly productivity and the issue of service obligations to female engineers’ sense of self-efficacy. Sarathchandra et al. (2018) found that female engineering faculty tended to measure themselves largely by “institutional measures” (publications, citations, grants, etc.) and less by informal measures (mentoring, personal relationships, etc.). They suggest that this may lead them to “perceive themselves as less competent” (p. 12) than their male counterparts, a conclusion that seems even more plausible if one considers the findings we have just described regarding women’s lower research productivity and higher service burdens.

While much of the research on academic science and engineering focuses on faculty, we reviewed several studies this year that touched on the experiences of students in engineering programs. Two studies, for example, examined the issue of male/female dynamics within student teams in engineering programs. Beddoes and Panther (2018) interviewed almost 40 engineering faculty at three universities, attempting to learn about their perspectives on gender dynamics in teams and whether they account for gender in their pedagogical practices for implementing teamwork. They found that gender was given very little thought in team formation and that some faculty knew their practices went against research recommendations about gender, but justified them anyway, citing other reasons. Faculty had witnessed problems (and acknowledged that they may not have heard about all such problems) and admitted that they weren’t sure what to do when they saw problems. Some went further, arguing that it was not a problem if women encounter gender problems in student teams, since this prepares them for the reality of the workplace.

Hirshfield (2018) reports on a case study of a student team of first-year design students in electrical engineering and computer science. Prior work had indicated there were no gender gaps in first-year, team-based design projects, but this follow-up study added an observational component to check on the accuracy of the reports submitted. Observational data revealed that traditional gender roles were enacted within the teams, despite reports to the contrary. Women contributed more to final reports, with little input from other team members, spent less time on technical tasks, and reported less self-confidence, even though male team members also struggled with much of the assignment. Although this is a case study, it confirms other research indicating that women in engineering programs often have different experiences than men within teams, a fact that may disadvantage them as their careers progress (less technical experience, lower self-confidence). It also confirms earlier research indicating that women often don’t identify their different experiences as “sexist” or negative; a follow-up with one female team member in the study, for example, indicated that she was satisfied with the team project even though she had not been treated with respect. This is a theme we will return to later in this review.

Roldan, Hui, and Gerber (2018) extend the scrutiny of female engineering students’ experiences to the issue of makerspaces, an increasingly important part of contemporary engineering programs. They emphasize that these spaces tend to be very masculine and male dominated and, based on the responses they received from a diverse group of 17 female participants, recommend that engineering programs take steps to ensure that equitable participation is facilitated, that help-seeking is scaffolded, and that values in diversity are made visible.

Main (2018) applies Rosabeth Moss Kanter’s (1977) theory regarding the effects of minority status on women in business to the situation of female students in doctoral programs in science and engineering departments. Kanter argued that women in business faced an uphill struggle because they were in the minority, a situation that left them with limited support and increased performance pressures. Main finds that female doctoral students are more likely to complete their degrees in departments with higher percentages of female faculty and that female doctoral students working with female advisors are more likely to complete their degrees than those who have male advisors. Gender balance in departments was found to have no effect on the likelihood that male doctoral students would complete their degrees.

Since a great deal of research on gender and academic engineering and STEM disciplines has already been published, it is not surprising that
scholarly attention has also turned to evaluating what can be done to address the problems that research has identified. This literature reveals a lack of consensus about whether concerted action is likely to be effective. Beddoes (2018) interviewed a group of 39 engineering professors across the United States to determine whether they believed that policy could play a role in female underrepresentation in engineering education. Her most notable finding was that the majority of the professors interviewed did not discuss policy at all. Those who did emphasized policies that could increase the number of engineering faculty from underrepresented groups, which would likely increase the number of engineering students from those groups. Several also mentioned the importance of improved family-friendly policies to demonstrate to female students that you can have both a career and a family. The focus on faculty-oriented policies, in a study about students, highlighted just how limited the community's attention to policy change in this arena is.

Long et al. (2018) report on a small exploratory study in which 12 faculty members at a large Midwestern university were interviewed about the role of mentoring in supporting women and minority faculty in engineering. Faculty reported that they found informal rather than formal mentoring to be the most useful and that their mentoring relationships were both varied and changing. The study’s authors recommend that universities create a variety of opportunities for faculty to develop mentoring relationships, as opposed to a “one-size-fits-all” mandatory mentoring program involving formally assigned mentors.

Somewhat in contrast, Posselt, Porter, and Kamimura (2018) present evidence that a more formal, focused approach to achieving gender equity may be the most effective strategy. This study compares two departments at a major public research university (civil and environmental engineering and chemistry) to examine their success in closing gender gaps in doctoral education. The chemistry department had engaged in a long process of organizational learning about gender equity and had participated in an NSF ADVANCE grant, leading to the hiring of outstanding female faculty, the recruitment of strong female graduate students, and broader discussions of equity. The engineering department’s efforts were a by-product of curricular reforms designed to maintain relevance in the field, which were then sustained by a small group of female faculty. While both programs saw progress toward gender equity, the study reveals that gains made without conscious, organized effort (the example of the engineering department) are more tenuous and depend on individual effort, which is more difficult to sustain.

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**Engineering Bachelor's Degrees by Discipline and Gender, 2017**

Source: Yoder, Engineering by the Numbers, American Society for Engineering Education, 2018
Female Deans and Directors of Engineering Programs in the U.S.

Cammy R. Abernathy, Ph.D., dean, University of Florida
Stephanie G. Adams, Ph.D., dean, Old Dominion University
Emily L. Allen, Ph.D., dean, California State University, Los Angeles
Nadine N. Aubry, Ph.D., dean, Northeastern University
M. Katherine Banks, Ph.D., P.E., dean of engineering and vice chancellor, Texas A&M University
Gilda A. Barabino, Ph.D., dean, City College of the City University of New York
Susamma Barua, Ph.D., dean, College of Engineering and Computer Science, California State University, Fullerton
Stella N. Batalama, Ph.D., dean, College of Engineering and Computer Science, Florida Atlantic University
Gail Baura, Ph.D., director of engineering science and professor, Loyola University Chicago
Barbara D. Boyan, Ph.D., dean, Virginia Commonwealth University
Mary C. Boyce, Ph.D., dean, The Fu Foundation School of Engineering and Applied Science, Columbia University
Bethany Brinkman, Ph.D., P.E., director, Sweet Briar College
JoAnn Browning, Ph.D., P.E., dean, The University of Texas at San Antonio
Janet Callahan, Ph.D., dean, Michigan Technological University
Jenna P. Carpenter, Ph.D., dean, Campbell University
Emily Carter, Ph.D., dean, School of Engineering and Applied Science, Princeton University
Judy L. Cezeaux, Ph.D., dean, Engineering and Applied Sciences, Arkansas Tech University
Tina Choe, Ph.D., dean, Frank R. Seaver College of Science and Engineering, Loyola Marymount University
Robin Coger, Ph.D., dean, North Carolina A&T State University
Jennifer Sinclair Curtis, Ph.D., dean, University of California, Davis
Teresa A. Dahlberg, Ph.D., dean, College of Engineering and Computer Science, Syracuse University
Natacha DePaola, Ph.D., dean, Illinois Institute of Technology
Doreen D. Edwards, Ph.D., dean, Rochester Institute of Technology
Sheryl H. Ehrman, Ph.D., dean, San Jose State University
Elizabeth A. Eschenbach, Ph.D., department chair, Humboldt State University
Amy S. Fleischer, Ph.D., dean, California Polytechnic State University, San Luis Obispo
Liesl Folks, Ph.D., dean, University at Buffalo, The State University of New York
Kimberly Foster, Ph.D., dean, School of Science and Engineering, Tulane University
Molly M. Gribb, Ph.D., P.E., dean, University of Wisconsin–Platteville
Christine E. Hailey, Ph.D., dean, College of Science and Engineering, Texas State University, San Marcos
Angela Hare, Ph.D., dean, School of Science, Engineering and Health, Messiah College
Wendi Beth Heinzelman, Ph.D., dean, Hajim School of Engineering and Applied Sciences, University of Rochester
Emily M. Hunt, Ph.D., dean, School of Engineering, Computer Science, and Mathematics, West Texas A&M University
Sharon A. Jones, Ph.D., P.E., dean, University of Portland
Maria V. Kalevitch, Ph.D., dean, Robert Morris University
Anette M. Karlsson, Ph.D., dean, Cleveland State University
Jelena Kova evi, Ph.D., dean, New York University
Hyun J. Kwon, Ph.D., chair, department of engineering, Andrews University
Laura W. Lackey, Ph.D., P.E., dean, Mercer University
JoAnn S. Lighty, Ph.D., dean, Boise State University
Tsu–Jae King Liu, Ph.D., dean, University of California, Berkeley
Elizabeth Loboa, Ph.D., dean, University of Missouri
Theresa A. Maldonado, Ph.D., P.E., dean, The University of Texas at El Paso
Norma J. Mattei, Ph.D., P.E., interim dean, The University of New Orleans
Cynthia A. McGowan, Ph.D., dean, School of Science and Engineering, Merrimack College
Charla Miertschin, Ph.D., dean, Winona State University
Holly J. Moore, Ph.D., interim chair, Salt Lake Community College
Kimberly Muller, Ph.D., dean, College of Innovation and Solutions, Lake Superior State University
Jayathi Y. Murthy, Ph.D., dean, Henry Samueli School of Engineering and Applied Science, University of California, Los Angeles
Pamela Obiomon, Ph.D., dean, Prairie View A&M University
Elizabeth Jane Orwin, Ph.D., professor and chair, department of engineering, Harvey Mudd College
THE MALE CULTURE OF ENGINEERING

Other research we reviewed this year explored questions that, while not entirely new, have not as consistently been the focus of studies of women in engineering. In the context of the growing sense of outrage about the culture of tech companies and other STEM workplaces (see sidebar on Brotopia), more researchers have begun to examine the culture of engineering programs and workplaces and to problematize its gendered characteristics.

Banchefsky and Park (2018) conducted research aimed at discovering whether students in male-dominated fields such as engineering have more traditional attitudes toward gender. They surveyed a convenience sample of 2,622 students in a psychology 101 class at the University of Colorado Boulder, finding that men in male-dominated academic majors are more likely to endorse the idea that women should adapt and conform to masculine work norms, that women should pursue traditional careers and roles, that it is true that men do better in math and science than women, and that attention to gender should be minimized. While this is a case study of students at one university, it provides another piece of evidence that male-dominated fields are home to a culture of gender inequality.

Freedman et al. (2018) conducted a series of experiments designed to explore gendered differences in explaining women’s anxiety and doubt in science. They conducted three experiments with respondents in the United Kingdom in which student-respondents were asked to interpret the account of a female student who encountered bias. The researchers observed differences in the ways in which men and women interpreted the narrative. Men were less likely than women to attribute the anxiety and doubt the woman in the story experienced as the result of bias and stereotyping; they were also more likely than women to attribute women’s negative emotions to lack of preparation. Women were more likely than men to agree that the account was typical of
women’s experiences in STEM. While this is also a relatively small-scale study, the results point to the existence of an unsympathetic climate for women in STEM disciplines.

Male et al. (2018) conducted a follow-up interview study of 13 students who had participated in an earlier survey of Australian engineering students’ experiences in mandatory work experiences during their training. Like the original survey respondents, the interview participants reported interactions consistent with gendered workplace cultures, including interactions that demeaned women or drew attention to their gender, requests based on gender stereotypes (e.g., asking female students to type documents), refusing to call the women engineers or to involve them in the full range of activities, and devaluation of stereotypically female activities such as volunteer work. Women responded in various ways, ranging from considering leaving the field to tolerating or even justifying the treatment they received. The small number of men included in the study reported similar treatment of women, providing evidence that the gendered workplace culture existed and was not simply a perception of the female students interviewed.

Kuchynka et al. (2018) surveyed 755 students in undergraduate engineering and health sciences courses as well as psychology students who had taken at least one STEM course to evaluate women’s experience of sexist treatment in STEM. Respondents reported experiencing various forms of sexism; some reported “hostile sexism” (negative, angry attitudes and behavior toward women), but more reported incidents of “benevolent sexism” (paternalism, attributing characteristics such as morality and sweetness to women, etc.). Some of the women in the study, especially those with relatively weak STEM identities, reported reduced intentions to major in STEM and lower GPAs as a result of their experiences of each kind of sexism.

Cabay et al. (2018) studied a group of 28 advanced graduate students in the physical sciences and engineering in U.S. universities. Online weekly posts and interviews with a subset of respondents provided data on women’s experience of the culture of STEM disciplines and their changing career plans. One-third of the respondents indicated that they planned to finish the degree, but seek alternative careers outside STEM research. Some reported being drawn to more altruistic careers, while others talked about wanting to be able to balance family and career. But, some also specifically identified their experience of a chilly climate as the reason for their changed career goals: They described feeling isolated and alienated; being uncomfortable with (masculine) communication that was perceived as boastful, critical, or argumentative; and reported hostile behavior ranging from microaggressions to three incidents of sexual harassment in the course of the seven-month study. Andrews et al. (2018) provide evidence that the findings in Cabay et al.’s study are not unusual. They summarize some of the existing published research on undergraduate work experiences of women in engineering (some of which has been reviewed in earlier SWE literature reviews), finding that female undergraduates frequently report encountering a hostile environment involving everything from crude language to sexual overtures; paternalistic, unequal treatment of women involving assigning them “female work” and excluding them from responsible tasks; and being ignored in meetings and project teams. These experiences fed women’s self-doubt and limited their job and career satisfaction. Thus, even while persistence rates in engineering education programs may be similar for men and women students, female students continue to have negative experiences that lead to attrition from the field postgraduation.

These studies of the male culture of engineering and STEM focus largely on the experience of students and tend to be relatively small-scale or experimental studies. There remains a need for more systematic examination of the nature of workplace cultures in engineering and whether the journalistic reports of a “bro” culture (see sidebar on Brotopia) are accurate and whether this hostile culture exists only in certain companies or sectors or is more widespread. It would also be important to have additional research on whether effective mechanisms for combating hostile, sexist treatment exists (see sidebar on sexual harassment).

Several of the studies reviewed here note that women who experience a hostile environment often either try to ignore it or rationalize their experience and are not inclined to report their negative experiences or to use existing legal tools
to effect changes. And Fink’s (2018) study of British law regarding “gender sideling” reveals that existing laws to combat gender discrimination and unequal treatment do not encompass all the forms of unequal or hostile treatment that women may experience in contemporary workplaces. For example, she notes that there is little the law can do about the reality that female scientists’ accomplishments are often overlooked or undervalued or about public perceptions that women are less capable in science than men.

