Being Female in Science

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Article by Paige Brown Jarreau, with special thanks to Dr. Samuel Caddick for editing and re-writing this piece into existence.

Today is International Women's Day. There isn't a more fitting day to publish this article, which has been months in the making. This article was originally pitched to *EMBO Reports*, but for various reasons (including a critique that this article presents too many anecdotes without clear evidence that the examples represent what can be defendably defined as gender discrimination / harassment) the editors chose not to publish it. I have chosen to publish the article in full below, because I believe the voices of the women interviewed for this article speak for themselves and deserve to be heard.

I'd like to thank every woman who spoke up to make this article possible.

" **I'm** always a female scientist, I'm never just a scientist," said Caroline Simpson, an astronomer and professor in the Department of Physics at Florida International University. Simpson can count the number of women in her department of 27 faculty members on one hand.

Simpson regularly encounters gender stereotypes that affect her confidence, even as a successful female researcher. "The first time someone says something [sexist], you shrug it off," she said. "The second time someone says something, you shrug it off. The 90th time, you stop shrugging it off."

On the day that Simpson was interviewed for this article, she woke up to a sexist joke on Facebook posted by a male colleague. She spent the next two hours thinking about how to approach her colleague about the joke without reinforcing the stereotype that women overreact, she said. "It said something like: 'Newton's third law: For every male physicist's action, there is a female over-reaction,'" Simpson explained. "When I came into work today, I sat down to talk to him to explain that that was one of the most offensive things I've seen on Facebook. He was shocked. He had no idea, he said he thought it was 'ok' because he got it from a female scientist friend of his [...] if I hadn't said anything, he would never have realized what it was like from my perspective."

Stacey Lance, an associate research scientist at a large US state university, has a similar anecdote about oblivious male colleagues. "I was out having a drink with a few male colleagues," she explained. "I went to the bathroom, and when I came back, I came in on a conversation. It was clear that they had been discussing the appearance of a female graduate student." Lance said she ended up getting into and losing a 40-minute debate with her colleagues about why their commenting on the appearance of a female graduate student was inappropriate. Most of the men "didn't get it", Lance said, and they could not understand why she was offended.

There is growing recognition that a negative or "chilly" workplace climate-with regards to overt or subtle sexism, stereotype threat (Smith et al. 2015), gender bias and discrimination-has affected the success of women faculty in science (Settles *et al.* 2006; Clancy *et al.* 2014). At the root of such negative

environments are gender bias and stereotypes, both of which can result in discrimination (Moss-Racusin et al. 2012). In one study of elite women scientists from 1995, 73% reported some form of gender discrimination (Sonnert, 1995). In a straw poll conducted on Twitter for this article (Sidebar A), 50 out of 55 respondents said they felt they had been treated differently because of their gender.

It is natural to perceive instances of overt sexism as shocking but isolated events. But these events have subtler origins. In addition to overt instances of sexism, we must acknowledge and deal with gender-based stereotypes and bias as pervading psychological, structural, institutional and cultural issues. Mild instances of discrimination or even passive expressions of stereotypes can create hostile environments for women and minorities in science (*minorities including not only women, but women and men of color, LGBT individuals and those with disabilities). Even subtle and unintentional instances of gender discrimination can result in lowered self-confidence, decreased job satisfaction, and a sense of isolation for women in STEM fields. Previous studies have shown that stereotype threat (for example, the stereotype that males are generally better than females at solving math problems) can reduce women's performance on various STEM related tasks (Appel, Kronberger & Aronson, 2011). "There are formal and informal structural mechanisms (e.g., discrimination, limited networking) that provide women scientists with fewer opportunities and more obstacles in their career paths, leading to lowered success, satisfaction, and retention in science," write Isis Settles and colleagues in a paper they published in *Psychology of Women Quarterly* (Settles *et al.* 2006).

What follows are the personal experiences of some women in various scientific fields that range from overt instances of sexual harassment to subtle examples of bias or discrimination. The latter might not seem particularly harmful in isolation, but on a day-to-day basis, they add up to make life significantly more difficult for women and minorities in science.

From Gender Bias to Discrimination

elen Walden is a principal investigator at the University of Dundee MRC Protein Phosphorylation and Ubiquitylation Unit. In 2015, Walden was only the third female researcher ever to be awarded the Colworth Medal, an annual Biochemical Society Award recognizing outstanding research by an early career biochemist. But even with all of her successes, Walden is acutely aware of and outspoken about sexism and structural inequalities in the scientific and academic communities. She has personally experienced both overt and subtle forms of sexism and gender bias, as well as the negative impacts of academic policies that favor the promotion of men over women.

