Calling for a Change in the STEM Climate

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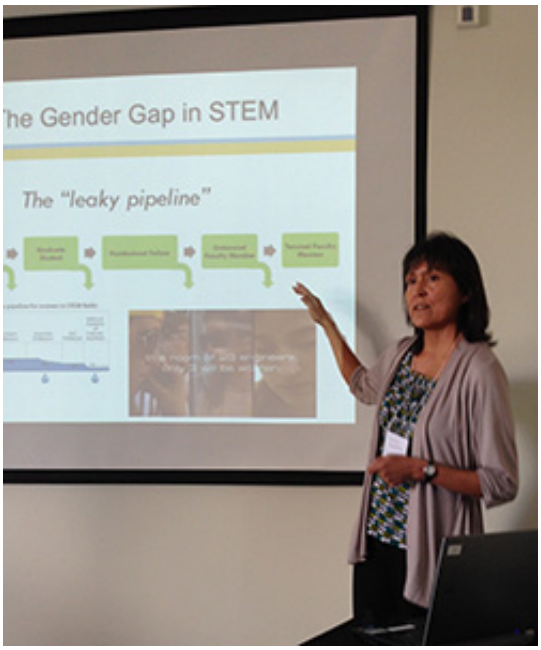

Denise Sekaquaptewa finds that women feel more welcome in STEM settings when they see more females represented in those male-dominated fields.

What accounts for women's lower participation in STEM (science, technology, engineering, and mathematics) compared to men? Discussion of this important topic has moved beyond the notion of gender differences in ability, and to some extent beyond women's "lack of interest" in or "choice" to avoid STEM. Instead, the conversation (and psychological research) has increasingly focused on external factors, including societal stereotypes about who has STEM ability and who doesn't. Of interest, these stereotypes are found to be heightened by features of the environment — the STEM settings in which women work and learn. Are there aspects of STEM environments that are turning women away, despite efforts to recruit and retain them? A focus on the nature of academic STEM environments — or climates — is important precisely because features of settings can be changed, and probably changed more readily than stereotypes can be.

Stereotypes

At a broad level, stereotypes — in this case, our schemas about science and scientists — serve as a strong influence on participation in STEM. This influence goes far beyond acceptance of stereotypes. Although it is certainly true that a woman who endorses the belief that "women are not good at science" may likely avoid science, recent work shows that even women who do not explicitly endorse stereotypes can be negatively influenced by them when they are held implicitly. For example, then-graduate student

Amy Kiefer and I found that among college women enrolled in calculus courses, the higher their implicit gender-math stereotypes, the lower their final exam scores, particularly among women who strongly identified with their gender, perhaps because the stereotypes seemed most salient and self-relevant to these women.

A report on women in academic science by Stephen J. Ceci, Donna K. Ginther, Shulamit Kahn, and Wendy M. Williams will appear in *Psychological Science in the Public Interest* later in 2014.

Research on stereotype threat shows that we can be negatively affected just by the awareness that others hold negative stereotypes about our group's ability in a domain, regardless of whether we ourselves believe those stereotypes. As discussed by psychologists Claude Steele, Steve Spencer, Toni Schmader, and others, just being aware that one is stereotyped as a poor performer in a particular domain can impair one's test performance in that domain, through both cognitive (e.g., diminished working memory) and affective (e.g., depression and physiological stress) mechanisms.

A large and growing body of research identifies situations that make stereotypes salient, focusing on academic motivation and identification with the domain. In particular, this research shows how these important factors are influenced by cues in the environment that signal "who belongs" in that field. Indeed, features of the people and even of the physical objects in STEM environments can increase the salience and relevance of gender stereotypes, and degrade the climate for women.

Lack of Female Peers

When a female undergraduate enters her introductory engineering lecture hall, she may see that 78% of the seats are occupied by male students, according to current national statistics. Seeing that one's social group is sparsely represented sends a subtle (or perhaps not so subtle) message about whether one belongs in that setting, and raises the specter of stereotypes. Fortunately, women can be reassured by the presence of other women. I recall the first day of my 7th grade shop class (also known as "industrial arts"). Upon taking my stool at the bench among a crowd of boys, I questioned my decision to forego home economics. It certainly appeared to be a space that was "not for girls." Then, however, I spotted the one other female student in the class, who looked as though she felt as awkward as I did. Soon we bonded and went on to face the world of power tools together.

Looking back, my experience appears quite consistent with current research on the powerful influence of having same-
gender peers for women in male-dominated fields. Psychological scientist Mischa Thompson and I found that women's performance on an oral examination (answering questions about previously studied material before an audience) in the lab was diminished for women performing as a solo — with an all-male audience — compared to women performing before other women. This outcome was even more pronounced when the task was made relevant to stereotypes about women's ability — i.e., was centered on math problems. Another researcher in this area, Mary Murphy (Indiana University), showed that perceptions that one will be outnumbered by men can lower women's motivation to enter and participate in male-dominated science settings, and even lead to increases in physiological indicators of stress. Nilanjana Dasgupta (University of Massachusetts Amherst) proposed a very useful summary model of how women's STEM experiences and outcomes are improved by the presence of same-gender

peers and role models.

Given the demonstrated benefits of strong representation of women in STEM to attract other women, STEM educators and employers would like to send the message that "there are women here!" Strategies based on providing female role models are popular and have been demonstrated effective in many contexts. There is the potential for this strategy to backfire if the role model is perceived as being too dissimilar to oneself or as having unattainable success. But under the right circumstances, female STEM role models can improve identification with science, indicating that STEM environments should feature women's contributions.