The law also cannot do much about situations in which a different standard is applied to evaluating the work of a female scientist, since it is very difficult to discover or to prove that the double standard actually exists.

LATER LEAKS IN THE PIPELINE

In previous literature reviews, we have identified the relative lack of studies of engineering workplaces and the tendency of researchers to focus on academic settings, where the gathering of data is considerably easier. Since it is becoming clear that women who enter engineering programs and leave tend to do so after they have completed their degree programs, knowing more about why women leave the profession after earning their degrees is essential. As we have just noted, there is some evidence that the experience of a hostile climate is one reason for women’s departure from engineering. There remains a need for much more research on engineering workplaces to enable us to construct a full explanation of why women leave.

We reviewed a few studies this year that make contributions toward such an explanation.

Singh et al. (2018), who are engaged in an ongoing major study of the retention of working women engineers, report on the results of a survey they administered to 245 of the participants 18 months after their original survey. Their original sample consists of more than 2,000 graduates of 30 universities that cooperated with their study. The follow-up survey focused on the issue of the role of work/family conflict in women engineers’ intentions to leave the profession. Singh et al. find that family interference with work (FIW) is positively related to occupational turnover intentions among currently employed female engineers: i.e., FIW encourages female engineers to consider leaving engineering altogether, not just their current positions. Work interference with family did not have a similar effect.

Singh et al. continue by noting that occupational commitment is stronger, and the effects of FIW are weaker, in organizations where the employer is perceived as supportive, while the reverse is true where perceived organizational support is absent. Since the sample contains no men, it is not possible to determine whether these relationships are specific to female engineers.

The sample included a number of women who had no children, so the results need to be treated

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**Percent of Bachelor’s Degrees Awarded to Women by Discipline, 2017**

| Discipline               | Percent
|--------------------------|--------
| Environmental            | 5.0%   |
| Biological               | 4.4%   |
| Agricultural             | 3.7%   |
| Chemical                 | 3.2%   |
| Chemical Engineering     | 2.7%   |
| Civil Engineering        | 2.0%   |
| Computer Science          | 2.4%   |
| Engineering Management   | 2.4%   |
| Engineering Phys. Eng.   | 2.6%   |
| Engineering Phys. & Eng. | 2.6%   |
| Environmental Science    | 1.8%   |
| Electrical               | 1.8%   |
| Electrical & Electron.   | 1.6%   |
| Electrical & Electron.   | 1.5%   |
| Electrical & Electron.   | 1.4%   |
| Electrical & Electron.   | 1.3%   |
| Electrical & Electron.   | 1.3%   |
| Electrical & Electron.   | 1.2%   |
| Electrical & Electron.   | 1.2%   |

*Source: Yoder, Engineering by the Numbers, American Society for Engineering Education, 2018*
with appropriate caution. Nevertheless, Singh et al. confirm the prevailing view that a major reason for women's departure from engineering may be work/family conflict.

Cardador and Hill (2018) surveyed 274 engineers employed in industry (40 percent were women) to examine how different career paths affect attrition. They identify three career paths — managerial, technical, and hybrid — and examine whether the intent to leave engineering is equally associated with each of them. Results indicated that, for both men and women, those on the hybrid path reported higher intent to leave engineering, although they had the highest levels of identification with engineering colleagues and reported higher levels of meaningful work. Those on the technical path reported lower levels of intent to leave, while those on the managerial path reported the lowest levels of identification with engineering colleagues. There were important gendered differences in the results. First, women were overrepresented in the managerial and hybrid paths, with the latter being the path most associated with intent to leave the profession. In addition, women on the managerial path reported higher intentions of leaving engineering than men on the same path; they also reported lower levels of identification with other engineers, lower levels of respect, and lower levels of satisfaction than men. In short, the career paths on which female engineers find themselves may be a factor in their decision to leave the occupation. Cardador and Hill do not offer an explanation of

Sexual Harassment of Women: Climate, Culture, and Consequences in Academic Sciences, Engineering, and Medicine

National Academies of Sciences, Engineering, and Medicine

https://www.nap.edu/read/24994/chapter/1

In 2016, the National Academies’ Committee on Women in Science, Engineering, and Medicine initiated the study Sexual Harassment of Women: Climate, Culture, and Consequences in Academic Sciences, Engineering, and Medicine to examine research on sexual harassment to determine what could be done to prevent it in academic science, engineering, and medicine. While the study was being conducted, the emergence of the #MeToo movement drew broader public attention to the problem of sexual harassment, making the study even more timely and important.

The study does not present original research but, rather, summarizes existing research on sexual harassment; develops an analysis of the roots of harassment in academic science, engineering, and medicine; and makes a series of recommendations about what needs to be done to curtail it. It outlines the various forms that sexual harassment can take, noting that it ranges from the creation of a hostile climate (creating an environment in which women’s work performance is adversely affected) to harassment directed at individuals that may involve a quid pro quo or outright coercion. As the case studies summarized in the report show, sexual harassment in academic science is alarmingly common and leads to a number of negative outcomes, from reduced job performance or commitment to withdrawal from academic science altogether.

Based on their reading of the existing research, the authors of the study contend that there are five factors that create the conditions under which sexual harassment is likely to occur in academic science, engineering, and medicine:

- The existence, in many academic settings, of a perceived tolerance of sexual harassment. Where there is a clear commitment to the view that any form of sexual harassment is intolerable, it is far less likely to occur.
- Gender imbalances — environments in which men far outnumber women and/or in which leadership roles are dominated by men are fertile soil for sexual harassment.
- Situations in which power is concentrated in a single person (such as a star researcher) and/or where people are strongly dependent on a superior, especially when they are physically isolated.
how male and female engineers come to be on the paths they are on.

Fernando, Cohen, and Duberly (2018a) report on a small study of engineers in the U.K. Thirty-four women employed at one of two large companies (one in petrochemicals, one in manufacturing) were interviewed about the factors that encouraged them to stay on as engineers. They report that care and support from colleagues, performance feedback, being given opportunities and responsibilities, and having positive role models all made them wish to stay. These forms of help made the respondents feel valued, enhanced their confidence as engineers and as potential promotion material, and helped them believe in their ability to combine work and family (this last point seems to echo Singh et al.’s finding that a supportive organizational culture reduces perceived work/family conflict).

These studies all examine factors that encourage or discourage female engineers’ departure from the occupation after they have begun working. Another study we reviewed this year points to an additional possible “leak” in the pipeline — the interview process that mediates between school and work. Wynn and Correll (2018) report on their analysis of observational data from 84 recruiting sessions by technology companies at a prominent West Coast university in 2012-13. This study is particularly interesting because the companies involved were actively trying to recruit women engineers and computer scientists. Wynn and Correll found that interviewing practices put women...
Most of the presenters were men, with women in marginal roles. Question-and-answer sessions were dominated by men and tended to turn into opportunities for “display.” Some of the interview presentations made use of sexualized images of women and there were a number of references to gendered pop culture images and a tendency to describe the workplace as having fraternity-like qualities. The sessions emphasized technicality above all else, which tended to put women off; Wynn and Correll reported that women were less confident in this area, even when they were equally qualified as men. And, there were numerous “geek culture” references (“Star Trek,” “Lord of the Rings”), references to gendered experiences such as playing video games, and an emphasis on how everything is available at the work campus, implying a lack of work/life balance.

Wynn and Correll contend that these practices make it less likely that women will want to work for the companies involved and less likely that they will be selected. The authors don’t conclude that this causes women to leave the occupation, but if women don’t gain access to some of the most important sources of high-quality employment and have interview experiences that signal the male culture of the workplace, it is reasonable to hypothesize that some of them may look elsewhere.

WAGES

One new theme we saw addressed this year, albeit with a small number of papers, was the wage gap. Research came from both the U.S. and Europe, and examined the wage gap from a variety of different approaches. The largest of these studies reported survey data from 2003 (n=5,095; 25.9% women); 2006 (n=5,233; 27% women); 2008 (n=4,686; 29.1% women); 2010 (n=4,794; 29.6% women); and 2013 (n=4,701; 30.3% women), revealing that in every year except 2003, women in STEM departments earned significantly less than men overall — between 4 and 4.9 percent less (Tao, 2018). However, this is less of a difference than has been previously found, suggesting that income inequality may be decreasing for some groups. The data came from full-time research and teaching faculty with Ph.D.s employed in engineering, computer and mathematical sciences, life sciences, and physical sciences in the U.S. Importantly, Tao analyzed the data intersectionally, which revealed the following differences within and between racial and ethnic groups: White women earned significantly less than white men in 2003 and 2006, but the earnings gap closed over time; African-American women did not earn significantly less than African-American men in any year; Asian-American women earned significantly less than Asian-American men in 2013; Hispanic women earned significantly less than Hispanic men in 2010; and, overall, African-American
men earned less than all other groups of men. Contextualizing the findings, Tao concludes that “experience, rank, working in universities with very high research activity, grants, having research as the primary work activity, and working in engineering increase earnings for all races/ethnicities. These findings, however, also remind us of women’s disadvantages — women are less likely than men to have these work characteristics and, as a result, less likely to benefit from them ... Taken together, this article finds some evidence that gender equity in earnings has improved as compared with earlier studies, but there are significant racial/ethnic differences. Furthermore, women continue to face challenges in other aspects of their careers. As a result, to achieve gender equality in STEM, more efforts are needed to improve women’s overall workforce experience, especially issues related to ranks, resources, productivity, and field representation” (p. 638).

New research on income inequality also came from Europe this year. Career-satisfaction data from Spain revealed that income plays a larger role in women engineers’ career satisfaction than in men’s (Martínez-León, Olmedo-Cifuentes, and Ramón-Llorens, 2018). In the United Kingdom, a salary survey at leading employers of chemical engineers revealed the current gender pay gap at those companies and universities (although the data was not limited to engineers). “Oil companies BP and Shell have reported that their median salary gaps for U.K. employees are significantly behind the national average, at 20.8 percent and 22.2 percent lower for women, respectively” (The Chemical Engineer, 2018, p. 16). The findings were attributed to a dearth of women in top leadership positions. This study was facilitated by new regulations in the U.K. that require companies with more than 250 employees to publish salary information by gender.

Approaching the wage gap from a different angle, Panther, Beddoes, and Llewellyn (2018) examined the salary negotiation process to identify ways that income inequality can be traced back to decisions made during the negotiation process. Based on a survey of more than 300 tenured and tenure-track faculty members in the U.S., they presented findings from 73 complete surveys, 37 of which were from engineering faculty. They found that women were as likely as men to negotiate their salaries, but men were more likely to receive a greater increase in salary from negotiating. Furthermore, men who negotiated with men were more likely to receive a greater percent increase in salary than women who negotiated with women. Examining disciplinary differences revealed that faculty members in engineering departments were more likely than those in nonengineering departments to receive a greater percent increase in salary through negotiating; however, institutional factors, such as size, union-
ization status, and degree-granting status, were not significant in decisions and outcomes related to negotiations. Although the findings presented were based on a relatively small N for survey data, the findings raised several important issues that warrant further research. First, they “raise critical questions about the dominant discourse (women don’t negotiate) that is used to explain and intervene in the wage gap. Focusing only on negotiation training for women is unlikely to mitigate the wage gap. Research and interventions will need to account for multiple ways in which gender norms and biases affect outcomes, how negotiators are perceived by administrators, administrators’ responses to negotiators, how initial salary offers affect the wage gap, interventions for men, and how the men and women administrators may be differentially empowered to give greater compensation to employees, to name just a few issues” (p. 10).

Finally, Echeverri-Carroll et al. (2018) point to a macroeconomic cause of gender wage inequality. They conducted a study of Austin, Texas, focusing on the consequences of high-tech growth in the region between 1980 and 2015. They found that employment shifts as a result of the tech boom had increased gender wage inequality. While women made gains in high-tech occupations, male gains were 1.7 times larger. Moreover, while women in the region made gains in high-skill occupations during the period under review, their gains were mainly concentrated in low-tech industry, while male gains were more concentrated in the higher-paying high-tech sector. In sum, if women have limited access to the most lucrative sectors of the economy, it is possible that this contributes to a pattern of unequal wages between men and women with similar qualifications.

INTERSECTIONALITY
In 2018, we continued to observe an upward trend in the number of papers that take an intersectional approach and the types of intersectional topics that were studied. As discussed above, one article examined the wage gap intersectionally, revealing new income patterns within and between genders and racial/ethnic groups (Tao, 2018). A second new topic explored this year was the experiences of women veterans in engineering education (Atkinson et al., 2018). Based on interviews with seven (5 white, 2 Asian) women veterans from four different universities, the researchers found that although the veterans did not believe gender was salient to their identities, family roles and caregiving were central to their educational experiences, and that their past military experiences helped them during their engineering programs.

A third new topic with an intersectional approach looked at the effects of social networks on scholarly productivity (Gaughan, Melkers, and Welch, 2018). As discussed above also, using survey data from 3,076 faculty members in civil engineering, mathematics, biology, and biochemistry departments at 487 different universities in the U.S. revealed that while professional networks improve scholarly productivity for everyone, the precise effects of those networks differ based on racial, ethnic, and gender identity. The study compared and contrasted differences in instrumental versus advice-giving professional networks, and found that men have larger instrumental networks, whereas women have larger advice-giving networks. This is a concern because the study also found that instrumental networks increase scholarly productivity, while advice networks decrease it. In other words, women’s professional networks are less likely to contribute to their scholarly productivity. White men had the highest levels of productivity out of any group.

“These findings suggest that professional networking strategies of academics should emphasize the cultivation of instrumental ties over advice-giving professional networks ... Our results ... challenge the academy to continue to examine how the social system works to systematically advantage white men while systematically disadvantaging members of all other groups” (p. 593).

Additionally, two other papers compared men and women engineering students across and among racial/ethnic groups and found differences in degree aspirations and engineering identity. Their findings raise new questions about why majority/white women in particular differ from other demographic groups, including minority women, in certain ways. In the first case, key findings from a survey of 7,482 engineering students in the U.S., conducted in 2012, included that white women had lower master’s degree aspirations than any
other group, and that compared with white men: Latina women did not report different aspirations; African-American women were 17 percent more likely to aspire to a Ph.D., but were not significantly different on M.S. aspirations; and international women were more likely to aspire to both M.S. and Ph.D. degrees (Litzler and Lorah, 2018). Numerous variables contributing to degree aspirations across the groups are discussed. Interestingly, having good professors was positively related to aspirations for white males, white females, and international females, but was not related for other groups. This finding contradicts older research findings that positive faculty contact was more important for African-American students than for white students. Yet, it also emphasizes that good teaching is a stronger predictor of aspirations for women than for men, overall. In another case, a survey of 342 introductory chemical engineering students in the U.S. comparing identity and sense of belonging in chemical engineering found that majority (white, Asian, Middle Eastern) women differ from all other groups in that they had the lowest engineering identities and sense of belonging of any group (Godwin, Verdín, Kirn, and Satterfield, 2018).