"We were known collectively as 'Gary's Girls'," Walden said of her time at the University of St. Andrews in Scotland, where she was one of four other PhD students in her lab, all of whom were female. "I have to say that when I was in my early 20's, I never even noticed that that was strange. It felt affectionate."

But as she moved on with her scientific career, Walden did begin to notice that things were said about women that would not be said about men. When she moved to Memphis, to St. Jude Children Hospital to do her postdoc, she had some professional issues with her lab group leader, who happened to be a woman. When she tried to talk to colleagues about these issues, she was met with blanket statements along the lines of 'that's just what women bosses are like'.

"I had not considered that the way she behaved was female *or* male behavior, it was just *her* behavior," Walden said. "I was surprised by the 'women bosses are bitches' mentality that went on. I have a really hard time with this idea that men and women are fundamentally different."

And yet there is a pervasive stereotype, held by many men and women alike, that women are more emotional in the workplace. A 2001 Gallup poll found that Americans associate the words "emotional," "affectionate," "talkative," "patient" and "creative" significantly more with women than with men, while they associate aggressiveness significantly more with men. Correcting this stereotype is hard, however. As Walden commented, people "feel threatened when you tell them that they are causing discrimination with their unconscious biases. Nobody wants to be called a sexist [...] Somehow we've reached a point where people are saying, 'well it's not me who's sexist,' and they are looking around at

others, as if they are the only ones who have figured out the magic formula of not having any prejudices."

While the majority of the sexist remarks Walden gets are "cartoonish," she says, other examples are more troubling. For example, a male colleague once told Walden he had decided against hiring women because, he argued, the European Research Council (ERC) doesn't make provisions on grants for maternity leave. Based on ERC Work Programe 2014 documentation, the ERC extends eligibility windows for applicants based on maternity leave, but no explicit provisions are made for funding duration based on maternity leave. "And this is my problem *why*?" Walden remembered thinking. "He should have taken this up with the councils that provide the funding. But simply by virtue of having boobs, I'm the one who gets told all of this. And I find *that* sexist."

A PhD student interviewed for this article, who wished to remain anonymous, had a similar experience: she was told by a potential PhD advisor that he was worried about a possible pregnancy getting in the way of her fieldwork. This student had made no mention of such a possibility to the advisor, but she was newly married. "It was humiliating," she said. "For him to think I would consider putting the logistics end of my fieldwork in jeopardy by having a kid and not being able to go to the field, or that that was something that couldn't be discussed, really horrified me. I think that if I was a male in the same situation, same age, married, the assumption would be: 'He will just figure it out.' But for me it was shoved in my face. And that was one of the major factors for why I decided not to take the position."

The Double Jeopardy Report from UC Hastings College of Law calls this the "prove-it-again" pattern: a stereotype that sets up an incongruity between being female and being a scientist such that women and other minorities must perform at a higher level than men to be seen as equally competent as men.

Walden believes much of the hardship for women pursuing careers in science comes down to the small things, including the gender stereotypes and the unconscious biases that make the white male "look more like a scientist" than the female, regardless of experience or performance. In a 2006 study of young children's perceptions of scientists, only 5 out of 30 students drew a female scientist when asked to draw a picture of a scientist (Buldu, 2006). Other "Draw-a-Scientist" tests have revealed similar patterns in gendered depictions of science and scientists.

"In all the stock photographs of women 'doing science,' they're always young and beautiful, in the lab," Walden said. "Whereas in the photos of men doing science, it's older men in front of a lecture theater or holding force while everyone is looking at him with rapt attention. It's like it's fine for the women to be in trainee roles. It's just not fine for them to be in leadership roles."

Being Female in the Field

A bby Lawson is a PhD candidate studying alligator population ecology to inform harvest decisions in South Carolina. When Lawson first started working on an alligator project at Clemson, with a research group that was predominantly male, she says she was very respectful in terms of safety. "Not having worked with a predator before, I definitely didn't want to overstep my boundaries or put anybody in unsafe situations," she said.

