

GENDER

Why Do So Many Women Who Study Engineering Leave the Field?

by Susan S. Silbey

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Engineering is the most male-dominated field in STEM. It may perhaps be the most male-dominated profession in the U.S., with women making up only 13% of the engineering workforce.

For decades, to attract more women to the field, engineering educators have focused on curriculum reform (e.g., by promoting girls' interest in math and science). While these efforts have brought in more women to study engineering, the problem is that many quit during and after school. Focusing solely on education doesn't address the fact that women tend to *leave* the profession at a higher rate than men. Women make up 20% of engineering graduates, but it's been estimated that nearly 40% of women who earn engineering degrees either quit or never enter the profession. Clearly, some elementary and high school reforms are working, but those at the college level are not.

So why do women who study engineering leave to pursue careers in other fields? We explored how the culture within engineering—the shared values, beliefs, and norms—might contribute to the under-representation of women in the profession. My colleagues Carroll Seron (UC Irvine), Erin Cech (University of Michigan), Brian Rubineau (McGill), and I conducted a longitudinal study of engineering students to see how “socialization,” or learning about the culture of engineering, affects their future job decisions. We found that female students do as well or better than male students in school—but often point to the hegemonic masculine culture of engineering itself as a reason for leaving.

Beginning in 2003 we have been following 700 engineering students across four schools—MIT, UMass, Olin College of Engineering, and the women-only Picker Engineering Program at Smith College. Although our sample is not representative of all engineering students, the variety of schools (elite private college, public land-grant institution, engineering-only college, and single-sex college) let us examine different approaches to engineering education.

We surveyed these students yearly during their four years of college and then again five years after they graduated, asking them about their interactions with other students and teachers in classes and on projects, how they felt about the college culture, and what their occupational and family expectations were for the future. We also collected personal diary entries from 40 of these students (19 men, 21 women), who wrote to us at least twice a month about the educational and career decisions they were making. (We offered each student \$100 per month to participate in the diary writing over the course of the 4 years, and we received more than 3,300 entries.) In addition, we interviewed 100 students (38 men, 62 women) during both their freshman and senior years.

Why men and women enter engineering

We found that men and women had similar reasons for enrolling in engineering. They describe being good at math and science in high school and wanting interesting, well-paid professional opportunities in the future. However, women, more often than men, add that they want to become socially responsible engineers, working to solve major problems and making a difference in people's lives—which is consistent with other research showing that women are significantly more likely than their male counterparts to be interested in engineering work that is “socially conscious” (i.e., specializations such as environmental vs. electrical engineering). For example, in our study, Juliette and Graciela (all names have been changed) wrote that they wanted to use their engineering skills to improve the situations of their countries of origin in Africa and Latin America. Megan, echoing others, hoped to use her engineering skills in “some type of humanitarian work.” This initial aspirational difference grew during their engineering education.

Throughout college, men and women succeeded equally in the classroom. However, we observed that women started to doubt their problem-solving abilities more than men. As Ashley described to us:

The biggest problem I seem to be having [is] self-doubt. I would look at a problem, and think of a way to solve it, but then I would second guess myself, and convince myself that my way of answering the question must be wrong, but then, it would turn out that I was correct the whole time. I don't understand why I keep doubting myself so much... Lack of confidence has never ever been a problem for me.

Women were also much more likely to look to others—teaching assistants, professors, and advisors—to affirm, and reaffirm, their confidence. Men did talk about doubting themselves, but they did not necessarily seek reassurance from others. We found that this search for positive cues carried over into expectations for feedback from supervisors in internships and jobs.

Why women start to change their minds

Each profession introduces students to its distinct culture, skills, language, practices, and values. Engineering students observe and practice these through group projects, where they learn how to think and act like engineers. They quickly discover that collaboration and teamwork constitute a core component of being an engineer.

For many women engineering students, however, their first encounter with collaboration is to be treated in gender stereotypical ways, mostly by their peers. While some initially described working in teams positively, many more reported negative experiences. When working with male classmates, for example, they often

spoke of being relegated to doing routine managerial and secretarial jobs, and of being excluded from the “real” engineering work. Kimberly wrote, “Two girls in a group had been working on the robot we were building in that class for hours, and the guys in their group came back in and within minutes had sentenced them to doing menial tasks while the guys went and had all the fun in the machine shop.”

There were also descriptions of being treated differently by professors. Rachel described when her team (the only all-girl team) won second place in a design competition: “Our professor wanted to get a picture of our prototype and us. We picked up our prototype and were all smiling and looking all professional; then he said: ‘You guys look like professional catalog models; this picture could go in a catalog and you could sell big time.’”