Of particular importance this year was a literature review published in the Review of Research in Education about the intersectional experiences of black women and girls in STEM education (Ireland et al., 2018). This synthesis should serve as a starting point for others wishing to begin research on the topic and/or better understand that research landscape to date. Based on a review of 60 articles, four leading themes were identified: identity; STEM interest, confidence, and persistence; achievement, ability perceptions, and attributions; and socializers and support systems. The authors also identify three implications, or suggestions, for research and two pedagogical suggestions. Suggestions, for future research, were: Reframe and reexamine the double bind to account for actions and responses and differences among black women; integrate intersectional scholarship from STEM and psychology fields; and develop and use of more complex research methods, particularly qualitative methods. Pedagogical suggestions were: implement culturally relevant pedagogy and curriculum; and attend to students’ well-being and psychological needs.

We suggest that other systematic literature reviews covering intersectional research (articles and conference papers) more broadly would likely be useful in advancing the intersectional research landscape more quickly and in more significant and systematic ways. In particular, they could help avoid repetition of the same type of study and previous findings. Although there appears to be growing interest in intersectionality, we have yet to see systematic development of a research agenda that builds off prior findings, and literature reviews could go some way toward growth in this area.

ENGINEERING AND GENDER IN COMPARATIVE PERSPECTIVE

Comparative research on women in engineering is also emerging as an important element in the literature. We have reviewed many articles in the past that pointed to similarities and/or differences between the experiences of female engineers in the U.S. and other countries, including developing countries outside of North America, Europe, and Japan. This year was no exception, as we reviewed articles showing that women in an elite Indian engineering school outperform their male counterparts, but that women remain underrepresented in STEM in India (Cheruvalath, 2018); that Spanish female students in construction engineering expect to encounter more barriers than men and are less secure and confident in their abilities than their male counterparts (Infante-Perea, Román-Onsalo, and Navarro Astor, 2018); that women in positions of STEM leadership in Singapore struggle with societal discourses that construct leadership as male (Dutta, 2018); and that, in Turkey, there is a higher percentage of women in academic science than in Western countries, in part because teaching is one of the relatively few occupations seen as “suitable” for a woman to pursue (Sağlam et al., 2018). Single-country studies such as these continue to provide evidence that the difficulty of creating gender equity in engineering and STEM is not confined to the United States.

continued on page 26
2018 Outstanding Women in Engineering

By Marc Lewis

American Society for Engineering Education (ASEE) Awards

WILLIAM ELGIN WICKENDEN AWARD
Susan Conrad, Ph.D., Portland State University

Women in Engineering ProActive Network (WEPAN) Awards

INCLUSIVE CULTURE AND EQUITY AWARD
Gretal Leibnitz, Ph.D., Washington State University

FOUNDERS AWARD
Jenna Carpenter, Ph.D., Campbell University

BETTY VETTER AWARD FOR RESEARCH
Lynnette Madsen, Ph.D., National Science Foundation

WOMEN IN ENGINEERING INITIATIVE AWARD
Iowa State University’s Women in Science and Engineering (WISE) program

WEPAN AND DISCOVERE GIRL DAY AWARD
University of Toledo Girl Day

PRESIDENT’S AWARD
Lee Ann Cochran, PRADCO

The National Academy of Engineering (NAE) Awards

NEW FEMALE MEMBERS
Mary T. Barra, General Motors Company
Angela M. Belcher, Ph.D., Massachusetts Institute of Technology
Aine M. Brazil, P.E., Thornton Tomasetti
Constance Chang–Hasnain, Ph.D., University of California, Berkeley
Jacqueline H. Chen, Ph.D., Sandia National Laboratories
Hongming Chen, Sc.D., Kala Pharmaceuticals Inc.
Margaret Sze–Tai Y. Chu, Ph.D., M.S. Chu and Associates LLC
Carolina Cruz–Neira, Ph.D., University of Arkansas at Little Rock
Jennifer Hartt Elisseeff, Ph.D., Johns Hopkins University
Efi Foufoula–Georgiou, Ph.D., University of California, Irvine
Diane B. Greene, Alphabet Google
Ann R. Karagozian, Ph.D., University of California, Los Angeles
Judith S. Olson, Ph.D., University of California, Irvine
Barbara Estelle Rusinko, Bechtel Nuclear, Security and Environmental Inc.
Yang Shao–Horn, Ph.D., Massachusetts Institute of Technology
Susan Mary Smyth, Ph.D., General Motors Corp. Manufacturing Systems Research Lab
Lisa T. Su, Ph.D., Advanced Micro Devices
Susan Hajarani Tousi, Illumina Inc.

Society of Women Engineers (SWE) Awards

ACHIEVEMENT AWARD
Jacqueline Chen, Ph.D., Sandia National Laboratories

SUZANNE JENNICHES UPWARD MOBILITY AWARD
ENDORDED BY NORTHROP GRUMMAN CORPORATION
Cindy Wallis–Lage, P.E., Black & Veatch Corporation

DISTINGUISHED ENGINEERING EDUCATOR
Elizabeth Hsiao–Wecksler, Ph.D., University of Illinois at Urbana–Champaign

ADVOCATING WOMEN IN ENGINEERING AWARD
Stacey DelVecchio, F.SWE, Caterpillar Inc.
Rose–Margaret Ekeng–Itua, Ph.D., Ohlone College
Mary Isaac, Ph.D., F.SWE, HEDGE Co
QuynhGiao N. Nguyen, Ph.D., NASA
Kristin Robertson, The Boeing Company

GLOBAL LEADERSHIP AWARD
Gail Heck–Sweeney, Keysight Technologies
Mariana Karam, John Deere
Kimberly Pittel, Ford Motor Company

GLOBAL TEAM LEADERSHIP AWARD
John Deere Tractor Embedded Architecture, System Engineering and Quality Team, led by Rekha Gore

PRISM AWARD
Kris Acosta, Northrop Grumman Corporation
Vicki Dawkins, Emerson Hermetic Motor
Deena Disraelly, Ph.D., Institute for Defense Analyses
Anca Eisele, John Deere
Katie Thorp, Ph.D., Air Force Research Laboratory, posthumously

SPARK AWARD
Vikki Mueller Espinosa, Intel Corporation
Kerrie Greenfelder, P.E., Burns & McDonnell
Anne McLaren, Ph.D., Cummins Inc.
Kimley–Horn Puerto Rico LLC

EMERGING LEADER
Lynn Davenport, Medtronic
Rebekah Feist, Ph.D., The Dow Chemical Company
Dayna Johnson, P.E., GE Power
Ana Paula Ribeiro Marimoto, Cummins Inc.
Maureen Masiulis, Ball Aerospace
Angel McMullen–Gunn, United Technologies Aerospace Systems
Ana Luisa Mendoza, Northrop Grumman Corporation
Eileen M. Vélez–Vega, P.E., Kimley–Horn Puerto Rico LLC
Alexis Wasserman, Ph.D., Merck
Theresa Wesley, Booz Allen Hamilton

SWE DISTINGUISHED NEW ENGINEER
Letia Blanco, Raytheon Company
Kaitlyn J. Bunker, Ph.D., P.E., Rocky Mountain Institute
Paola Chavira, SoCalGas
Stephanie Foege, Ambitech, a Zachry Group company
Natalie Miller, James G. Davis Construction Corporation
Amy Jo Moore, Northrop Grumman Corporation
Rupali Patil, John Deere
Adriana Porter, P.E., Black & Veatch Corporation
Cathleen Saunders, P.E., Quible & Associates, P.C.
Cassandra Zook, Naval Surface Warfare Center, Philadelphia Division

FELLOW GRADE
Elizabeth Bierman, Comcast
Pamela Dingman, P.E., Lancaster County, Nebraska
Cindy Hoover, Spirit AeroSystems, Inc.
Gina Janke, Modine Manufacturing Company
Andrea Karalus, Pratt & Whitney
Mary Roybal, Ph.D., Raytheon Missile Systems
Alyse R. Stofer, Medtronic

DISTINGUISHED SERVICE AWARD
Nora Lin, F.SWE, Northrop Grumman Corporation
Linda M.S. Thomas, F.SWE, The Boeing Company

OUTSTANDING SWE COUNSELOR
Ann Peedikayil, Caterpillar Inc.

OUTSTANDING COLLEGIATE MEMBER
Saheba Bhatnagar, Rice University
Carlisle DeJulius, The University of Akron
Cheryl Fichter, University of California, Davis
Bridget Hegarty, Yale University
Caitlyn Hines, University of Michigan–Ann Arbor
Sarah Lobsenz, The University of Texas at Austin
Abby Pakettis, University of Illinois at Urbana–Champaign
Francine Reyes–Vega, University of Puerto Rico Mayagüez Campus
Kelsey Riffle, The Ohio State University
Catharine Rose Scoboria, Villanova University

The Anita Borg Institute for Women and Technology Awards

TECHNICAL LEADERSHIP ABIE AWARD
Rebecca Parsons, Ph.D., ThoughtWorks

ABIE AWARD FOR TECHNOLOGY ENTREPRENEURSHIP

DENICE DENTON EMERGING LEADER ABIE AWARD
Debbie G. Senesky, Ph.D., Stanford University

STUDENT OF VISION ABIE AWARD
Chiara Amisola, Yale University

CHANGE AGENT ABIE AWARD
Mariana Costa Checa, Laboratoris

National Society of Black Engineers (NSBE) Golden Torch Awards
PRE–COLLEGE INITIATIVE STUDENT OF THE YEAR (FEMALE)

OUTSTANDING WOMAN IN TECHNOLOGY
Kathryn V. Hamilton, Northrop Grumman

PROFESSIONAL MEMBER OF THE YEAR
Sierra S. Williams, Department of Navy Space and Naval Warfare Systems Center Atlantic

MIKE SHINN DISTINGUISHED MEMBER OF THE YEAR (FEMALE)
Jeremy Waisome, Ph.D., University of Florida

Society of Hispanic Professional Engineers (SHPE) Awards

COMMUNITY SERVICE
Claire Hayhow, The Procter & Gamble Company

JUNIPERO SERRA AWARD
Salome Hector, Lockheed Martin

HISPANICS IN TECHNOLOGY – GOVERNMENT AND CORPORATE
Olga Mendoza–Schrack, Ph.D., U.S. Air Force Research Laboratory

JAIME OAXACA AWARD
Wanda T. Ronquillo, IBM

MANAGER OF THE YEAR AWARD
Angela Nieto, John Deere

YOUNG INVESTIGATOR AWARD
Markita Landry, Ph.D., University of California, Berkeley

CHAPTER ADVISOR OF THE YEAR AWARD
María Larrondo–Petrie, Ph.D., Florida Atlantic University

2018 LITERATURE REVIEW
Comparative data on gender differences in achievement are now available through the Programme for International Student Assessment (PISA), a worldwide study by the Organisation for Economic Co-operation and Development in member and nonmember nations intended to evaluate educational systems by measuring 15-year-old school pupils’ scholastic performance on mathematics, science, and reading. These data make possible broad international comparisons, not simply studies of the situation in individual countries. Two studies we reviewed this year make interesting use of these data in an attempt to relate outcomes in math and science to the broader pattern of gender inequality in societies.

Rodríguez-Planas and Nollenberger (2018) analyzed PISA data to examine the effects of culture on the test scores of the children of people who migrate. They are interested in whether the culture of the country from which immigrants came has an effect on the performance of second-generation immigrant students. They find that second-generation girls whose parents come from more gender-equal countries gain an advantage on boys in reading and science, as well as math. Girls’ sense of self-efficacy in math appears not to be related to the degree of gender equality in parents’ countries of origin; girls whose parents come from more gender-equal countries, however, report that they like math more. Rodríguez-Planas and Nollenberger conclude that the cultures of second-generation immigrants’ parents do have an effect on students’ performances on tests of math, science, and reading.

Stoet and Geary (2018) examine data from PISA on sex differences in science literacy. They find that girls outperform boys in 19 of the countries examined, boys outperform girls in 22, while there were no differences in 26 others. Boys were more likely to have science as their stronger subject than girls, even in countries where girls outperform boys in science, and these differences were greater in countries with higher overall levels of gender equality. Boys also had a stronger sense of science self-efficacy in 39 of the 67 countries studied and expressed a stronger broad interest in science than girls in 51 countries, again particularly in gender-equal countries. Generally, Stoet and Geary’s analysis reveals that, in almost every country, there are more girls capable of being successful in science than earn degrees in science. The researchers hypothesize that part of the reason for the outcomes lies in boys’ having science as their best subject, while girls often having reading as their best subject, even when they have strong science scores. Self-efficacy scores are also a factor, as boys tend to overrate their abilities in science, while girls do the reverse. Stoet and Geary conclude that their results illustrate “expectancy value” theory — people tend to pursue academic paths consistent with their sense of their personal strengths. The anomaly of gender-equal countries may result because the more liberal mores of those countries amplify the effect of individual strengths — people are encouraged to pursue subjects at which they are good. It may also reflect the lower penalty associated with foregoing a STEM path. In less-gender-equal countries, STEM may appear to be an investment in a more-secure economic future, so girls may pursue STEM degrees, and be encouraged to do so, even when it is not their strongest area or the area in which they are most confident.

These comparative studies underline the reality that increasing the numbers of women in engineering (or STEM more broadly) is not simply a matter of improving women’s test scores. Gender patterns in STEM are linked to broader cultural beliefs about gender and to overall patterns of gender equality and opportunity. Even where women outperform men in subjects related to success in engineering, their representation in the field is unlikely to increase unless it is seen as a field in which they are welcome and that is preferable to other areas of opportunity they might reasonably pursue, based on their interests and abilities.

CONCLUSION

It appeared that 2018 was going to be a breakthrough year for women in STEM when it was announced that Donna Strickland, Ph.D., had been awarded the Nobel Prize in Physics. She was only the third woman ever to receive this distinction, and the announcement of her award brought a great deal of public attention to the issue of gender in science and engineering. The story took
a different turn, however, as it developed. Many were astonished to learn that Dr. Strickland was still an associate professor, even though she was a Nobel Prize recipient well into her career at age 59. Despite her accomplishments, no Wikipedia page on her or her work existed. In fact, one article we reviewed this year noted the general absence of Wikipedia pages on female scientists (White, 2018). Dr. Strickland herself expressed surprise at the focus on her gender and said she preferred to think of herself as a scientist, not a woman scientist (McBride, 2018). When asked why she was still an associate professor, Dr. Strickland answered, “I never applied.” (Crowe, 2018).