But when Lawson hired a male technician to help with her own alligator capture work, everything was different. "It was 'boom, boom, boom.' On my technician's third day, my collaborator said, 'Alright, I think that Mike [name changed] should hop on this next alligator, and we'll show him all the handling techniques.'" Lawson said. "I felt really foolish, because I had told [Mike] it was a *really* slow process to handle alligators, and that even I didn't do all parts of it."

Lawson was hurt that her collaborators, with whom she had been working for several years, had never invested in teaching her the more physical alligator capture skills up front. "I regretted not being more assertive and asking to be trained," Lawson said. "These collaborators were all men whom I respected and genuinely enjoyed working with. Looking back, they probably didn't even realize they were acting discriminatory."

Even with things like backing up a trailer or driving a boat in the field, Lawson says, her male colleagues tend to step in to complete these tasks without thinking or asking. "I think in fieldwork sometimes there's this sense of urgency, of 'no, we don't have time for you to take 40 minutes to back the trailer to the boat ramp, we need to go now,'" Lawson said. "And so I've started to, when I can, try to correct that, just deciding that no, I'm going to do this because it's going to save us time in the long run if everybody knows how to fulfill every role."

Lawson has even had trouble accessing certain sites for her alligator research because landowners are sometimes hesitant to grant access to a female-only crew. Lawson finds it is easier for her to obtain access if she has a male technician with her.

"As a female student, I feel like the type of sexism that we're warned about is mostly the blatant stereotypical kind that is actually the easiest to handle," Lawson said. "Like being accused of being on your period. That hardly ever happens, and if it does, it's corrected immediately," she said. "But I feel like it's the more subtle forms that are the real danger, and they aren't talked about enough."

Lawson says she thinks the struggles for women in science and especially for women working in male-dominated field environments will only change when there are more women in the field, and also more women in positions of power within the scientific community. "I can see how the cycle perpetuates," Lawson said. "I wonder whether if I had an all female crew, would that restrict my access to certain sites? It's *really* hard to accept that that's a legitimate concern I have. [...] But I do think [the cycle] is slowing down. It's a very slow cultural shift, but as there are more women in science, I think it won't be seen as this novelty anymore."

hristine Lee, an assistant professor of biological anthropology at California State University in Los Angeles, has been a trendsetter in terms of being the only woman on numerous bio-archeological digs. She studies the human skeletons that come from archeological excavations all over the world. But Lee admits that if she had known how uncomfortable some of the things she has experienced during fieldwork were going to be, she might not have ever gone. "If I had to tell myself when I was younger, 'you're going to have guys think that you'll sleep with anyone, you are going to have guys stare at your ass because you happen to be curvier,' I might not have done it."

Lee warns graduate students who come through her lab that archeological fieldwork in foreign countries can involve uncomfortable situations. "There can be sexual harassment. And no one ever believes it," Lee said. "It's really strange; students never think it will happen to them."

During her PhD studies, Lee traveled to Beijing for fieldwork and within the first month was sexually *assaulted at a banquet where she was the only woman sitting at a table with several high-ranking male professors. "Throughout the whole dinner, the professor sitting next to me [...] constantly put his hand on my thigh during the dinner, and I kept pulling his hand up and putting it back on the table, to the point that my colleagues knew something was wrong, but it never occurred to them what it could possibly be," she said. "The thought that a high-ranking professor from a foreign country would feel up a graduate student at a dinner never occurred to them."

After dinner, two professors Lee was working with in China asked her how she knew the foreign professor who had been apparently touching her at the table.

"I told the two professors that if that ever happened again, not only was I leaving and going back home, but I was going to tell everyone what happened and how they didn't take care of me," Lee said. "They were shocked, and said, 'No, no, we just didn't know what was happening. Now that we know, that will never happen again.' And it never did happen again. That professor was never invited back. But things like that are embarrassing and humiliating. And when other men are sitting there watching and they don't know what to do, you assume that they are in on it."

Recent research suggests that a high percentage of scientists engaged in field research, up to 64% according to a study published in PLOS (Clancy *et al.* 2014), experience sexual harassment at field

sites. And most of these scientists are students or early career researchers, and women.

"This is happening to them when they are trainees, when they are most vulnerable within the academic hierarchy," evolutionary biologist Katie Hinde and co-author of the PLOS study told NPR in July 2014. This might be a factor in the high attrition rate of young female scientists from fields such as archeology. Sexual harassment in the sciences can lead to lowered job satisfaction, decreased job commitment and productivity, withdrawal, lowered self-confidence and other psychological outcomes common with gender discrimination in general.

