Countering Stereotypes and Enhancing Women's Sense of Belonging to Reduce Gender Gaps in pSTEM
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The gender gap in pSTEM (physical science, technology, engineering, and math) fields is a pervasive problem. Women are underrepresented in many pSTEM college majors and careers, particularly computer science and engineering, where women earn less than 20% of bachelor's degrees.[1]

THIS GENDER DISPARITY is not because women don't do as well as men in these subjects.[2] Instead, a major factor driving this disparity is that girls are less interested than boys in pSTEM fields.[3] Girls' lower interest is caused in part by social experiences and expectations, beginning as early as elementary school and continuing through higher education. Research by the Mindset Scholars Network and others speaks to the systemic nature of this challenge and offers potential solutions to reduce gender gaps. If we remove the social barriers that push girls away from these fields, girls can have more opportunities to discover where their true interests lie.

Unpacking the social psychological factors in gender gaps in pSTEM

It might seem like interest should be based only on how much a person likes a subject. But there are many hidden influences on our interests that can go unnoticed. Our culture creates expectations about how we will think and act based on our social identity (gender, race/ethnicity, etc.). When people violate those expectations—for example, when girls like science—it can make them worry about how others will react. Psychologists call this worry "social identity threat"—individuals' concern that they'll be viewed negatively due to a social group that they belong to.[4] This concern is universal; it can affect anyone who faces a group stereotype.[5]

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Stereotypes about gender can decrease girls' interest in math and science from an early age

Some of these social identity concerns come from stereotypes that our group isn't good at something. In the case of gender, our society conveys a stereotype that girls and women aren't as good as boys and men at math and science. Girls are aware of these negative stereotypes as early as second grade.[6]

When women are reminded about this stereotype, they may worry that they will confirm the stereotype by doing poorly on tests or other assessments of their ability—a distraction and source of stress that can hurt their performance and mask their true ability.[7]

Social identity concerns can arise from other sources, beyond reminders of ability stereotypes. These concerns can come up any time there are cues in the environment that "people like me don't belong here." In the case of gender, these cues can range from the proportion of women vs. men in a room to the physical attributes of an environment (e.g., if the objects in a room are stereotypically associated more with men than women, like science fiction items).[8,9] When women notice these cues, they may worry that they'll be judged in that environment on the basis of their gender.[10] The behavior of other people can trigger these concerns, too. For example, when men act dominant and flirty, women may worry that they will have to deal with sexist attitudes in that environment.[11]

Regardless of the identity—whether it's gender, race, or another social group—many different kinds of social identity concerns can lower people's interest in an area in which their group is negatively stereotyped. These include worries about whether they will confirm the stereotype, whether they belong there and will be welcomed by others, and whether they will be treated fairly and judged on their own merit. In the case of math and science, these worries can diminish some girls' interest from a very young age.
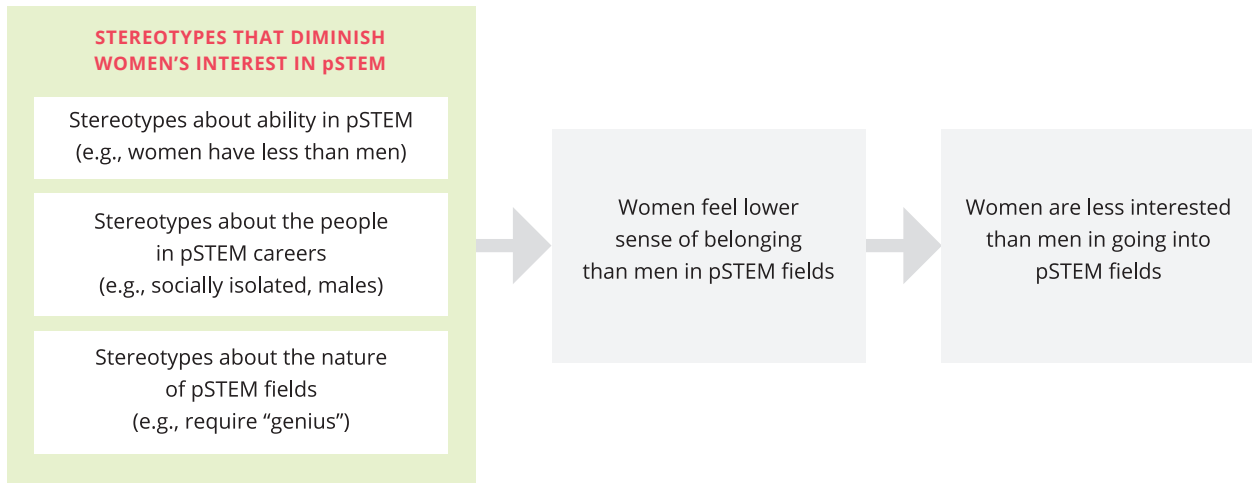
Stereotypes about pSTEM fields can diminish women's sense of belonging and enrollment in pSTEM degree programs

To increase women's representation, a key issue is to get more women enrolled in pSTEM degree programs in college and beyond. Besides stereotypes about gender that can reduce women's interest, there are lots of stereotypes about pSTEM careers, and the people in them, that can make women feel like they won't belong—that they won't be similar to others in the field or feel accepted by them.