Dr. Strickland’s puzzlement and reluctance to engage actively with the politics of gender in science illustrates a dilemma confronting those who seek to increase the numbers of women in engineering and science and promote gender equity in STEM. As we have noted in previous reviews, many female engineers and scientists share Dr. Strickland’s avoidance of gender politics and tend to see the underrepresentation of women in STEM not as a structural problem but as a matter of individual choices and abilities.

This was made clear by an important article we reviewed this year titled “I Am Not a Feminist, but ....” Seron et al. (2018) conducted research at four engineering programs in New England (MIT, Olin College of Engineering, Smith College, and the University of Massachusetts Amherst). At each school, they tracked a cohort of female students over a four-year period (2003-7), asking them to complete diaries about their experiences. The results of the study showed that respondents generally were aware of their marginalization as women in a male-dominated field, but they rejected a feminist critique of the discipline, tending instead to embrace an individualist account of their own success. Respondents associated feminism with a demand for preferential treatment, something they rejected because they saw themselves as having succeeded on their own merits. The underrepresentation of women in engineering, to them, was unfortunate but natural — the only solution was better-prepared women. Seron et al. say of their respondents: “While providing clear and strong criticisms of their experiences, they rarely recognize structural inequities, or translate these matters and their own marginality, either individually or collectively, into a commentary on the engineering profession itself.” (p. 133)

Seron et al.’s conclusion that many women engineers accept the meritocratic ethos of the profession with its emphasis on individual achievement makes it seem unlikely that organized pressure to change the gender balance in engineering will arise from within. But, in the absence of such a critique, where will the impetus to change come from? As the research we reviewed this year (and in past years) has shown, women have greatly increased their performance on objective tests of math and science ability, but this has not yet translated into significant increases in the numbers of women in engineering, computer science, and related fields. The literature we have reviewed points to the existence of powerful structural and cultural barriers that continue to push against gender equity in STEM. The question is, who will push back? 🌟

About the authors

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and as chair of the European Society for Engineering Education (SEFI) Working Group on Gender and Diversity. In 2017, Dr. Beddoes received an NSF CAREER award for her work on gender in engineering. Further information about her research can be found at www.sociologyofengineering.org.

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References
The following comprise all of the noteworthy articles and conference papers found in our search of the 2018 literature on women in engineering. We selected for discussion in our review the literature that seemed to be based on the most substantial research and/or that offered interesting, fresh insights into the situation of women in engineering. For readers’ convenience, we have included the complete list of materials we consulted.


**CoNECD CONFERENCE PAPERS**

Held for the first time in April 2018, the Collaborative Network for Engineering and Computing Diversity (CoNECD; pronounced “connected”) conference brought together nearly 400 people to hear “97 presentations ... [on] topics ranging from issues facing transfer students of color, to connecting social justice and STEM integration.” CoNECD was designed to “provide a forum for exploring current research and practices to enhance diversity and inclusion of all underrepresented populations in the engineering and computing professions including gender identity and expression, race and ethnicity, disability, veterans, LGBTQ+, 1st generation and socio-economic status.”

CoNECD accepted both “peer-reviewed papers and peer-reviewed presentations” providing engagement opportunities for researchers and practitioners. Organizers noted, “CoNECD values all efforts to broaden participation in engineering and computing, recognizing that both research and implementation are vital to achieving our goals.” The conference was co-hosted by the National Association of Multicultural Engineering Program
Advocates, the Women in Engineering ProActive Network, and the Minorities in Engineering and Women in Engineering divisions of the American Society for Engineering Education (ASEE). Plans are underway to hold this conference annually.

(ASEE Education and Career Development, 2018)


The SWE Magazine State of Women in Engineering edition provides an overview of recent research and covers the most important trends affecting the advancement of women in engineering. This edition is supported by Cummins Inc. Through this project, SWE is able to both advance its mission and further empower the persistence of women in engineering and technology at all stages of their careers.
What Motivates Men to Champion Gender Diversity?
Allies come from a variety of experiences and backgrounds, yet the first challenge is for men to recognize that sexism exists.

By Sandra Guy, SWE Contributor, and Anne Perusek, SWE Director of Editorial and Publications

Men become champions of gender equity in any number of ways, but research shows that a sense of fair play, empathy, and life experiences are key contributors. Especially for men with a strong sense of fairness and empathy, certain life events and occurrences — such as having a first-born daughter, switching stereotypical parenting roles, having been marginalized in some way, or working under a woman’s leadership — can activate an awareness of sexism and commitment to gender equity.

With these points in mind, we are left to consider: Do men raised to believe in gender equity, or whose lifestyle changes prompt them to become equity advocates, act on those beliefs in the workplace? Or will men become more open to workplace gender equity when they (themselves) benefit from it? Or, is equity in the workplace a combination of incentives and enlightenment? Researchers concede there is no single silver bullet to ensuring men’s advocacy for gender equity in the workplace.

ESTABLISHING THE GROUNDWORK

A helpful place to begin exploring these questions is the article “Allies against Sexism: The Role of Men in Confronting Sexism,” by Benjamin J. Drury, Ph.D., a Google researcher, and Cheryl R. Kaiser, Ph.D. (2014), a psychology professor at the University of Washington in Seattle. Providing a review of the social science literature on male allies available at the time, they cite some of that research to define an ally as “someone who aligns with a disadvantaged group by recognizing the need for further progress in the fight for equal rights” and who then works alongside the disadvantaged group in the search for justice.

Among the highlights from their review is the finding that men are less likely than women to recognize both interpersonal and organizational forms of discrimination against women, and that they fail to recognize the severity of sexism when it occurs. For example, a study by Peter Glick and Susan T. Fiske (1996) revealed that men are less sensitive to and cognizant of subtle forms of sexism, such as when a man interrupts a woman who is talking; benevolent offers of help to women employees when no help is needed; or a woman being asked to take notes in a meeting when it’s not her job. These less conspicuous expressions of sexism take a heavy toll on women, especially those with low self-esteem, because while these behaviors appear less overt or threatening, they are unfair, restricting, and condescending.

Certain men, however, do recognize that there is unfairness in the status quo, and consequently are more likely to acknowledge discrimination against low-status groups, including women. These men reject so-called “legitimizing” beliefs that are used to justify the current state, such as the view that engineering is a meritocracy; that people receive promotions and earn rewards solely because they have worked hard and proved themselves to be exceptional individuals; or that biases and structural systems are irrelevant. Questioning or rejecting these beliefs is significant, as pointed out by Adams, Tormala, and O’Brien (2006), because doing so undermines the high-status group members’ belief that they deserve their standing.

When men self-identify with groups who have experienced unfair treatment due to race, sexual orientation, or other demographic categories, they may be more inclined to perceive and acknowledge sexism. Research also shows that men who have been marginalized may be more attuned to the way groups are treated differently and, therefore, are more likely to reject certain beliefs and structures to instead become allies.

Finally, nice guys qualify as allies, too. Research by Gervais, Hillard, and Vescio (2010) found that men who are motivated by and believe in social responsibility — in being helpful and considerate of others — may develop an ally identity. The researchers discovered that the more such men embraced notions of social responsibility, the more likely they were to perceive another man’s sexist statement as unacceptable. Referencing this study,
Drury and Kaiser suggested that men who are particularly concerned with the well-being of others may also be willing to ally with women to fight against unfair treatment.

**THE IMPORTANCE OF DAUGHTERS**

Indeed, people’s outlooks on gender, diversity, and fairness are complicated. How these various outlooks play out in the workplace and society overall occupies a great deal of attention on the part of Iris Bohnet, Ph.D. A behavioral economist at Harvard University, Dr. Bohnet was appointed academic dean of the Kennedy School of Government in 2018. She is also a professor, director of the women and public policy program, and co-chair of the Behavioral Insights Group at the school.

As the author of *What Works: Gender Equality By Design* (2016), Dr. Bohnet noted in an interview (Salario, 2016) with the publication *Metro*, “There’s research showing that male politicians and CEOs who are fathers of daughters are more gender equal than other men or fathers who don’t have a daughter. So I do think that whole question of empathy and walking in other people’s shoes is very helpful.” (See the sidebar focusing on her book, *What Works: Gender Equality By Design*, later in this article.)

Other research, publicized widely recently because of NBA basketball star Stephen “Steph” Curry’s crediting his daughters for his women’s-equity advocacy, concludes that men whose first child is a girl are more likely to support policies that promote gender equity than men whose first child is a boy.

Curry, a Golden State Warrior point guard, wrote in *The Player’s Tribune* in August 2018 that his experience as a father of a daughter means that “the idea of women’s equality has become a little more personal for me, lately, and a little more real.” He also wrote that, “every day — that’s when we need to be working to close the pay gap in this country. … And every day is when the pay gap is sending the wrong message to women about who

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**How Policy Can Contribute to Gender Equality**

The effects were widespread: The likelihood that a woman would speak up in a village meeting increased by 25 percent; parents were more likely to want their daughters to study past secondary school; and villagers who had exposure to at least two female chiefs in West Bengal overcame their initial bias against women as leaders and rated male and female leaders equally, according to research on the outcome. Women were more likely to run against men for election if a council seat had been reserved for a woman in the previous election, a study in Maharashtra state showed.

And girls who observed female village chiefs spent less time on household chores and wanted to marry later. Researchers Chattopadhyay and Duflo, Ph.D., wrote about the results in “Women as Policy Makers: Evidence from a Randomized Policy Experiment in India,” *Econometrica* 72(5) (2004). [Excerpted from *What Works: Gender Equality by Design*.]
they are, and how they’re valued, and what they can or cannot become.”

Contributing to our understanding of the ways family dynamics may shape views on gender equality is a study by Sharrow, Rhodes, Nteta, and Greenlee (2018). Their research, “The First Daughter Effect: The Impact of Fathering Daughters on Men’s Preferences for Gender Equality Policies,” revealed that men whose first child is a daughter are more likely to express support for gender-equity policies. They found that the birth order is particularly important, because men whose first child was a boy did not express a shift in their views. Their research also suggests that as new fathers, men attach greater significance to the events and information they receive as they undergo parenting experiences with a firstborn child who is female than with subsequent daughters, or when their only daughter follows later in the birth order.

A similar study conducted in the U.K. showed that men who have daughters — not necessarily firstborn — are less likely to agree with a “traditional gender division of work.” Conducted by Borrell-Porta, Costa-Font, and Philipp (2018), this research found that fathers’ attitudes change once their daughters reach school age. Fathers of daughters in secondary school are even less likely to hold traditional gender views than fathers of younger-age daughters. The research suggests that as parents become increasingly aware of what is at stake for their daughters, they may adjust their gender-norm attitudes. For fathers, indirect exposure to disadvantage has the potential to change their views on gender equity. As the authors note, “We conclude that gender norm attitudes are not stable throughout the life-course and can significantly be shaped by adulthood experiences.”

THE ROLE OF AWARENESS

Men with a high awareness of gender bias were more likely to view women’s workplace exclusion as a competitive disadvantage for corporations, according to a 2009 Catalyst study titled “Engaging Men in Gender Initiatives: What Change Agents Need to Know.”

These highly aware men tend to reject traditional male norms, especially the one that calls for men to “avoid all things feminine,” and are more likely than their less-aware peers to express admiration for women co-workers, the study showed.

The norms — avoid all things feminine, be a winner, show no chinks in the armor, and be a man’s man — are deeply ingrained and start at an early age, the study revealed. Men then police one another to keep the norms going, criticizing those who deviate with pejorative terms such as “wimp,” “sissy,” and “whipped.”

Despite these powerful norms, the researchers theorized that when men experience gender norms as a restrictive barrier in their own lives, they may be more apt to see them as a barrier in women’s lives, too. Men who had experienced pivotal moments in their lives from having violated a masculine norm were more likely to become proponents for gender equity, the study found.

One man described how his co-workers talked about him disparagingly when he sought a part-time position to help his spouse with child care. “When I came back (full-time) a year or two after, they asked if I was still breast-feeding,” he told the researchers.

Men who have female mentors also say they’ve had their eyes opened to gender equity issues, the study revealed. “When I was working for [company X], I had some real strong, real assertive females … in my organization, in my direct team,” a Dutch man told the researchers. “We were good friends … It was all very well-intentioned, but they were honest with me … about my issues … about my behavior ... [They were] really good role models.”

Finally, men with a strong sense of fair play were more likely than those without this mindset to be aware of gender bias, the Catalyst study showed. Those with a strong sense of fair play had greater concerns about inequality in general, such as being concerned with extreme poverty and feeling burdened by the lack of fairness in the world, the study found. Such men were more likely to speak up publicly for their ideals of fairness and equity.

And, intriguingly, they were also more likely to have firsthand experience with marginalization or exclusion, the researchers discovered. The Catalyst researchers conclude that these men’s commitment to fairness stemmed from very personal and emotional experiences.

In fact, being marginalized led Robert E. “Bob”
Robert E. Moritz

Moritz, global chairman at PwC and an IMPACT 10x10x10 Champion committed to achieving global gender equality, to an “aha” moment, which he described in an interview. (An initiative of UN Women, IMPACT 10x10x10 aims “to engage governments, corporations and universities as instruments of change positioned within some of the communities that most need to address deficiencies in women’s empowerment and gender equality and that have the greatest capacity to make and influence those changes.”)

The “aha moment” began when Moritz was assigned to work in Japan. He said he “definitely saw, felt, and experienced what it felt like to be a minority — that part of the world being more homogeneous with set expectations of male vs. female in the workplace.”

“Issues of people who experience the negative side of [those expectations] became informative in terms of my thinking and behaviors — as well as the need to overcome these biases,” Moritz said.

He said he was most uncomfortable because he didn’t speak Japanese and yet he knew that, at times, his co-workers were talking about him. “I was on the outside looking in,” he said. “You feel isolated. You feel discriminated against. You could understand without changing your gender or skin color what it felt to be in the minority.”

Moritz extrapolated his experience to the broader issues of diversity and inclusiveness. He said he came to wonder: “Do women feel they are part of the group at work? Are they in the position of others talking about them without them being in the room?”

Moritz said his second “aha moment” occurred as he was going through a divorce, when he said nothing to anyone at work and had to make his children’s meals, oversee their homework, and get them off to school. “You’re putting yourself in the shoes of women who do that regularly, in terms of the challenges they are dealing with,” he said.

“How did it feel to leave work at a certain hour because my obligation in work and life was more than I had dealt with previously?” Moritz said. “How did I manage the expectations inside the organization? I never shared it with anybody. Therefore, I was not able to get help from others perhaps experiencing the same thing. So how do you have an environment in which people can open up — about work, life and flexibility?”