Working as a woman on archeological excavations in foreign countries brings its own set of unique gender-based challenges, Lee explained. She and accompanying graduate students often have to watch their own behavior very closely. "I usually end up being the only female, or one of only a few females," Lee said. "So there's a certain way I have to act, and behave, and dress [...] I try not to be noticed for being a woman, if I can, in the field, because I've learned that it is distracting, and I've been told it's distracting." Lee typically doesn't wear make-up, and wears baggy clothing, when working on excavations sites. The few times that she has worn make-up and professional clothing in the field, she has had male colleagues comment explicitly on her appearance in disconcerting ways.

One time, Lee "made the mistake" of wearing a colorful pair of underwear into the field. On excavation trips, Lee explains, everyone does their laundry together and all clothing is hung up on clotheslines to dry. "So it was really jarring that I had this one really frilly, lacy pair [of underpants]," Lee said. "And the guys were all talking around dinner, and I heard them saying, 'whose underwear do you think THAT is?' And I overheard one of them respond that it must be Christine's. I was like, what the hell?"

When Lee confronted the men about their conversation, they hesitantly told her they identified her underwear by her "curves."

"If you don't think of it as just being funny, it can be kind of rough," Lee said.

As an astronomer at the Carnegie Institution for Science, Johanna Teske also experiences field observatory work as particularly uncomfortable. "Sometimes, I am the only woman," Teske said. "I don't feel unsafe, but it makes me feel like I stand out." She avoids wearing skirts and dresses when conducting fieldwork. "It's not a super conscious thing, but it might have something to do with not wanting to stand out even more than I often already do," she said.

Increasingly, however, female scientists are realizing that this pressure to not "stand out" in a male-dominated environment is damaging to their self-confidence and power within the scientific community. For example, the creation of the #distractinglysexy hashtag after comments Tim Hunt was alleged to have made at the 2015 World Conference of Science Journalists was a means for young women to speak out against the sexist idea that they have somehow invited romantic or sexual advances or have been a distraction for their male colleagues.

Women with a Voice

A fter Lee was sexually *assaulted as a PhD student at a banquet during her fieldwork in China, it took her being angry enough to confront her colleagues about the incident for them to "get it," she said. Since then, she has learned that sometimes it takes verbal aggressiveness and even threats to ward off advances by male researchers.

But getting angry and speaking up can bring trouble, as women might be labeled as overly aggressive when they display assertiveness at the same time that men are evaluated positively for the same behaviors. Various studies have demonstrated that women are often judged harshly for displaying attributes that do not fit the stereotypes of their social roles-or that fit the stereotypical social roles of men (Eagly, 2004).

Stacey Lance experienced the trap of speaking up for herself when fighting for a salary equal to that of her male colleagues. When Lance realized she had accepted a salary that was much lower than that of

her peers, she prepared a letter to her lab director requesting a raise. "I had included data in my letter about the experience, productivity and salary of other people at my facility," Lance wrote in an online open-ended survey conducted for this article. "I included no negative comments about my colleagues, merely data. I ran the letter past several women colleagues who deal with women in science issues on their campuses, past a previous biology chair I had (male), and past my dad who was an executive VP at a large company. With their help I made sure I followed all of the 'rules' to not include emotions, just facts to make my argument."

But when Lance sent the letter to one of the interim directors who had asked to see it, she was told that the paragraph that included data would be viewed as too "aggressive."

"I don't know how that's possible," Lance said. "The data I included were salaries that were publicly available, data from people's CVs that were available, and data comparing public publication records and grant records. I was basically arguing that I wasn't earning what I deserved compared to the other people in my department, especially the men." Lance was eventually awarded a raise after sending a revised letter to the senior lab director.

Lance says her awareness of the issues facing women in science was further highlighted when a new lab director was appointed: he immediately set out to undo the damage done by the previous director. "The change in atmosphere was palpable when he came in," Lance said. "That emphasized to me how every woman's experience is going to be so different, just depending on where they end up and who ends up being ahead of them."

Micro-aggressions Build Up

Julie Libarkin is an associate professor of geoscience at Michigan State University and has experienced a range of sexism and sexual misconduct as a woman in science, from micro-aggressions to physical assault in workspaces.