In one set of studies, we examined an environmental intervention based on introducing cues that women are normal and valued contributors in STEM. Laura Ramsey and Diana Betz, then graduate students in my lab, developed an intervention emphasizing factors identified as being beneficial to the success of women already in a positive STEM environment: the Women In Science and Engineering (WISE) residence program at the University of Michigan. The intervention focused on increasing awareness of women's presence in and contributions to STEM by placing in the lab setting flyers promoting a female-dominated panel of science speakers, and giving students pencils to work with on which were printed an encouraging statistic about the increasing number of women earning science degrees. Participants also completed a "Famous People Quiz" which exposed them to female scientists such as the late biophysicist Rosalind Franklin. Our experiment showed that compared to a control group, female STEM majors exposed to these female-positive environmental cues reported lower concerns about gender stereotyping and increased implicit identification with science, particularly when primed to think about their own experiences as a woman in STEM.

Such environment-based interventions can be easily integrated into the classroom setting and curriculum. As an example of how this might be done, Desdemona Rios (University of Houston–Clear Lake) and colleagues designed one section of a political psychology course to integrate examples of the contributions of women in politics; another section used a traditional (male exemplar-focused) curriculum. Results showed that at the end of the term, female students in the female exemplar-focused section more strongly considered women to be "good leaders" and themselves identified more with leadership than those women in sections using the traditional curriculum.

Other research in this area, conducted by Sapna Cheryan and colleagues at the University of Washington, points to additional features of the physical environment that matter. Items that signal that an academic environment is a stereotypically "male" space (such as the presence of video game controllers and sci-fi fan gear) can turn women off from the setting, regardless of the actual gender ratios in that environment. Perhaps such items are not often part of academic settings; however, examination of STEM departments reveals other cues that signal who belongs and is valued in that field.

Social psychologists Jessica L. Cundiff, Jes Matsick, and Theresa K. Vescio conducted an analysis of photographs presented on STEM department websites and found that virtually all websites showed men outnumbering women, a cue previously demonstrated to diminish women's desire to enter that setting. These researchers also noted the presence of what may be termed "walls of fame" — the ubiquitous display of notable contributors to the department's field, such as past award winners or department chairs. Invariably, the individuals in these displays are predominantly White and male. It seems likely that being exposed to these physical cues communicates to the female and underrepresented minority

students who walk past these displays every day that their groups are not valued contributors to the field or the department.

Negative Behaviors

Perhaps most significant to working women in STEM are climate issues. How women are treated in STEM workplaces matters, and even seemingly small events (such as female faculty being mistaken for administrative staff, or being addressed by patronizing terms such as “princess”) can trigger rumination over how to interpret or respond to these events. These “microaggressions” can be evinced even by the most well-intentioned colleagues, and can affect women even when they themselves are not the target.

Specifically, when women simply witness the negative treatment of other women in STEM settings, the incident can trigger subtle stereotyping processes that diminish women’s STEM outcomes. In one study from our lab, women majoring in STEM fields were invited to a lab study in which they were to interact with “other students” (actually videotaped confederates) using an audiovisual system. The task of each group member was to read and summarize a passage of science information, and then on camera summarize it for the group to use in an upcoming group task. The female participant went last, after seeing another woman in the group give her impromptu summary first. The video system was set up such that when one person gave their summary, the reactions of other group members to it could be seen on the participant’s screen. In one condition, the displayed reactions of the men in the group to the other woman’s summary was neutral; in another, the men’s reactions were disapproving and unsupportive (but their reactions were neutral to other men’s summaries). Seeing how another woman was treated by the men in the group sent the message that in this STEM setting, women’s contributions were not valued, which in turn triggered a subtle stereotyping process among the women. Specifically, on a subsequent task these women were more likely to attribute men’s STEM failures to fleeting circumstances such as bad luck, while attributing women’s STEM failures to internal and stable factors such as low ability. Finally, the negative treatment manipulation diminished women’s intentions to pursue a career in STEM, the very domain in which they had invested time as STEM majors.

Also germane to climate issues are perceptions of what STEM fields are like to work in. Miami University social psychologist Amanda Diekman’s work showed that STEM fields (computer science, engineering) are seen as meeting individualistic goals more than other male-dominated fields (such as law). Of importance, it is the most individualistic STEM fields where women are most absent. Laura Ramsey (Bridgewater State University) showed that this perception of science as noncollaborative is equally prevalent among faculty and students in the sciences. The perception that STEM fields are individualistic, competitive, and even antagonistic may be an important deterrent to individuals from social groups that tend to be more relationally oriented (including women and racial/ethnic minorities). Therefore, when science is depicted as a place where one must engage in “intellectual battle” to “defend one’s work” from “attack” and to “beat others” to the publication finish line, one can see the mismatch between the agentic qualities seen as required for STEM success and those expected of and encouraged in women.

Small Changes, Significant Gains?

Given the research evidence, it makes sense to rethink our science settings to make them more inclusive

to women. Institutional change is not an easy thing, but even small changes might make a big difference. Generally, changes that reduce the salience and perceived relevance of stereotypes may disrupt the processes leading to negative outcomes. What might be the effects of featuring in our STEM course curricula the valued contributions of women? Of revising our STEM department websites to deemphasize gender imbalances? Of setting a norm in which science is collaborative and uncivil behaviors towards colleagues, male and female, are not tolerated? Would there really be any detrimental effects to our departments of taking down our White male walls of fame? Making changes that improve the climate for women may make science settings more welcoming to all, and broader participation in science can ultimately benefit scientific progress and innovation.

Certainly gender discrimination happens. Indeed, discrimination is evident in other social identifications as well, such as race/ethnicity, class, and sexual orientation, all critical issues that are equally worthy of our attention. But even without biased behaviors and judgments, compelling research indicates that women can be dissuaded from STEM by environments that send the subtle message that women need not apply. œ

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