ADVOCATES FOR CHANGE

Moritz said his organization requires men to be “sponsors” rather than “mentors” — a key differentiator because it requires the sponsor to become more actively involved by advocating for the woman being sponsored. “A sponsor creates an opportunity and feels an obligation to see it through,” Moritz said. “So, for example, a male sponsor would go to the leadership team and say, ‘I think Susan (or Sally or Cheryl) has the right skills for this job or this promotion. Why are we not considering that? I am happy to support her, not only to get the role, but to make sure that she is successful and to help her deal with obstacles that might get in the way in terms of anyone who would change roles.’”

Moritz noted, “Women feel supported in that regard — that the backbone of the organization is behind them,” acknowledging that setting the right tone is crucial. “The leadership’s responsibility is to show that diversity enhances the organization and the individuals within the organization,” he said.

“It has to be portrayed as a ‘win-win.’ You have to (explain it) as a business case.”

Another view of what it means for men to be allies of women in the workplace, with women helping men along in the quest, is the basis of an upcoming book — yet to be titled — following up the initial volume, *Athena Rising: How and Why Men Should Mentor Women*. The authors are David G. Smith, Ph.D., associate professor of sociology in the national security affairs department at the U.S. Naval War College, and W. Brad Johnson, Ph.D., professor of psychology in the department of leadership, ethics, and law at the United States Naval Academy, and a faculty associate in the Graduate
WHAT MOTIVATES MEN TO CHAMPION GENDER DIVERSITY?

They assert that allyship encompasses both interpersonal skills — listening, empathizing, and engaging in reciprocal, collegial relationships — and taking a public stance in the workplace, calling out sexist behavior, sexist comments, or salary discrepancies that harm women, Dr. Johnson said. “It’s not enough [for a male ally] to be kind and competent interpersonally,” he said. “Women also need public allyship. It’s being the guy who calls things out when something is unjust, including sexist behavior and comments from other men. If the man who’s an ally sees discriminatory policies that put women behind or make it tougher for them to step away from family obligations, he steps up to remedy that.” Explaining this approach, “There’s more skin-in-the-game when you’re deliberately role modeling for other men and policing the behavior of other men,” Dr. Johnson noted.

Dr. Smith said managers should beware of men who aren’t legitimate allies. They include predators, or those who would take advantage of women, especially young employees as they start their careers; the men who talk a good game of being a “male feminist” only to benefit themselves; and those who make hostile and sexist comments to male-only groups while spouting feminist support when around women or mixed-gender groups.

New employees could seek out more senior women in management to get advice on the real versus the phony allies. In fact, it should be women who decide who their allies are, the authors say. “You’re an ally when women call you that,” Dr. Johnson said. “Don’t proclaim it. That’s very presumptuous.”

How does the process start — and develop? It starts with peer relationships and work friendships — relationships that develop and build with trust. “We need the average man in the workplace to be less afraid of engaging deliberately and publicly with women and not be afraid of the #MeToo movement,” Dr. Smith said. “You have to set boundaries and have impulse control,” the authors said. “It is never in a woman’s best interest for a man to sexualize a relationship at work. That’s never going to be useful for her. You have to use good judgment.”

Consistent with other research, the co-authors note that men who become allies are, in many cases, influenced by either a personal connection, such as seeing a friend, colleague, or family member being discriminated against, or a life event in which they found themselves in the minority. “It gets in touch with their sense of fairness and justice,” Dr. Johnson said. “It’s important to who they are.”

Corporations can support such accountability in their workplace policies, but women also can play a role, the authors said. “Give guys feedback,” Dr. Smith said. “For men who are asking, women can play a role in helping [men] understand appropriate ways of being allies.”

For men who default to helping women they find attractive, women or managers can call out the behavior. “The question needs to be asked: ‘How does that behavior bias and influence your work?’”

Women can also invite men to attend women’s leadership conferences to learn more about issues of importance. “It starts with awareness,” Dr. Johnson said. And it continues with communication. “If you don’t have the ability to ask questions, you never have the opportunity for someone to say, ‘Oh, now I get it,’” Dr. Smith said.

References

WHAT MOTIVATES MEN TO CHAMPION GENDER DIVERSITY?


The Importance of Male Allies: A Review of the Literature

An examination of peer-reviewed research across various industries regarding the roles men can take to improve gender equality in the workplace.

By Roberta Rincon, Ph.D., SWE Senior Manager of Research

Though not always referred to as “male allies,” men have long been involved in various aspects of addressing gender equality. Abolitionist Frederick Douglass was a supporter for female suffrage back in the mid- to late 1800s. In the 1950s, the “husbands and boyfriends” of SWE Philadelphia Section members created the informal “Men’s Artillery” for companionship while waiting for section meetings to conclude, and in 1967, the more formal Men’s Auxiliary, Society of Women Engineers (MASWE) was established Society-wide to provide fundraising and other support for SWE members. In the 1970s, men came together to advocate an end to violence against women, establishing influential groups across the United States. While the motivations of men advocating women’s rights throughout the years may differ, these examples show that men’s influence in addressing gender equality can lead to significant change.

Often when we think about male allies in the workplace, we consider men who mentor, sponsor, and advocate the fair treatment of women — and this is especially true in male-dominated industries and in places where women hold few high-level positions. Where men are the majority, their behaviors and actions are necessary to address inequities within their immediate spheres, but research shows that they also have the ability to serve as role models and spokespersons for other men.

We conducted a review of research literature to learn more about the effectiveness of male allies in improving gender equality in the workplace. While important research has been conducted by companies and organizations to inform the work of male allies, only studies published in peer-reviewed publications or conference proceedings after 1998 that contained either findings, conclusions, or recommendations concerning men in roles as mentors, sponsors, or advocates in promoting women’s equality were included in this review. Using a keyword search, we sought relevant literature in the following databases: Academic Search Complete, JSTOR®, Business Source, and Google Scholar™.

We acknowledge the significant body of literature related to male allies’ involvement in addressing race, LGBTQ+, and larger gender-equity issues (such as violence against women) and recognize that this research can inform the work of male allies in addressing gender equity in the workplace. However, we purposefully kept this review focused on the research available on male allies and gender equity/equality in the university and the workplace. Though we had intended to focus on gender equity in the STEM workforce, this proved too narrow a focus. The following literature review includes research that pertains to the role that men can take as allies, across different industries.

MALE ALLIES IN STEM

There is surprisingly little peer-reviewed research available that focuses on male allies for gender equity in STEM. Some studies from the National Science Foundation’s ADVANCE program, a grant-funded initiative to increase the representation and advancement of women faculty in STEM, consider the impact of male ally programs. For example, North Dakota State University researchers conducted a review of the university’s NSF...
ADVANCE-funded program of male faculty advocates, and concluded that developers of male allyship programs can benefit from the insights gained from gender-equity anti-violence programs, noting the similarities that such programs share (Anicha, Burnett, and Bilen-Green, 2015). A 2013 evaluation of the advocates and allies program at the university found that women faculty reported feeling more comfortable approaching men in the program for support. Women faculty also reported appreciation for the awareness of gender bias that the program offered their male colleagues and the encouragement to discuss the issue with other male faculty (Bilen-Green, Green, McGeorge, Anicha, and Burnett, 2013).

Bilen-Green et al. (2015) conducted a separate review of the implementation of the NSF ADVANCE-funded program of male faculty advocates and allies across five different institutions, noting that the endorsement and support of top university administrators are critical to successful implementation. Visible support among senior administrators adds credibility to the work while publicly recognizing those who participate.

In the professional sector, an international study of self-identified mentors in leading research groups in the field of optical engineering was conducted to understand the motivations and actions of mentors in their efforts to increase female leaders in engineering (Kodate, Kodate, and Kodate, 2014). Researchers found both male and female participants favored joint mentoring by a man and a woman for female engineers. They felt that this complementary model of mentoring provides more learning opportunities for both men and women, increasing the quality of mentoring for mentees.

MALE ALLIES AND EFFECTIVE MENTORING

Expanding the search beyond STEM and focusing on male allies as mentors, we found a 2002 review of sociological literature on the construction and maintenance of mentoring relationships for women in male-dominated fields in academia. Researchers noted that while senior faculty, most of whom are male, may need training to be effective in cross-gender mentoring relationships, a mentoring program should be part of a larger structural transformation that includes addressing organizational reward systems, culture, and norms that make it difficult for women to persist (Chesler and Chesler, 2002). This aligns with studies indicating that a single diversity initiative alone is not enough to change the culture of an organization — see the article, “What Research Tells Us About Diversity Training,” also in this issue, for more discussion on this point.

A Catalyst study of women executives and CEOs of Fortune 1000 companies looked at women’s advancement into senior levels of leadership to understand the organizational barriers to advancement they experienced and the strategies used to overcome them (Ragins, Townsend, and Mattis, 1998). In the realm of male advocacy, a number of women executives noted having both male and female mentors, taking advantage of the different strengths each have in a mentoring relationship. Male mentors were found to be more influential in organizations, providing access to inner power circles, while female mentors were better at identifying and providing empathy regarding barriers to advancement. The findings from the study also support the need to raise the consciousness of chief executive officers and other senior officers about the importance of closing the gender gap, as organizational change requires the support and guidance of top management.

In a study of gender differences in social capital among business and political leaders (referred to as those in “elite positions”), Palgi and Moore (2004) discovered that more business leaders (both men and women) utilize several mentors from different hierarchical levels to help them advance in their careers. Additionally, female leaders reported having more mentors than their male peers. The researchers learned that for women leaders in business, having had a senior-level male mentor was associated with a broader range of networking contacts, with the greatest impact from mentoring seen early in their careers. However, in general, men reported a wider range of personal elite contacts than women. The exception to this was for women in social democratic countries where gender equality measures are strong. In these countries, women appear to have more access to elite networks than women in other countries.

A longitudinal study of lawyers, a profession where gender equity is an issue, used a social
capital perspective to understand the career rewards associated with the mentoring relationships between lawyers in Ontario (Kay and Wallace, 2009). Researchers observed that both men and women lawyers were equally successful in securing mentoring relationships of nearly identical quality in their social network properties and embedded resources, but were unequal in capitalizing on those relationships. Women gained more advantage from having multiple mentors, even if they were exclusively male mentors, potentially connecting the protégés to a diversity of resources and opportunities that help them as they maneuver through different stages of their careers.

A survey of graduates from a large Midwestern university found that women in male-dominated industries see a greater return from a mentoring relationship with a senior male mentor in terms of compensation and career progression satisfaction (Ramaswami, Dreher, Bretz, and Wiethoff, 2010). The researchers also indicate that women in these industries need sponsorship from senior male mentors to a higher degree than their male counterparts. They suggest that mentorship is of greater value when senior males voluntarily select female protégés for informal mentoring relationships rather than being paired through a formal mentoring program. Such voluntary selection indicates that senior leaders observe certain leadership qualities that their organizations value.

Guthrie and Jones (2017) studied the impact of relationship structure on mentoring functions in public accounting, a field where women are underrepresented in upper levels, and discovered that the origin of a mentoring relationship matters more to women protégés than the gender of the mentor. Interestingly, the majority of the females in the study who participated in informal mentoring relationships chose male mentors. The study showed that programs that support formal pairings may be significantly less helpful to female protégés than informal relationships, recommending that firms encourage more senior men to take the initiative in reaching out to potential female protégés.

MALE ALLIES AND EFFECTIVE CHAMPIONING

To understand the role that male allies can have in championing women, particularly when it comes to addressing inequities head-on and publicly advocating for women, we discovered a few interesting studies — particularly regarding the powerful role that men can have in effecting change in other men.

A study conducted by Czopp and Monteith (2003) that looked at confronting gender and racial bias among university students suggested that when nontarget group members challenge prejudiced responses, the individual who is confronted is likely to feel more guilt and less uneasiness than if confronted by someone from the target group. The authors theorize that this may be due to the unexpectedness of a nontarget confrontation, and that men may have a unique advantage in utilizing a confrontational approach to addressing prejudices. However, the researchers noted that participants were more responsive to confrontation about a racially biased response than a sexist response, indicating that combating sexism requires patience and perseverance.

In line with Czopp and Monteith’s findings, Drury and Kaiser (2014) reviewed literature on male allies confronting sexism and found that when men speak up about sexism and confront it, they are taken more seriously than women, are less likely to experience social costs (e.g., derogatory remarks), and are more persuasive in convincing others (particularly other men) that sexism exists. Men are taken more seriously because confronting sexism does not seem to directly benefit them. Alternatively, when women confront sexism, they may be seen as acting out of self-interest, or “trying to benefit their gender group.” Drury and Kaiser included a study involving men and women reading about either a male or female confronting sexism in the classroom in which researchers discovered that male study participants found male confronters more credible than the female confronters and viewed the perpetrators’ actions as more sexist when confronted by a male.

A 2016 Australian study of high-level executives’ effectiveness in championing women’s programs and gender equity discovered that a leader’s gender is complexly related to self-presentation, others’ perceptions and expectations, individual choice, and organizational forces (de Vries, 2015). Analyzing interviews with both male and female CEOs, who were recognized as advocates for gender
equity, researchers noted overall agreement among those interviewed in the need for attention to resourcing, high visibility, strategic positioning of programs, persistence over time, and consistency of attention to the issues. However, they highlight the struggles that female leaders face in addressing gender equity in organizations where men dominate the executive ranks, including a reduced sense of belonging due to spotlighting their “outsider” status, the risk of having women’s issues marginalized when mentioned by a woman, and the personal cost of advocating change. Male advocates who utilize their positions of power among the male establishment to challenge the status quo seem to do so with little personal or professional cost, particularly when they appoint senior women to lead their change initiatives, effectively removing themselves from the active work required while making gender equity women’s responsibility. The researchers highlight the potential for complementary championing roles for senior men and women to lead change initiatives, which would reduce senior women’s vulnerability and utilize men’s power to influence other men to the cause, and the need to treat equity as an organizational mandate rather than a personal choice (particularly for men).

Another Australian study looked at mobilizing men and women toward gender equality as a common cause and found that positioning men as agents of change enhanced men’s support for gender equality (Subašić et al., 2018). The study, involving multiple experiments with university students and members of the general public, found that it is important to consider motivation when engaging men, noting that common-cause messaging (expressed through feelings of solidarity with women on issues of inequality), appears to be most effective for a male audience when championed by male leaders.

A subsequent study by Hardacre and Subašić (2018) extended the research of Subašić et al. (2018) to examine the role of leadership and influence processes in effecting social change. They found that common-cause messaging is effective, regardless of a leader’s gender, with both men and women audience members appearing to hold a more favorable and receptive view of leaders who speak of equality as a collective group interest. However, in line with the research of Subašić et al. (2018), male leaders were more effective than female leaders in mobilizing male participants, regardless of how the message was framed. The researchers theorize that a shared gender identity and dominant in-group membership, coupled with shared-cause messaging, suggests that men are doubly advantaged as mobilizers for gender equality as they are able to reach both men and women with such messaging.