These stereotypes can create a "mismatch" for some women, who may think, "That's not me." For example, many of these fields, like computer science, are stereotyped as being dominated by males. Other stereotypes are that pSTEM jobs are isolating, and involve sitting alone and staring at a computer all day. These stereotypes can be more problematic for women because research shows that women are more likely to value working with and helping other people.[12] When women think, "I won't belong there," then they aren't as interested in taking those classes or majoring in those fields.

Stereotypes that pSTEM fields require brilliance or natural talent can also push women away. There is a stereotype in our culture that men are more likely than women to possess raw ability (to illustrate this stereotype: how many famous female geniuses can you name? And how many famous male geniuses?). It turns out that the pSTEM fields with the lowest rates of female participation are the ones perceived to be most associated with "natural talent."[13]

**STEREOTYPES THAT DIMINISH
WOMEN'S INTEREST IN pSTEM**

Stereotypes about ability in pSTEM
(e.g., women have less than men)

Stereotypes about the people
in pSTEM careers
(e.g., socially isolated, males)

Stereotypes about the nature
of pSTEM fields
(e.g., require "genius")

Women feel lower
sense of belonging
than men in pSTEM fields

Women are less interested
than men in going into
pSTEM fields

Belonging concerns are also a key reason women enrolled in pSTEM leave these programs

Once women start down the path to earning pSTEM degrees, it's critical to keep them in these programs. Stereotypes can contribute to some women feeling a lack of belonging, even once they're involved in these fields. For example, women enrolled in pSTEM majors report more worries about confirming stereotypes compared to men in pSTEM majors or women in other majors. Women also report more experiences of discrimination.[14]

Over time, these experiences can compound to make women (and other groups who face negative stereotypes) feel like they don't belong in their field.[15] Because they would rather find a field where they feel like they belong, women in pSTEM programs are more likely than men in pSTEM or women in other fields to think about changing their major.[16] This makes them less interested in continuing to pursue a degree or a career in pSTEM.

Ultimately, experiences of bias and discrimination that diminish women's sense of belonging can continue even after they earn their degrees. For example, astronomer Dr. Kelsey Johnson was incorrectly referred to as "he" in news articles about her

research. In her own words, "even small things add up over time to create an environment that makes it clear you're an outsider." [17]

Certainly it is important to reduce bias and discrimination against women in pSTEM, and many psychologists are exploring interventions to do so.[18] But what may be even more important is how women themselves feel in these settings, and how they respond to the different challenges that they experience over time.

Using research on mindsets to increase women's participation in pSTEM

Many people—from educators to policymakers to tech companies—want to increase the number of women in these fields. Research on stereotypes and mindsets suggests some approaches to increase women's participation. The key is to both change messages from the environment *and* equip women to overcome the stereotypes they will likely encounter.

Strategy 1: Changing environments to increase women's sense of belonging

Stereotypes and social identity concerns can diminish interest and create extra challenges for members of stereotyped groups. What kinds of approaches can help address these issues? One strategy is to change environmental cues to signal that women are respected, valued, and welcomed in these settings.

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First, we can change the physical environment to help women feel a greater sense of belonging in pSTEM. In one study, researchers found that changing the objects in a computer science classroom to be more neutral (like potted plants and art posters) instead of objects that invoke male stereotypes (like video games and science fiction posters) made high school girls three times more likely to be interested in taking a computer science class.[19]

Second, we can change the way we talk about pSTEM careers. Some women become more interested in these fields after learning how they involve collaborating with and helping others.[20] We can also talk about how success in pSTEM is due to hard work, rather than brilliance or genius.

Third, teachers in pSTEM subjects can communicate through words and actions that they aren't biased against women.[21] Students from stereotyped groups have to interpret all the feedback they get with the knowledge that their teacher may hold negative stereotypes about their group's ability. On one hand, biased teachers might have lower expectations for them and give them less criticism and easier assignments.[22] On the other hand, biased teachers might criticize them unfairly due to negative expectations about members of their group. For negatively stereotyped students, both possibilities are very real and worrying.