"There's quite a bit of misogyny in my field," Libarkin said. "I've had male faculty colleagues say to women who are geology majors: 'You're a woman, you can't do geology. It's too hard on your body.' These are more subtle forms of sexism, but they make me an 'other.' They set me apart."

Other micro-aggressions Libarkin has experienced are things like male superiors telling her "now don't get emotional" before she has even spoken. "If you knew me, I'm not emotional," she said. But she faces outrageous misconceptions about the female body and the implications of being a woman on a regular basis.

Libarkin also gets regular comments about her body in professional settings. As a student, she had several male colleagues make overt sexual passes at her in field environments. She has written openly about her experiences on her blog, Geocognition Research Laboratory .

Like many women, I have experienced sexism and blatant sexual harassment within the scientific community. I would never advise someone to simply "put up with" harassment. I have to put up with harassment and my sense of belonging within science has diminished as a result." - Libarkin, in a letter published on her blog to the Science Career Editor about the retracted Ask Alice June 1, 2015 column

"It is debilitating to have to deal with these things," Libarkin said. "The blog post that I wrote [about my experiences with sexism] took me weeks to write, because it was a very emotionally charged thing for me. And some of these things you brush off. But some of these things are psychologically damaging. And I don't think that the scientific community recognizes how stressful it is to essentially come into a hostile environment when you are in certain spaces. That stress is something that I don't think scientists acknowledge. And I'm pretty successful, but it makes me want to quit. It does make me want to support women in science. And I think that people of color have a worse time, people with disabilities, anybody who is 'other' has a worse time, I think. So it makes me want to support 'other' people in science."

Libarkin has also, like many women in STEM fields, had her successes explained away by her gender. She has been told that it is easier for her to get grant funding or other opportunities because she is a woman. Even though funding in her area of research is relatively difficult to attain, colleagues have often used her gender as a rationale to explain away her funding success, she says.

Libarkin says it will take more speaking out on the part of upper administration to help resolve issues of sexism in academia. "I've heard a young female faculty member at a meeting say that she didn't think that one of the candidates for a position was good-that she was a fine researcher, but she had taken off some time to have a child and follow her husband to a position, so she couldn't be a serious researcher," Libarkin said. "And the department chair didn't say anything. That's not ok."

Stereotypes

Gender stereotypes about what women aren't good at, or even stereotypes about what they*are* good at, can have real impacts on the success of women in science fields, as related by "S" below. "S" wished to remain anonymous for this article. She currently works at a NASA-affiliated laboratory and says that in general she has a positive work environment, at least on the surface. But while she has the expertise and experience to be directly involved in research within her program, her bosses have encouraged her toward more supportive roles including program facilitation, research budget management and event organization. These are not the roles she would prefer to be filling for her institution.

"I think the fact that I'm a woman plays into how some people interact with me," S said. "I'm a scientist by training, I self-identify as a scientist, and I'm encouraged in such endeavors, but I get way more encouragement in support-style tasks than I do in my technical tasks. And I feel that a large part of that is that I am a woman. There are certain tasks that I'm asked to do that don't create dissonance with my gender. It's more normal to see a young woman taking notes or organizing meetings as opposed to speaking up with technical expertise."

S has also experienced more overt instances of sexism, including colleagues calling her "sweetheart" and directing all technical questions posed in her presence toward other men, even though she clearly has the education and expertise to answer them. But these negative experiences are not as common, or as frustrating, as is the blatant *encouragement* she gets to pursue supportive over technical program tasks.

S is not alone in experiencing focus on her support-oriented work, as opposed to her technical roles and skills. Research sponsored by the NSF ADVANCE program has shown that when it comes to awards and recognition in STEM fields, female scholars are over-represented among winners of awards for 'soft' contributions to their field, including service, mentoring and teaching, but under-represented among winners of scholarly research relative to their male colleagues (Cadwalader, Herbers & Popejoy, 2014). The gap is widest for awards in the field of mathematics and might be due to implicit stereotypes that guide what kind of roles and skills women are recognized for in science. It is a tricky issue to address because it does not involve active discouragement, but rather the lack of encouragement, or even the over-encouragement of women to pursue particular scientific roles that others believe 'fit' their gender.