WHAT RESEARCH DOES AND DOESN’T TELL US

The review of the research uncovered a few key points. The first is that there is a significant gap in the research around male allies for gender equity in STEM, particularly regarding sponsorship of women in the workplace. While companies are developing male-ally programs and working to encourage male advocates in their efforts to work alongside women in promoting gender equity, we do not have enough information to help us understand the impact that male advocates can have on this work.

Second, the research on male allies in supporting women of color in STEM is practically nonexistent. While research on male allies for women and male allies for people of color are available, there is no research to reference for those who want to increase men’s support of women of color.

Finally, we attempt to pull together what the research tells us about effective male allyship:
- Visible support from senior leadership adds credibility to the work of male allies while publicly recognizing those who participate.
- Women benefit from having multiple mentors to help them advance in their careers.
- Women see a higher return from informal mentorships that are initiated by senior men who voluntarily select their protégés.
- Male leaders who publicly advocate gender equity within their organizations should avoid delegating the responsibility for action to senior women. Rather, male leaders should serve as complementary champions for the cause with women.
- Both men and women leaders should encourage common-cause messaging to promote solidarity on the issue of gender equity. However, this message resonates more for men when championed by male leaders.

We close this review with the observation that
male-ally programs cannot be effective in isolation when cultural and structural changes are needed. In extension, as Subašić et al. (2018) note, addressing gender equity requires addressing issues in the domestic, professional, and political spheres: “To the extent that gender-based prejudice stems from and reflects unequal social relations, to eliminate prejudice and bias it is necessary to first change the social reality of gender inequality.”

Endnotes
1 Although MASWE was disbanded in 1976 when men were allowed full membership in SWE, a scholarship created by its founders remains. 2 Catalyst’s Knowledge Center offers a Research Series: https://www.catalyst.org/research/engaging-men-in-gender-initiatives-what-change-agents-need-to-know/. NCWIT offers resources for male advocates and allies: https://www.ncwit.org/resources/male-advocates-and-allies-promoting-gender-diversity-technology-workplaces. The Center for Women and Business at Bentley University released a curated research report in 2017 on men as allies: https://www.bentley.edu/centers/center-for-women-and-business/engaging-men-advance-women. 3 Keywords used in the search, individually or in combination, included: male, men, ally/allies, champion, mentor, sponsor, gender, sponsorship, sexism.

Bibliography


What Research Tells Us About Diversity Training

New research shows diversity training can change people’s ways of thinking and behaving, but only if done with finesse, expertise, and over a sustained period.

By Sandra Guy, SWE Contributor

As even seemingly savvy companies have learned the hard way, diversity training can backfire, leading employees to feel angry, resentful, and betrayed. A less-dramatic, but equally frustrating unintended outcome: Diversity training sessions are often seen as ineffective.

Researchers are just beginning to unravel the science behind successful diversity training — and, in the process, gaining respect for the rigorous analysis they have brought to the way such training should be conducted. “[Diversity training] is not just something that should be done because it’s the right thing to do,” said Katerina Bezrukova, Ph.D., associate professor of organization and human resources at the University of Buffalo’s School of Management and one of four co-authors of a seminal analysis assessing the effects of diversity training. “If you don’t do it right, you can get a lot of horrible and tragic outcomes.”

The researchers’ analysis examined more than 40 years of studies, fusing data from 260 studies and more than 29,000 participants from a variety
of fields. The 260 independent samples assessed the effects of diversity training on four training outcomes over time and across characteristics of training context, design, and participants, according to the report, titled “A Meta-Analytical Integration of Over 40 Years of Research on Diversity Training Evaluation” (Bezrukova, Spell, Perry, and Jehn, 2016).

The analysis used models from diversity training literature and psychological theory to generate theory-driven predictions.

DEFINING A FRAMEWORK

Due to the complexity of the topic and the strong emotional responses it can bring, diversity training is a branch of its own in the study of training methods. Dr. Bezrukova notes that the research team conducted its analysis within the established framework of diversity training and philosophy. Citing earlier work, the authors write, “We define diversity training as a distinct set of instructional programs aimed at facilitating positive intergroup interactions, reducing prejudice and discrimination, and enhancing the skills, knowledge, and motivation of participants to interact with diverse others (Pendry et al., 2007).”

The study found training is most effective when it is delivered over an extended period, integrated with other initiatives, and designed to increase both awareness and skills. The setting, whether it consisted of young people on college campuses or corporate employees of varying ages at their job sites, made no difference. Based on a review of the overall research, neither voluntary nor mandatory training was clearly superior, though some researchers assert that mandatory training frequently backfires.

Among the positive indicators: People can learn about other cultures by working with those of different and diverse backgrounds. The long-term aim of effective diversity training could be what diversity trainers Thomas Kochman, Ph.D., and Jean Mavrelis, co-authors of Corporate Tribalism: White Men/White Women and Cultural Diversity at Work, call cultural pluralism, or an environment in which people appreciate and value one another’s norms, behaviors, and attitudes.
Dr. Kochman and Mavrelis, a husband-and-wife team whose firm, Kochman Mavrelis Associates, is based in the Chicago suburb of Oak Park, lead diversity training sessions in which employees' differences are openly discussed. “Ours is not an assimilationist model,” Mavrelis said. “It’s where there is no ‘one way.’ … If we take things that aren’t in the rulebook and make them explicit, we could say, ‘A lot of people [who work together] could be great leaders.’ We make the implicit explicit.”

“Building trust is the key,” Dr. Kochman said. “With cultural pluralism, there’s a greater social equity. People want to be respected for their differences. That sets a dynamic into motion where, if you want to be treated as you see yourself, others have to know how you see yourself. That’s where the learning comes in, the educational aspect. In our training, we don’t make it accusatory. We make it educational, and minimize the defensiveness.”

“Diversity can be unbelievably painful when you can’t understand [a new culture], but [at the same time], you want new experiences and [the] sheer knowledge that comes from a different perspective or [a different] take on a problem,” Dr. Bezrukova said. Diversity training is equally complicated, since people can fall back into their old patterns of attitudes and behaviors, even while their cultural knowledge remains consistent or has even increased.

“Cognitive learning tends to increase over time,” said Dr. Bezrukova, who grew up in Crimea and became interested in diversity when she attended The Wharton School at the University of Pennsylvania as a postdoctoral researcher and social psychologist. Coming from a decidedly different culture, she has had little in common with everyone she has worked with.

“The attitudes this [diversity] training attempts to change are generally strong, emotion driven, and tied to our personal identities, and we found little evidence that long-term effects to them are sustainable,” Dr. Bezrukova said. “However, when people are reminded by their colleagues or even by the media of scenarios covered in training, they are able to retain or expand on the information they’ve learned,” she said.

It’s the kind of learning that needs constant reinforcement. “It’s critical to offer diversity programs as part of a series of related efforts, such as mentoring or networking groups for minority professionals,” Dr. Bezrukova said. “When organizations demonstrate a commitment to diversity, employees are more motivated to learn about and understand these societal issues and to apply that in their daily interactions.

“If there is good support — through hiring practices, promotions, and clear goals — anything in support of diversity, the coordinated efforts help,” she said. People who become more attuned to diverse cultures tend to seek out information verifying their new insights on TV and social media, for example. “I was happy to see people [involved in the studies] increase their cognitive knowledge,” Dr. Bezrukova said. “Just knowing about something provides better understanding and leads to better relationships with people who are different. That’s a positive trend.”

For diversity training to have staying power, a simple lecture won’t cut it, the research found. Diversity training participants responded more favorably to programs that used several instruction methods, including lectures, discussions, and exercises. “If it’s just a one-click response setup, it’s not going to work that well,” Dr. Bezrukova said.

Dr. Bezrukova’s co-authors on the study are Karen Jehn, Ph.D., professor of management, The University of Melbourne Business School; Jamie Perry, Ph.D., assistant professor, Cornell University School of Hotel Administration; and Chester Spell, Ph.D., professor of management, Rutgers University School of Business-Camden.

THE DIFFICULTY OF CHANGE
Interestingly, another meta-analysis on diversity training outcomes was conducted several years prior to Dr. Bezrukova’s. That study examined quantitative evidence that diversity training changes affective-based, cognitive-based, and skill-based trainee outcomes (Kalinoski, et al., 2013). Consistent with Dr. Bezrukova’s study, this earlier
work, “A Meta-analytic Evaluation of Diversity Training Outcomes,” also found that longer trainings were more effective than shorter trainings.

Additional findings from the Kalinoski study include that trainings with active (e.g., exercises) rather than passive (e.g., lecture, video) forms of instruction and implementing face-to-face rather than computer-based formats were more effective in changing attitudes of participants. They also looked at trainee motivation, noting that training is more effective for those who perceive that the training is important and relevant.

Significantly, the authors note the need for more research examining diversity-training effects that account for trainees’ attitudes prior to training. They state that one would expect little change in attitude from trainees who go in with a favorable attitude toward diversity.

Seeking insight and possible solutions, some scholars have examined the effectiveness of awareness-based and behavioral approaches to diversity training. Margo Monteith, Ph.D., professor of psychological sciences at Purdue University, West Lafayette, Indiana, said, “Stereotypes are so ingrained in our culture, they become a habitual way of responding. The role of motivated self-regulation really is about breaking a bad habit.”

Practicing self-regulation requires effort and practice, she said. “It requires continual efforts and vigilance toward understanding the nature of one’s biases and working on regulating them. It’s across time where people become better at generating alternative types of responses (other than the stereotypical knee-jerk responses).”

So, how do people see that they are biased? Confrontation can be an effective tool in diversity training, but, in dealing with sexism, confrontation must be paired with evidence that people

**CHARACTERISTICS OF EFFECTIVE DIVERSITY TRAINING**

- **Delivered over an extended period of time**
- **Utilizes different instruction techniques:** lecture, discussion, hands-on activities
- **Increases both awareness and cognitive skills**
- **Integrated with other diversity initiatives:** not stand-alone
- **Supported through coordinated efforts:** hiring, promotions, compensation, etc.

**THE BIGGEST CHALLENGE IN ADDRESSING DIVERSITY THROUGH TRAINING: TRAINEE MOTIVATION**

- **Training is more effective for those who perceive it as important and relevant**
- **Motivation can be internal:** concerned about their own biases
- **Or external:** violation of employer’s or society’s norms and values
What research tells us about diversity training

participating in the training exhibit bias — and that the results have repercussions, said Dr. Monteith, who is co-editing a new book, *Confronting Prejudice and Discrimination: The Science of Changing Minds and Behaviors*, with Robyn Mallett, Ph.D., an associate professor of psychology at the Loyola University Chicago. That’s because, as Dr. Monteith described it, “Sexism is a unique kind of ‘ism. Women and men have communal relationships. Women often are viewed very positively in terms of attitudes. In the president’s words, ‘I have respect for women,’” she said.

Logically, it follows that diversity training should include hands-on activities. That might include showing participants identical resumes — one from a man and one from a woman. When the diversity trainee decides to “hire” the man, the response would be to present the evidence of the identical applications.

“Presenting that evidence has clear implications for the well-being of women versus men,” Dr. Monteith said. “People with (higher internal motivation) will then experience this negative self-directed affect and become more concerned about their biases.

Everyday Considerations

Scott E. Page, Ph.D., the Leonid Hurwicz Collegiate Professor of Complex Systems, Political Science, and Economics at the University of Michigan, is the author of five books, including *The Difference*, which demonstrates the benefits of diversity in social contexts, and his most current book, *The Diversity Bonus: How Great Teams Pay Off in the Knowledge Economy*.

Dr. Page said he uses technology to help stay on course. A change in protocols and organizational routines can help leaders monitor their efforts toward creating a more diverse, equitable workforce, he said.

In line with the notion that diversity training can’t be the stand-alone fixture of a diversity program, Dr. Page noted, “The issue is less how I score on an implicit-bias test and more about my daily measurable actions — to the extent that they’re measurable — how am I performing in terms of communication, promotions, and assignments?”

Dr. Page said he uses metrics available in Microsoft® Office to track, for example, the number and lengths of emails he’s sending to female colleagues versus male colleagues.

“How many notes did I send in a day? What was the nature of those communications? You can 360 [degree look at it. Look at your own personal behavior,” Dr. Page said. “If you don’t measure, you cannot manage.”

It’s important that the leaders meet certain thresholds that demonstrate zero tolerance for discrimination — because small amounts of discrimination accumulate over time, Dr. Page said. Requiring leaders to meet certain standards showing inclusiveness and performance, tied to their promotions and compensation, can work, he said.

Dr. Page pointed out that similarly, leaders can track whether women, people of color, or nontraditional employees are being assigned to remote locations or being asked to attend meetings at 6 o’clock in the morning or entertain clients at hockey games, for example, when these requirements don’t work with women’s or other nontraditional employees’ lifestyles.

“If the employee doesn’t like hockey and/or would rather be with the kids in the evenings, why is entertaining clients at nighttime hockey games a big part of the job?” he said.

The essential underlying belief and experience must be that a diverse workplace “makes us better at what we do,” Dr. Page said.

Dr. Page is also the author of *Complex Adaptive Systems* (with John Miller), which describes complexity theory, and *Diversity and Complexity*, which explores the contributions of diversity within complex systems.

Note: For more on the diversity bonus, please see Dr. Page’s video: [https://www.youtube.com/watch?v=FKCYtzkDEWw](https://www.youtube.com/watch?v=FKCYtzkDEWw).

A panel discussion on the topic, including Dr. Page, is also available: [https://www.youtube.com/watch?v=3GsZtACZi3M](https://www.youtube.com/watch?v=3GsZtACZi3M)
“Encouraging reductions of sexist biases often requires that people have experiences where their own biases come to light,” Dr. Monteith said. For those who are less motivated to see their own biases, the appropriate motivation can spring from showing that they are violating society’s or their employer’s norms and values, rather than browbeating them or failing to offer them choices, she said. The idea is to create clear norms of behavior.

“Any time an authority figure models a certain behavior, people are more likely to go along with it,” Dr. Monteith said. “And grassroots movements, even the #MeToo movement, people coming together who aren’t in positions of power but gathering in solidarity and presenting their common experiences, can have a positive effect.”

**CHALLENGES FOR INDUSTRY AND ACADEMIA**

As the workforce becomes more diverse, researchers studying all sorts of companies and industries are identifying the “sore points” — or places where a lack of understanding and/or bias causes problems to become evident. “Our research shows that for any given situation, the type of program and the way it’s designed, especially with respect to how the rest of the organization operates, are very important,” Dr. Bezrukova said.

