



Career Advice for Women and Men

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Role Models and Peers as a Social Vaccine to Enhance Women's Self-Concept in STEM

In 1998, I met a student in the undergraduate class I was teaching who stood head-and-shoulders above her peers academically. I learned that Jennifer had started college as an engineering major. Because she was mathematically talented and interested in engineering she was heavily recruited by the university, which was trying to increase enrollment of undergraduate women in engineering majors.

As a first-year student, Jen jumped into all her engineering prerequisites with motivation and enthusiasm. At first all was well, but she noticed that the numbers of women in her classes were significantly smaller than the numbers of men. As the semesters progressed and classes got more advanced, the women dwindled steadily. Pretty soon Jen was one of very few women among a sea of male students in every engineering class. She felt isolated and out of place. Most of her friends were in other majors. Although Jen was doing well in engineering, her motivation was ebbing. Without the motivation to fire her up, continuing on with engineering started becoming a chore.

After a lot of soul-searching, Jen switched to a psychology major in her junior year. That was when I met her. In hearing her story it was clear that Jen interpreted her switch in major as a personal decision that engineering was not for her. At the time she didn't have the language to understand that her "choice" was not free, but rather heavily constrained by the homogeneity of her learning environment. Jen's experience is similar to the story of many talented women who drop out of majors and careers in science, technology, engineering, and math (STEM). While her story is more common in departments where the gender composition is very skewed toward men (physical sciences, engineering, computer science), it is also

relevant to the life sciences, where the prototype of successful scientists continues to be male. And the more advanced one gets in the research track, the stronger the stereotype.

What Jen experienced is called *social identity threat*—feeling isolated, like a misfit, as if one doesn't belong in the academic community because of one's group membership (e.g., one's gender or race).^{1,2,3,4} Social identity threat and the related, better-known phenomenon *imposter syndrome* are especially likely to affect talented individuals who, despite objectively good performance, privately feel like imposters in their discipline, as if their success is a fluke and not driven by real ability.^{5,6} This phenomenon



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seems to be more common among women than men. Women who are talented in math and science may drop out of STEM because they believe, either consciously or unconsciously, that they don't belong in it. Looking in from the outside, people assume that these women are "opting out" of STEM out of free choice because they would rather be doing something else.⁷ We argue that what looks like a free choice is not truly free. It is, at best, a constrained choice made in an environment where one and one's gender or ethnic group is virtually invisible.

My research, with my collaborators, identifies interventions that inoculate talented girls and women against social identity threat and imposter syndrome. Our work shows that, analogous to biomedical vaccines that inoculate one's physical body against bacteria and viruses, exposure to own-group experts and peers acts as "social vaccines" that inoculate individuals' mind against noxious stereotypes.^{8,9,10}

Female Professors and Teachers in STEM Serve as Social Vaccines

One simple but powerful solution entails exposing students to female scientists, mathematicians, and engineers in the classroom. Meeting female experts enhances young

women's positive attitudes toward STEM and how much they value STEM fields and boosts their confidence and motivation to pursue careers in science and engineering. We came to this conclusion on the basis of longitudinal studies of adolescents and young adults taking science and math classes in middle school and college.^{9,11} We found that female students were more likely to relate to female professors relative to male professors in STEM. Greater identification with female professors made one's own success seem more attainable because young women could imagine following the same academic trajectory as their professor.

Interestingly, men's reactions to STEM in college were not influenced by their professor's gender. This gender difference suggests that because women are negatively stereotyped in math and science (in a way that men are not) having a same-sex math professor helps deflect negative stereotypes for female students but is not needed by male students.⁹

Media Exposure to Female Scientists and Engineers Also Serves as a Social Vaccine

Reading stories of successful female scientists and engineers has the same positive effect on young college women as face-to-face contact.⁹ Based on our findings, I recommend using coursework, guest speakers, and other means to showcase female scientists and innovators. For example, consider drawing students' attention to scientists and engineers who are responsible for some of the discoveries and innovations students learn in class—with special attention to female scientists and engineers. Consider inviting a female scientist as a guest speaker to your class. Consider connecting female students with internship opportunities in research labs headed by female PIs. These strategies showcase the expertise of female scientists and innovators, thereby undercutting the power of gender stereotypes.

An important take-away from our research is that ideal role models are female scientists who are easy to relate to, personable, and whose successes are framed as achievable by others. Superstars framed as exceptional and brilliant can be deflating because their success is viewed as out-of-reach.¹² Describe female scientists as real people who achieved success through a combination of talent, curiosity, hard work, and perseverance despite obstacles. This type of framing is more likely to make women's success be inspirational and attainable by others.¹²

Peer Mentors in STEM

While female professors and teachers serve as important role models from a distance, it may be difficult for students to have a sustained relationship with them once the course is over, especially at the undergraduate level. This is where peer mentors fill an important need. In our research we have been looking at whether having peer mentors in the first year of college sustains women's success and retention in STEM majors until graduation, and whether the gender of the mentor makes a difference.¹³ Our emerging findings show that having a mentor during the first year of college (regardless of the gender of that mentor) boosts self-confidence, performance expectations, and career aspirations among young women in STEM. In addition, having a *female* mentor is a bonus if the mentee feels a sense of connection with her mentor. The stronger the connection the mentee feels, the greater her sense of belonging in STEM, the more she likes and values STEM fields, and the more she wants to pursue an advanced degree and career in STEM. Feeling connected with a male mentor is not associated with these added benefits. We are keeping track of mentees every year until they graduate to assess the long-term impact of having a peer mentor in one's first year, which is typically a time of uncertainty. As a take-home message, provide peer mentors to young women entering STEM fields, especially in their first year of college. If possible, provide a female peer mentor.

Teamwork with a Critical Mass of Female Peers Acts as a Social Vaccine

Teamwork is ubiquitous in science and engineering, and individuals' success has a lot to do with well-functioning teams. For women in STEM, success and the risk of attrition is also affected by the gender composition of their teams. One solution is to allow young women to work in small teams with a high concentration of female peers even though they might be a numeric minority in the larger environment.

We conducted a study in STEM where we created small teams in which 75% of team members were women, 50% were women, or 25% were women.¹⁴ We measured how the team gender composition affected women's motivation, verbal participation, confidence, and career aspiration. We found that women felt less anxious when they worked in female-

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majority teams and gender parity teams compared with female-minority teams. This was particularly true for beginners. Women were able to deflect gender stereotypes and feel confident about their ability and committed to a STEM career after working in female-majority and gender-parity teams, but not female-minority teams. Finally, women “leaned in” and spoke up much more if they were assigned to female-majority teams compared with the other two teams. These data suggest that creating small teams with a high concentration of women in STEM fields is one way to keep women engaged and aspiring toward STEM careers. This matters especially for beginners.

Consider the Timing of These Interventions

The anecdote about my student Jennifer’s experience in STEM early in college highlights something important about the timing of effective interventions. Increasing contact with women scientists and engineers is particularly important at transition points in one’s academic training. Young people beginning a new chapter of their academic life are more likely to be vulnerable to self-doubt (especially if they are a small numeric minority) than advanced peers who have weathered the early years and figured out their place in this world. My research suggests that first-year female undergraduates benefit substantially more from seeing female scientists and experts in STEM than their peers who are juniors or seniors. Exposing less-experienced students to competent female role models in STEM promotes resilience and interest in pursuing STEM in the future. The same logic is likely to hold at every transition point in one’s early training: the transition to college, the transition to graduate school, and the transition to one’s first job. Like a vaccine, interventions that inoculate female students in those early transition years build their resilience to social identity threat and allow them to flourish. ■

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