However, this bias is more pernicious than simply encouraging 'appropriate' career paths for women. It can impact hiring decisions from the outset. A study published in PNAS in 2012 revealed that a nationwide sample of biology, chemistry and physics professors given mock application materials rated a student applicant for a lab manager position as less competent, and offered a lower starting salary, when the student was presented as female. What is more troubling is that this gender bias was observed among both male and female faculty members, suggesting that implicit or unconscious male-science stereotypes are to blame. There are pervasive cultural stereotypes that "portray women as less competent but simultaneously emphasize their warmth and likeability compared with men" (Moss-Racusin *et al.* 2012).

The study results, while shocking, might not be surprising to many female scientists who have struggled with gender discrimination or the threat of gender discrimination throughout their careers. "Many people, including myself, were largely unsurprised," Walden wrote in a 2013 Guardian article on the subject of sexual discrimination in science. "Several non-scientists found it hard to believe that the same CV could be evaluated so differently, and with such serious consequences in terms of pay and mentoring. Yet since the beginning of my career, I have always been acutely aware that I need to do better than a man to stand a chance of being hired ahead of him."

Where We Go from Here

G iven the clear issues of sexism, bias and discrimination that women face, even among highly educated colleagues, where do we go from here? How can we begin to break down gender stereotypes and promote women's sense of value as scientists?

Structural changes and transparency are a good starting point. Julie Libarkin believes that academic departments should make data about faculty course load assignments, service assignments, merit raises, salaries, resource allocations and productivity in terms of research and grants publicly available. That way, anyone could compare themselves to the data and clearly see any disparities based on gender, race, etc. "Why not be transparent, unless you have something to hide?" she said.

Many of the structural barriers that exist within scientific institutions affect women more than men. For example, provisions for maternity leave, flexible tenure deadlines and childcare support programs are often minimal or non-existent in academic programs and especially research grant packages. "It's very difficult for women to go for a career in science, or any profession, if they don't have this kind of family care support," said Beatriz Rico, a professor of developmental neurobiology at King's College in London. Rico is outspoken about the impacts of cultural biases and the need for women to speak up more about their goals and expertise. But even where these structural barriers are beginning to change, many women remain under the impression that having children and having a successful career in academic research are somehow at odds with one another. Gender-science stereotypes and stereotypes about what it takes to be a scientist are likely at play in these beliefs.

Changing the systems and structures alone is therefore not enough; we need to do more to address unconscious biases and social expectations. David Miller is a researcher in the department of psychology at Northwestern University, where his research has broadly encompassed gender and science. Miller, along with Alice Eagly and Marcia Linn, recently published a in the rigorous cross-national study *Journal of Educational Psychology* revealing that national gender-science stereotypes follow trends in women's representation in STEM fields. Gender-science stereotypes can come in two major flavors: explicit and implicit stereotypes. Researchers measure the explicit stereotypes by directly asking people how strongly they associate science or liberal arts with men or women. Implicit stereotypes are the subconscious reflections of culturally ingrained gender biases. These are measured by how quickly, in milliseconds, people can pair science-related words with male- or female-related words during a computer-based test.

The good news, according to Miller, Eagly and Linn's analysis of cross-sectional data from 350,000 participants in 66 nations, is that gender-science stereotypes *are* weaker in nations where women represent a greater percentage of those employed in STEM fields. The authors found that higher female enrollment in college-level science education predicts weaker explicit and implicit gender-science stereotypes among college-educated participants across these nations. Higher female employment in the researcher workforce, however, did not predict weaker implicit national stereotypes connecting science with men, likely because female researchers are less frequently encountered.

The bad news, Miller says, is that a nation's gender equity has only a minimal impact on the gender-science stereotypes its people endorse. Gender-science stereotypes are robust even in nations where the gender gap in STEM fields is narrow.

"Seeing examples of counter-stereotypical women can change our beliefs," Miller said. "But it's going

to be a slow process." The take-away is that exposure to counter-stereotypes specifically connecting science with women is necessary to shift gender-science stereotypes. But is taking a mathematics course from a female instructor sufficient to change culturally ingrained gender-science stereotypes? Not likely, Miller says. You can learn propositional information about women's representation in science, for example that almost 50% of college graduates in chemistry programs are women (most people guess something around 20%). And you may update your explicit gender-science stereotypes according to this information. But the underlying implicit stereotypes are much more difficult to shake. Miller suggests that we turn our efforts to the ways that female vs. male scientists are represented in cultural artifacts such as textbooks, TV shows, movies and media articles, because his research suggests it takes *repeated* exposure to gender-balanced representations of science to move implicit stereotypes that associate science with men. And for college students, repeated exposure to science classrooms with equal numbers of women and men might also be key.