For example, Dr. Spell, Dr. Bezrukova, and their colleagues Sayan Mukherjee, Ph.D., assistant professor at the T.A. Pai Management Institute, and Alok Baveja, Ph.D., professor at Rutgers University, are studying how diversity in police departments may be connected with bias in arrests and unequal treatment of minorities. Some high-profile cases of bias and wrongful shootings of innocent citizens were major social issues even before the 2014 Ferguson riots and others since then, energizing groups such as Black Lives Matter.

Another project, presented in 2017 at the Industry Studies Association conference in Washington, D.C., examined the role bias plays in the way patients are treated in hospitals, and how diversity of both medical staff and patients can result in differential treatment. The study found that patients in some demographic groups showed higher chances of being readmitted to the hospital for the same condition within days of discharge. Patients who were single, nonwhite, older, low income and who spoke English as a second language, and those with poor access to food, had a higher likelihood of being readmitted within seven days.

In yet another area of research, in separate studies Patrick McKay et al. (2011) and Eden King et al. (2011) have shown how the extent to which the proportion of minorities in the workforce is representative, or matches, that of the business customer base, matters in how customers are treated.

Offering additional perspective, Alexandra Kalev, Ph.D., professor of sociology at Tel Aviv University and co-author with Frank Dobbin, Ph.D., professor of sociology at Harvard University, of the *Harvard Business Review* article “Why Diversity Programs Fail” (Dobbin and Kalev, 2016), said diversity training should never be a requirement. “There is no in-and-out, quick solution for diversity,” Dr. Kalev said. “The actual experience of training often creates more antagonism than buy-in and motivation.

“Most training is mandatory. People have to sit in a room instead of doing what they are busy with and listen to how bad and biased they are,” she said, as this can be the case particularly when evidence-based confrontation methods are not handled with the necessary sensitivity and thoughtfulness. While diversity training has become “a huge industry, run by well-meaning people,” Dr. Kalev posits it can be done correctly at a much lower cost and in a much less flashy way than many companies implement it. “It’s not going to go away, so we need to make sure to do it right,” she said.

From Dr. Kalev’s perspective, doing it right would mean:

- **Implementing diversity training on a**
voluntary basis — and only after employees understand the business case for diversity, and as part of a larger organizational project. “Diversity training should be held only when it’s relevant,” Dr. Kalev said, echoing the point that training needs to be part of a larger effort that includes examining and instituting new company policies and processes. “Sometimes it’s not even about biases. Sometimes women must attend meetings from 5 p.m. to 7 p.m., and if not, they’re left out. Yet they may have to pick up their children from school. In cases where we’re talking about arrangements that aren’t family friendly, move the meetings to no later than 3 p.m.” She emphasized that, “When managers understand the business case for their department, their company — that it’s not about replacing white men; just getting the best workers, it works,” she said. “When managers get to devise the plans — when they are engaged — this is when it works.”

- Using contact theory. Let employees from different backgrounds, roles, and ethnicities work together. For example, a cross-functional project team comprising employees from various departments, a mix of salaried and hourly workers from a research and development department, along with those who work in assembly, and from customer service, can weaken the participants’ biases by learning more about one another.

- Engaging mentors. “Once senior executives do one mentoring assignment, they start recruiting other managers and take it on as their own,” Dr. Kalev said. “This kind of engagement creates a buy-in. That’s one of the mechanisms we see works — creating buy-in of the idea that diversity is important, not threatening, and a goal that the leaders can help achieve.”

- Implementing targeted recruitment. Seek diverse job candidates and have line managers interview them. “It creates commitment, engagement, contact. We see the numbers add up.” Dr. Kalev notes that the above approaches are “not as costly as training, and even small organizations can adopt them.”

FINAL THOUGHTS

The work of inclusiveness — making space for everyone and everyone’s culture, experience, and personality — is as difficult and complicated as people themselves. We all have biases, yet the search continues for the best way to open everyone, including the most resistant people, to change.

The effort will require that mentors, colleagues, executives, managers, and hourly workers take on one another’s struggles with a buy-in deep enough to help each other, honor each other, and hear each other out.

References


A Look at Gender Bias in India

In an effort to understand unconscious gender bias in the engineering workplace in India, SWE undertook a study based upon the real-world experiences of working engineers.

By Roberta Rincon, Ph.D., SWE Senior Manager of Research

In 2016, the Society of Women Engineers released our first research study of gender bias in the engineering workplace, focusing on engineers in the United States and Canada. This study, a collaborative project conducted with researchers from the Center for WorkLife Law at the University of California, Hastings College of the Law and led by the Center’s director, Joan C. Williams, J.D., highlighted the impact that unconscious gender and racial biases can have on engineers’ decisions to stay or leave their organizations.

Building on this important work, SWE collaborated once more with the Center for WorkLife Law to understand unconscious gender bias in the engineering workplace in India. SWE focused on India for our first international research study because of the tremendous momentum SWE has experienced there, with growing membership, affiliates, and ambassadors who have helped develop successful networking events in various cities around the country. SWE’s study of unconscious bias in India expands our understanding and involvement in the region, allowing us to identify areas of similarity and difference between the members SWE has historically served in North America and SWE’s newest members in India with regard to the challenges women face in the engineering profession.

WOMEN ENGINEERS IN INDIA

In the U.S., we often point to two indicators that highlight the gender inequity that exists in engineering: (1) that the percentage of engineering baccalaureate degrees earned by women has remained relatively static, hovering around 20 percent for years, and (2) that despite the increase that we have seen over the past few decades of women engineers in the STEM workforce, women still account for only 13 percent of employed engineers. The U.S. has a major problem attracting women into engineering degree programs, and we recognize that as one of the driving factors behind our slow progress toward reaching gender parity in the engineering profession.

If we look at these same metrics in India, we see something quite different. In 1980, women earned less than 2 percent of engineering degrees, but since then, India has seen a growth in the number of engineering degrees earned by women. In 2018, the Ministry of Human Resource Development’s annual survey of higher education institutions in India found that over 31 percent of engineering and technology degrees awarded were earned by women.

While not exactly gender parity, this movement in the higher education sector is significant. Studies have found that the “chilly climate” that women engineering students face in the U.S. does not seem to be an issue for women in India. The problems they face really begin after university.

First, it is important to note that the number of employed women across India is decreasing. According to a recent article in The Economist, the most recent employment rate of women in India has fallen to 26 percent. The societal expectations for women across all socioeconomic levels keep many women out of the workforce, including women engineers. Only 12.7 percent of working engineers in India are women. The unemployment rate for women with engineering degrees in some parts of India is about five times higher than the unemployment rate for men. Nationally, the unemployment rate for women engineers in India is about 40 percent.

Second, employed women in STEM face unequal treatment in the workforce. Few women engineers in the private sector are promoted into higher ranks. Few women receive awards or are elected...
to the National Academy of Sciences. It is this unequal treatment of women engineers in the workplace that we sought to better understand through our gender bias research. By highlighting the existence and impact of bias in the workplace, we aim to encourage organizations to address the biases that are causing inequities in the engineering profession.

THE PATTERNS OF UNCONSCIOUS GENDER BIAS IN THE WORKPLACE

Understanding the impact of unconscious bias in the workplace is important, as is understanding and changing the root causes of biased behavior. This is discussed in greater detail elsewhere in this publication (see the article “What Research Tells Us About Diversity Training”). Researcher Margo Monteith, Ph.D., says in the article, “Stereotypes are so ingrained in our culture, they become a habitual way of responding. The role of motivated self-regulation really is about breaking a bad habit.” We all possess these biases, and they influence our interactions, behaviors, and decisions. To address this, we must first recognize that we hold these biases so that we can mitigate the impact that they can have on those we work with and those who report to us.

For the research study in India, we followed a similar methodology and framework as that used in the U.S. study to allow for some comparisons to be made. Joan C. Williams has identified four basic patterns of bias that we framed our study around:

- **Prove-It-Again** centers on the need to continue to prove yourself over and over again, despite past achievements and level of expertise. Prior studies on unconscious bias have shown that women often have to work twice as hard to be seen as equally competent to their male counterparts. This bias has also been documented in other areas, including age, race, sexual orientation, and disability status.
- **Tightrope** describes the need to behave in masculine ways to be perceived as competent, while still being expected to maintain your femininity. Those who experience this bias walk a tightrope between being seen as too feminine to be competent and too masculine to be likable.
- **Maternal Wall** concerns the biases that are held against women with children. In some cases, their commitment and competence are questioned, and they are denied access to opportunities that women without children and men (regardless of whether they have children or not) are offered.
- **Tug of War** involves the competition that can exist among women in organizations. For those in male-dominated professions, this bias can manifest itself as a fight for the “woman’s spot.”

Given the social science research that has been conducted on gender bias in engineering, as well as reports of gender inequities in India, we expected to find the existence of the four patterns of bias in

Figure 1: Bias Reported by Men and Women Engineers in India

<table>
<thead>
<tr>
<th>Bias</th>
<th>Men</th>
<th>Women</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prove-It-Again</td>
<td>76%</td>
<td></td>
</tr>
<tr>
<td>Tightrope</td>
<td>77%</td>
<td></td>
</tr>
<tr>
<td>Maternal Wall</td>
<td>68%</td>
<td></td>
</tr>
<tr>
<td>Promotions</td>
<td>77%</td>
<td></td>
</tr>
<tr>
<td>Performance Evaluations</td>
<td>67%</td>
<td></td>
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<tr>
<td>Assignments</td>
<td>74%</td>
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</tr>
<tr>
<td>Sponsorship</td>
<td>76%</td>
<td></td>
</tr>
<tr>
<td>Compensation</td>
<td>78%</td>
<td></td>
</tr>
<tr>
<td>Belonging</td>
<td>55%</td>
<td></td>
</tr>
<tr>
<td>Exclusion</td>
<td>58%</td>
<td></td>
</tr>
</tbody>
</table>
the engineering workplace in our study of Indian engineers. We were surprised, however, that many of these biases and stereotypes are experienced at similar levels by both men and women engineers in India.

METHODOLOGY
The Workplace Experiences Survey, the instrument we used in the U.S. study to look at objective measures of workplace gender and racial bias, was customized based on feedback from focus groups of engineers in India to allow for applicability for an Indian audience. This survey allowed us to ask engineers in India about their personal experiences in their careers and compare the responses of men and women engineers. Through our growing network in India, we reached out to engineers from across various disciplines and industries. The survey contained questions about workplace processes, including pay, promotions, and performance evaluations, to see if female engineers believe that gender bias has an impact on these decisions and, in turn, their career advancement opportunities within their organizations. The survey also included a handful of open-ended questions that allowed respondents to offer personal examples and feedback about gender bias in their workplaces.

Acknowledging our position as American researchers studying the experiences of engineers in a different country, we recognized the need for local expertise to assist us with this research. In addition to the focus groups that we conducted prior to launching the survey, we invited two academic researchers from India to assist us with the survey development and data analysis.

Almost 700 engineers working in India for Western companies responded to our survey, with a gender split of about 60/40 (women/men). Engineers with at least two years of experience in the profession were eligible to participate. All responses were obtained anonymously. In addition to demographic questions, the survey included questions measured on a Likert scale (strongly disagree to strongly agree) that we dichotomized to ease comparison between engineers who “agree” and “disagree” with each statement. Most of these questions were categorized under the four bias patterns, allowing us to develop a composite variable (or scale) to report a percentage of people who experienced each bias type. Unfortunately, we were unable to do this for the U.S. study, so comparisons and contrasts between the India and U.S. results are limited. What we could see was whether the difference in reported bias by men and women engineers in India mirrored that seen in the U.S., where women reported much higher levels of bias in the workplace than their white male counterparts.

In addition to the quantitative data collected, we utilized the qualitative data obtained from our focus groups and from the comments left on the online survey. These data allow us to provide context for the quantitative results.

RESULTS
As mentioned earlier, the most surprising finding was the level of workplace bias experienced by both men and women engineers in India (Figure 1). The Prove-It-Again, Tightrope, and Maternal Wall bias patterns were experienced by a large percentage of
both men and women engineers. Over 75 percent of engineers also reported bias in promotion, sponsorship and mentoring programs, and compensation decisions, while 67 percent of engineers reported bias in performance evaluations. More than half of respondents reported feeling excluded by their colleagues and not feeling a strong sense of belonging in their organizations.

Why are men reporting high levels of bias in India? We cannot say for certain, but based on the data received from our focus groups and survey, we hypothesize that while the bias experienced by women in India is based primarily on gender, the bias men are facing is based on other factors, such as race, region of origin, language, or nationality. We did ask about these factors in the survey, but our ability to dig more deeply to understand the underlying cause of these bias experiences by men is limited because our survey was not structured to allow for investigation into non-gender-related biases.

However, we were able to look more closely at the four bias patterns in relation to gender.

**PROVE-IT-AGAIN**

"Male colleagues ask me more questions and wish to detract me more. I have to prove it to them that I know what I am doing and that I have done my homework."

The Prove-It-Again bias scale included questions that asked about having to prove yourself over and over, or work harder to receive the same level of recognition or respect as your colleagues, and having your ideas "stolen" when others take credit. A high level of Prove-It-Again bias was reported by both men and women engineers in India, with 76 percent reporting experiencing this bias in their workplace. The percentages of both men and women engineers is similar to the percentages of U.S. women engineers who reported Prove-It-Again bias in the U.S. study (Figure 2).

Using regression analysis, we were able to examine the relationship between each bias pattern and workplace processes and outcomes. This allows us to tie the existence of bias in the workplace to retention indicators, which can be helpful to organizations striving to retain diverse talent. An increase in reported Prove-It-Again bias was associated with:
- A decrease in feelings of belonging at work
- A decrease in career satisfaction
- An increase in reporting that they are considering looking for a new job elsewhere

**TIGHTROPE**

"I never used to speak up so my manager used to take the credit. It felt bad. But when I started to speak up, it was seen as bossing around."

Tightrope bias typically focuses on gender. Women are often expected to take on specific roles at work: to be submissive, supportive, and nonassertive, which makes them less likely to be seen as leaders. When they act assertively, they can experience backlash for such behavior. The Tightrope bias scale included questions about being interrupted frequently, being delegated to perform more administrative-type tasks, and being able to express anger at work.
While both men and women engineers in India reported similar levels of Tightrope bias as that reported by U.S. women engineers (Figure 3), there were a couple of questions where gender differences were apparent. When asked if respondents felt pressure to play a traditionally feminine role in the workplace, such as office party planner or meeting note taker, 45 percent of women agreed versus 30 percent of men. Also, when asked about whether it is inappropriate for women to argue at work, even if it is business related, 45 percent of women agreed compared with 28 percent of men. This indicates that women feel less able to express certain emotions in the workplace, and men are unaware of this constraint.