Men, on the other hand, described mandatory group design projects as exciting turning points, where theory and practice come together. “I made a pretty big stroke of progress last week,” one student wrote in his semi-monthly diary, “I ended up proving the professor wrong on something she had done last year, which actually helped us find better results (well, also more correct results)... It’s really a blast working on something like that.”

Exposure to the workplace causes concern

Internships and summer jobs provide students additional opportunities to “try on” the role of engineer—and the culture. We found that these work sites echoed the gender stereotyping experienced in school projects: men were assigned interesting problem-solving tasks where they could develop their analytic and technical skills, while women were often assigned jobs sorting papers, copying, collecting equipment, writing notes, and coordinating—tasks they felt did not value or cultivate their skills.

Almost without exception, men reported the experience of internships and summer jobs as a positive, often even a highlight of their education. Women's reports were not as uniformly positive. Of course, some women spoke highly of their internships, while others felt they were not given equal opportunities.

For example, Aurora described an early internship experience at a military defense contractor: "The environment was creepy, with older weirdo man engineers hitting on me all the time and a sexist infrastructure was in place that kept female interns shuffling papers while their oftentimes less experienced male counterparts had legitimate engineering assignments."

Rachel offered similar observations: "One thing that really bugs me about being an intern and a young girl is that the people whom I work with don't take me seriously. Not everyone does this, but a fair amount of the older men in my working environment do this. They'll treat me like I know nothing."

This second round of gender stereotyping in the workplace, coupled with unchallenging projects, blatant sexual harassment, and greater isolation from supportive networks, leads many female students to revisit their ambitions. Women begin to question whether engineering is what they really want to do. For example, Haley, Taylor, and Heather explicitly articulated worries that the career path looked too "boring" and "unfulfilling." Jennifer described how she was "seriously offended" when a supervisor spoke to her about appropriate dress, reminding her "No tank tops, now. We wouldn't want to distract the guys." Another student wrote,

But, one thing that really bugs me about being an intern and a young girl is that the people whom I work with don't take me seriously. Not everyone does this, but a fair amount of the older men in my working environment do this. They'll treat me like I know nothing... What they don't know is that I have a 3.7 GPA... I never used to really care, but now when it interferes with my profession, it just irritates me.

Further, many women discover in their internships that the engineering profession is not as open to being socially responsible or as dedicated to tackling pressing national and global problems as they had hoped. This is a result of the assignments they are given, the values that are supported, and the messages that are communicated to them.

Our recent work helps explain why some women who go to college intending to be engineers end up leaving the profession before even starting their careers. Of course, not all of the men we studied decided to pursue engineering careers, but they wrote that they appreciated the tools that their education gave them. Women's experience of their education differed along two critical dimensions – they encountered a culture where sexism and stereotypes were left unaddressed, and they saw only lip service offered toward improving society—and both of these disproportionately alienated them.

The number of women and men are nearly equal in law and medicine, and the number of women in basic sciences is growing annually. With such a low proportion of female engineers nationally, educators and businesses need to pay more attention to how an occupation founded on a commitment to complex problem-solving so consistently fails to repair its well-documented gender problem.

Efforts focused only on changing the curriculum are insufficient because they simply reproduce the norms and practices of the profession. In order to curb the high rates of women leaving the field, engineering programs need to address gendered tasking and expectations among teams, in class and at internship work sites. The culture has to learn to take women seriously.

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Jamie Bruckner 6 months ago

Actually math is only one part of all the engineering fields. It's been my experience in the aerospace field that women are horrible at this type of engineering. They fall flat on their face when it comes to detail design. Why is that... well I'll tell you... Women do not spend time in their youth taking things apart, putting them back together and other such associated endeavors. Simple fact is that women are people centric, not mechanism centric. Women make fantastic chemists and bio researchers... in fact Bio Research is one field where women excel. Women are pushed toward engineering because they show math skills, by people who know nothing about engineering. In approximately 25 years I cannot name one instance where I had a good technical discussion concerning hardware on flight vehicles... not one time. I know one young woman who was doing 'Weights' engineering on a new aircraft program.. she was attractive and smart so she had the opportunity to use her 'looks' to her advantage if she chose to do so. One day she said she was bored out of her mind with engineering, with in a month of that conversation she left one of the biggest aerospace companies in the world to go to law school. Why would she do this... she is the perfect example of female psychology... people centric... she found it much more interesting to engage in interpersonal contact solving problems than doing mech engineering.

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