But exposure to counter-stereotypes is not in and of itself a solution to gender-science stereotyping. It also often takes the *right* counter-stereotypes to meaningfully change opinions and women's identity with science. "If you don't identify with your professor, having a female professor can actually lead to small *increases* in [gendered] stereotyping of science," Miller said. "There is emerging research that addresses the attainability of role models. If you don't see the position and accomplishments of a role model as possible for yourself, that is not likely to change your aspirations and stereotypes in the same way."

This has important educational implications, Miller says. For example, in educational settings, Marie Curie may actually be a poor example of a female scientist role model. Having won two Nobel prizes, her accomplishments likely seem unattainable to most women just beginning their scientific careers. "That's more likely to demotivate rather than to motivate diverse scientists," Miller said.

Counter to the nature of many campaigns intended to guide girls toward careers in STEM, overly feminine science role models-for example wearing pink clothes and makeup and depicted as being into fashion-have also been found to demotivate young students (Betz & Sekaquaptewa, 2012). "Girls are already put to high standards in terms of beauty, that it's seen as almost unattainable to achieve both that and intellectual prowess or scientific achievement," Miller said.

It's important that we think about how young women will relate to the female scientist role models we serve up to them as proof that they too can "do it." Indeed, several studies have shown that relatable female science role models and mentors are instrumental to women's identification with science and commitment to science as a career path.

Johanna Teske, a postdoctoral research fellow at the Carnegie Institution for Science, emphasizes how important a role the female mentors in her graduate program played in guiding her toward a technical science field, something she might not otherwise have done. Teske is keenly aware that in her field of astronomy, many fewer women than men end up in theory-heavy or instrumentation-based research tracks.

"I bonded very strongly with another woman in my science field who was interested in instrumentation," Teske wrote in a survey response for this article. "This prompted me to consider a job with an instrumentation component, which I don't think I would have considered without her positive influence."

"I really do feel that finding strong female mentors - people who were not only female but who I got along with, because women aren't just automatically going to get along with other women - really kept me motivated," Teske said. "Not so much because I thought, if she can do it so can I, but more because I thought, here is a person who cares about me and wants me to succeed. So I think that for anyone coming into astronomy, but particularly for those who are not as well represented, it's really helpful to find a good mentor early on. Someone who is going to advocate for you, support you, but also let you make mistakes."

T he pressure to be a role model for younger female scientists can sometimes be taxing, even daunting, for female faculty struggling themselves to claim their space in a competitive research environment. But they might be encouraged by the fact that it's important for students to see their mentors and role models having a healthy work-life balance. "I think the female mentors that I connected with had a realistic work-life balance," Teske said. "They came in, they worked all day and were focused, but went home at the end of the day and didn't work at home, or did minimal work at home. They had outside interests and modeled not a life where you could 'have it all,' but where you could have a job and also have things that weren't your job."

Maria Mota, a group leader and Executive Director of Instituto de Medicina Molecular in Portugal whose lab studies the biology and physiology of malaria, says she doesn't want other women looking to her as a 'perfect' role model. "I don't want people to feel that I'm able to do everything, because it's not true," Mota said. "I don't feel that we should put this pressure in young girls that you have to be a superwoman to be a female scientist."

Caroline Simpson says that if she could change anything about her experience as a woman in science, it would be to get more scientific respect from her colleagues. "I have difficulty being taken seriously scientifically sometimes by my peers," Simpson said. "Most of them are parts of big research groups, or pulling in a lot of funding, which is difficult for my area of research."

What can male colleagues do to support their female colleagues? Simpson says it starts with not asking female colleagues to explain yet again the issues they face. "I'm expected to educate everybody else about the issues facing women in science," Simpson said. "But it's not my job to teach you about stereotype threat or unconscious bias. I've read all the papers, I've given talks on these subjects. But you are a grown-up, I'll give you words to Google, you can figure it out. Educate yourself. And call out your buddies when they say sexist things."

*Indicates update as of 3/8/2016 at 10pm central US time.

Corrections: A previous version of this article referred to an instance of unwanted touching / groping as sexual harassment, when this can more accurately be defined as sexual assault. According to WomensHealth.gov, sexual assault includes " fondling or unwanted touching above or under clothes." Thank you to a reader for pointing this out.

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