An increase in reported Tightrope bias was associated with:
- A decrease in seeing a clear path for advancement for yourself at your organization
- A decrease in perceptions that the assignment process was fair
- An increase in feeling excluded at work

MATERNAL WALL

“Men take pride in boasting about the long hours that they put in, it is viewed as a good thing, but if women say the same it is viewed as being ambitious while compromising on family.”

Survey questions under the Maternal Wall bias focused on the expectations placed on women to be homemakers and men to be breadwinners. Women are often expected to take on the family-care responsibilities, whether caring for children, parents, or the home.

In our study, 40 percent of women and men engineers agreed that there is an attitude in their workplace that mothers should work less because they should be caring for children. Also, 27 percent of women and men engineers said that their colleagues think that fathers should work more after having children. These expectations are in line with traditional gender roles, with mothers expected to be at home with the children and fathers expected to work longer hours to support the family.

When asked about caregiving responsibilities, 71 percent of women engineers and 69 percent of men engineers agreed that those with caregiving responsibilities have a harder time getting ahead. Differences were seen between men’s and women’s responses when asked about flexible work arrangements, with 60 percent of women engineers versus 51 percent of men engineers saying that they would have trouble obtaining flexible work arrangements for family care.

A significant difference between gendered responses was seen in response to a question about people without children. When asked whether they are expected to work longer hours because they don’t have children, 50 percent of men engineers and 39 percent of women engineers agreed. This is the opposite of what was seen in the U.S., where more women engineers than men engineers agreed with this statement (Figure 4). This may be due to cultural differences, as the stereotype in the U.S. about women without children is that they have no other responsibilities, whereas in India, women are expected to care for parents, in-laws, and manage the home. In other words, it is men without
An increase in Maternal Wall bias was associated with:
• A decrease in perceptions that diversity is supported in the workplace
• An increase in feeling excluded at work

TUG OF WAR
“Women will say that another woman was promoted because of her looks.”

Tug of War bias focuses on conflicts among women in the workplace. This bias occurs when women are judgmental of one another, or compete against one another for a perceived “woman’s slot” in the office.

In our U.S. study, many women did not report experiencing this particular bias. Rather, they felt that the bigger problem was that there weren’t enough women, with some indicating the existence of a “Boys’ Club” environment in their workplace. While this did come up in the India focus groups, what was striking was that only 42 percent of women engineers in our survey agreed that their female colleagues generally support one another.

Delving more deeply, we asked about the Tug of War bias based on age differences. In India, 63 percent of more junior women reported feeling as though more senior women have assimilated to the way men do things and are not doing enough to change things to help women feel more comfortable. On the flip side, more senior women reported feeling like more junior women don’t understand what it takes to succeed as an engineer. These figures were much higher than those seen by engineers in the U.S. (Figure 5).

An increase in Tug of War bias was associated with:
• A decrease in belonging
• An increase in feeling excluded at work
• An increase in reporting that they are considering looking for a new job elsewhere

THE SHOPS AND ESTABLISHMENTS ACT
India has a law in place that limits the permissible working hours of female employees. The Shops and Establishments Act (SEA) includes measures to address the safety of working women. Women can work late nights if permission is given by the state. Approval is based on the woman’s employer meeting certain requirements, including providing adequate security and ensuring that women can get home safely at night. For companies that do not provide this level of security, the women who work there must leave by a certain time in the evening.

In our study, 57.5 percent of respondents reported working for companies that require them to leave by a certain hour. In exploring the positive and negative consequences of this policy, we found that women overwhelmingly reported feeling safer because of this policy. However, women engineers did report nonsafety concerns associated with the policy, with 17 percent feeling that the policy jeopardizes their opportunities for advancement, 14 percent reporting that they are forced to miss out on business opportunities, and 11 percent reporting that they feel undermined in front of their co-workers, as some must be escorted off the premises by security at the appropriate hour.

CONCLUSION AND RECOMMENDATIONS
This study is unique, and perhaps the first of its kind in India, because the findings are based on real-world experiences of working engineers.
While we learned a great deal from this research, we walked away with more questions. We expected to see high levels of reported bias from women in India, but the high levels of reported bias from men was surprising. After further research into potential causes, we theorize that because most (if not all) engineers in our study were employed at Western companies, and that men are more likely to move for employment than women, the biases reported by men are likely due to regional biases that were beyond the scope of our study.

Women in our study did report more bias based on parenthood than men, and women in India expressed much more conflict among women than that seen in the U.S. Associating bias with workplace processes and outcomes allowed us to show the impact that experiencing bias at work can have on business outcomes for employees. When employees face bias in the workplace, they feel less engaged, are less satisfied with their jobs, and are more likely to consider leaving. We see these outcomes from both men and women engineers in India.

How can companies address these biases that threaten their efforts to develop a more diverse workforce? One way is to ensure that clear policies regarding workplace processes are in place. Employee perceptions of fairness and equity are important, and clear and transparent policies can go a long way toward making employees feel confident that decisions affecting their career advancement are being made based on merit.

Relating to clear policies, companies should also make sure that employees understand that supporting diversity is a priority for the company. This requires a financial investment as well as support staff for diversity efforts, and ensuring that employees can easily participate.

Additionally, organizations can take a systemic approach toward addressing bias in their workplace processes. This approach involves understanding the unique problems that exist in your workplace, identifying the outcomes you want to improve, and taking incremental steps to mitigate bias. Addressing these issues is an iterative process and takes time, but continuous monitoring is required if changes are to be effective.

To download the full report, visit https://research.swe.org/.

This research project was made possible by the Society of Women Engineers’ Corporate Partnership Council.

About WLL
The Center for WorkLife Law (WLL), based at the University of California, Hastings College of the Law, is a nonprofit organization dedicated to measuring and documenting implicit bias in the workplace, with a focus on how bias differs depending on gender and race. For more information about the Center, please visit https://worklifelaw.org/.

Endnotes
10 Neeti Sanan, Ph.D., from the Indian Institute of Management Udaipur, and Mridul Maheshwari, Ph.D., from the Indian Institute of Management Kashipur, provided guidance throughout the study.
Title IX Still on the Brink

Women’s rights proponents hope the public’s comments can somehow change what they see as the Trump administration’s proposals to gut Title IX law.

By Sandra Guy, SWE Contributor

The Trump administration’s proposed Title IX overhaul would require K-12 schools, colleges, and universities to ignore sexual harassment until the harassment becomes so bad, a student wouldn’t feel safe to attend class or drops out of school altogether, according to legal experts.

Title IX is a federal civil rights law that prohibits discrimination on the basis of sex in any education program or activity that receives federal funding. Discrimination on the basis of sex can include rape, sexual assault, or other types of sexual harassment.

“[The Trump administration’s proposed revisions] ignore that a majority of sexual harassment is not reported; that 30 percent of survivors drop out of college; and that when girls and students have to face their harasser or their rapist at school or in their classrooms, they often no longer feel safe,” said Shiwali Patel, J.D., senior counsel for the National Women’s Law Center, a Washington, D.C.-based nonprofit group that advocates the rights of girls and women through litigation and policy initiatives.

“They may feel forced to miss classes or drop out altogether.”

The Trump administration would change the definition of sexual harassment — “with the effect of giving schools enormous liability protections,” said Osub Ahmed, a policy analyst for women’s health and rights for the Center for American Progress, a Washington, D.C.-based public policy research and advocacy organization.

According to the Obama administration, sexual harassment is defined as: “Unwelcome conduct of a sexual nature.” The Trump administration proposal defines it as: “Unwelcome conduct on the basis of sex that is so severe, pervasive, and objectively offensive that it effectively denies a person equal access to the recipient’s education program or activity.”

“The proposal would undo a lot of the progress to advance gender equity and to ensure that victims of sexual assault — about one in five women and nearly one in 18 men — have access to the resources they need to pursue justice,” Ahmed said.

The change also would hurt LGBTQIA students, who experience sexual harassment at a disproportionately higher rate than their peers, said Anne Hedgepeth, director of federal policy for the American Association of University Women (AAUW).

Hedgepeth, Ahmed, and Patel say just about every detail of the Trump administration’s Title IX redo, served up by U.S. Secretary of Education Betsy DeVos, would do untold harm to sexual assault and harassment victims.

The other major areas of concern include:

- Sexual harassment would have to take place on campus — thereby excluding harassment that’s conducted online on a personal computer or at extracurricular activities not sanctioned by the university. That would open enormous exemptions to the numbers and types of harassment that a school could act upon.
- Trump’s proposed reporting process would require students to report their assault to the specific school official responsible for Title IX oversight. Here is the directive: In order for a
school to be held liable for a Title IX violation, a student must report his or her assault to a Title IX coordinator or a school official “with authority to institute corrective measures.”

Under the current guidance, students can report their sexual assault to almost any school employee, including faculty or advisers, and a school is required to investigate when it “knows or reasonably should know” about a possible sexual assault.

“[Under the proposed changes], schools would be allowed to ignore harassment simply because a student didn’t submit [his or her grievance] to the right person,” Patel said. “Many students, particularly K-12 students, don’t know who the Title IX coordinator is. Many adults don’t know.

“In K-12 education, who is the most likely person a child would tell? Probably a teacher’s aide or someone who is close enough to the student that they’re trusted. Yet the teacher’s aide isn’t the one with authority. So if a teacher’s aide who receives a report of sexual abuse doesn’t say anything, the school is not liable.”

In fact, the proposed rule would require sexual assault or abuse survivors or Title IX coordinators to produce and sign a formal document about the assault for the school to begin an investigation. The Title IX redo would also let survivors and accused students have advisers who would conduct a cross-examination.

Additionally, either party could request that “cross-examination to occur, with the parties located in separate rooms with technology enabling the decision-maker and parties to simultaneously see and hear the party answering questions.”

Live hearings and cross-examinations are not mandated for any other student-conduct issue, Patel said. “Why create these separate processes that re-traumatize victims and make it harder for them to come forward, particularly when they’re unnecessary?” she said. “Schools can offer other ways for parties to obtain information from each other.”

“Permissioning victims to be cross-examined or questioned in a live hearing is highly problematic,” Ahmed said. “Such a move is likely to undermine

“The proposal would undo a lot of the progress to advance gender equity and to ensure that victims of sexual assault — about one in five women and nearly one in 18 men — have access to the resources they need to pursue justice.”

— Osub Ahmed, policy analyst, Center for American Progress

“We still want people to make their voices heard, whether that’s by writing letters to the local newspaper or making their concerns known with their schools and school boards.”

— Anne Hedgepeth, director of federal policy, American Association of University Women
the rights and safety of victims and contribute to a hostile environment, in direct contradiction to the purpose and spirit of Title IX.”

The Trump administration proposal also would give schools a broader exemption from Title IX responsibility due to religious reasons.

According to the Center for American Progress, “Under current guidance, schools are permitted to claim religious exemptions from certain Title IX provisions, such as admissions of certain students or counseling services, but must submit a letter to the U.S. Department of Education requesting specific exemptions...The new rule will no longer require schools seeking religious exemptions to submit such a letter, explaining that ‘even if an institution has not sought assurance of its exemption, the institution may still invoke its religious exemption during the course of any investigation pursued against the institution by the Department [of Education].’”

The National Women’s Law Center says, under the proposed change, “schools could come up with a religious excuse justifying their discriminatory action after the fact, once they are already under investigation for violating Title IX. Students and families would not know in advance whether the student’s school is claiming the right to discriminate against them without any liability.”

Schools would be required to use a more demanding standard to investigate sexual harassment. The proposed rules also could make it more difficult to kick off campus a harasser or attacker. That’s because the proposed changes let schools choose between a “preponderance of the evidence” standard of proof and a higher “clear and convincing” standard when determining guilt.

That’s a clear shift from the Obama administration’s 2011 guidance that identified the preponderance of the evidence standard as the correct standard of proof in campus sexual misconduct cases.

“The proposed rule would bolster the rights of accused students,” Patel said. “These changes tap into a sentiment — which President Donald Trump’s rhetoric against the #MeToo movement has stoked — that men have suddenly been put on trial without due process.

“For instance, the proposed rule underscores the importance of the presumption of innocence,” Patel said. “That would mean schools would start with the presumption that the reported harassment did not occur, exacerbating the rape myth that women and girls ‘lie’ about sexual assault, when in fact, most don’t even report it.”

The rule also requires schools to conduct individualized risk and safety assessments before removing an accused student from campus and allow the accused to immediately challenge their removal.

Though the deadline to comment on the proposed changes to Title IX has passed, AAUW’s Hedgepeth said there may yet be another opportunity for opponents to comment if and when the Trump administration issues a final rule for Title IX.

“We still want people to make their voices heard, whether that’s by writing letters to the local newspaper or making their concerns known with their schools and school boards,” Hedgepeth said. 

Comments can be submitted at nwlc.org/respectstudents or at https://www.regulations.gov/.
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SWE has once again taken on the enormous task of summarizing a year’s worth of broad-ranging, compelling, and timely research about women in engineering, presented in this issue of SWE Magazine. Now in its 17th installment, the literature review offers a summary and discussion of the most significant scientific research on women in engineering and STEM published in the past year, from almost 200 articles, conference papers, and books covering a variety of disciplines. Our literature review team looked at the most rigorous studies using the best scientific methods, as well as studies that offered new and important insights. The literature review authors also draw attention to areas of disagreement that future research needs to resolve, to neglected areas of inquiry where more research is needed, and to areas that have been the subject of research over time and where consensus has emerged.

Among the focus areas in this year’s State of Women in Engineering issue are the factors that lead men to become allies in gender diversity. The feature article “What Motivates Men to Champion Gender Diversity?” is followed by a review of the available literature on male allies promoting gender equality in the university and across various industries. This is certain to offer valuable insights and information.

We also take a careful look at diversity training, including a meta-analysis of more than 40 years of diversity training (yes, 40 years!) in the article “What Research Tells Us About Diversity Training.” A useful infographic is provided with key points gleaned from the wealth of information reviewed, as well as interviews with experts, including the lead author of the meta-analysis.

Additionally, we look at SWE’s gender bias in India study, which has been reported on in the Indian media and shared at the State of Women in Engineering presentation at WE18 in Minneapolis last fall.

Finally, we take a look at recent guidelines from the U.S. Department of Education and some of the concerns raised about the Title IX update.

We encourage you to become familiar with the wealth of information provided here. Our State of Women in Engineering issue is an important tool on the path of fulfilling the SWE mission and achieving a diverse engineering workforce. Thank you for your help in this endeavor.

Penny Wirsing, F.SWE
FY19 SWE President

Karen Horting, CAE
Executive Director & CEO

A Wealth of Information