One way for caring teachers to dispel these concerns is by communicating that they have high expectations for students' performance, along with the assurance that students can meet those expectations. For example, women majoring in science and engineering who were given this type of feedback from a male science professor did better on a science presentation compared to men who received the same or other feedback, as well as women who got other types of feedback.[23]

Strategy 2: Giving individuals psychological tools to reduce the negative impact of stereotypes and belonging concerns

A complementary strategy is to provide individuals with tools that can change how they interpret environmental cues so that they are less affected by the stereotypes they encounter. The environmental strategy described above is important, because it can help create long-term change that makes these settings more welcoming for all women. Unfortunately, the reality is that many women will experience these stereotypes and challenges at some point, so it is also important for individuals to have techniques to shield themselves from potentially negative consequences.

One approach to reducing social identity concerns is to encourage women to think about all the other important parts of their identity that matter to them. When women become concerned that potential bias against their gender is an issue, it can make them focus only on that concern. But when they're reminded about other values that are personally important to them, it reduces that concern. One way to do this is by having women think about a value that is important to them (such as making a difference in the world). For example, women majoring in engineering who incorporated reminders of important identities and values into their daily lives were better able to manage their academic stress.[24]

Another tool is to show women that stereotypes about ability are based on the incorrect belief that people are naturally either smart or not at a subject—what psychologists call a fixed mindset about ability. The fixed mindset can make social identity concerns worse, because if only some people are believed to have that ability, then those from stereotyped groups are assumed to be the ones without ability. In contrast, growth mindset is the belief that ability can grow and improve. The growth mindset can help shield women from the negative consequences of stereotypes. It

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makes the stereotypes less threatening because there is always the possibility to improve and show that the stereotype about your group is wrong. Research has also found that the mindsets about ability conveyed by the people and organizations that women interact with matter, too.[25]

A third tool is to show women that it's normal to have doubts about belonging, especially when entering a new environment. Because members of stereotyped groups worry about whether they belong in certain academic environments, they can be more sensitive to cues about belonging and more likely to base their sense of belonging on their immediate experiences. For example, if they have trouble finding study group partners, or hear about how their new lab mates went to dinner without them, it can make them less certain that they belong there. But studies show that conveying to women that these feelings are normal and often temporary can be very powerful. When women in an engineering program read previous students' stories about how their worries about belonging were normal and typically got better with time, they felt more positive about their experiences and built better relationships with other students in their program.[26]

THESE PSYCHOLOGICAL APPROACHES CAN BE A VALUABLE TOOL BUT ARE NOT A SILVER BULLET

Many of these techniques have been tested as programs that successfully improved the experiences and even academic outcomes of underrepresented groups. But they are not silver bullets. They do not change the underlying societal problems of stereotypes or discrimination. How effective they are can depend on the particular situation. Many academic contexts have multiple and complex challenges that need to be overcome before women feel welcome, from the availability of women's restrooms in an engineering department to "weed-out" courses designed to eliminate "weaker" students from the major.

In addition, many research studies have been done with groups who might be different from average students (such as women at elite universities who had already chosen to major in STEM fields). Members of the Mindset Scholars Network are testing these techniques in larger, more diverse populations. These studies will help us get a better understanding of when, and for whom, they are most effective.

Summary: Sources of, and potential solutions to, belonging concerns in pSTEM

SOURCES OF WOMEN'S LOWER SENSE OF BELONGING	EXAMPLES	POTENTIAL SOLUTIONS TO HELP ALLEVIATE THE ISSUE	
		Environmental change	*Tool for the individual*
Potential bias against women in pSTEM	Teachers perceived as too easy or too harsh on women	Communicate high standards and belief that students can reach them	Encourage women to think about other values that are important to them
Stereotypes about ability in pSTEM	Stereotype that women have less ability than men in pSTEM	Classroom practices that convey a growth mindset (e.g., opportunities to revise assignments)	Teach students about how the brain is like a muscle that forms new connections with learning
Stereotypes about the people in pSTEM careers	Environments have objects stereotypically associated with men	Change the physical environment to send a broader message about who belongs there	Convey message to students that doubts about belonging are normal and typically get better over time
Stereotypes about the nature of pSTEM fields	Stereotype that pSTEM fields are socially isolating and require natural talent	Expose students to opportunities in pSTEM fields to collaborate or help others	Show students that success in pSTEM isn't due to innate talent

Countering stereotypes and increasing belonging complement other efforts to increase women's representation in pSTEM

These strategies represent merely one approach to closing gender gaps and broadening representation in pSTEM: to recruit and retain more women in pSTEM degree programs. Other researchers have suggested other approaches that could help increase representation at other stages of women's careers, such as better childcare support and tenure-track flexibility for women in academia.[27] Recent research also suggests that women are in great demand in academic hiring.[28] This is very encouraging, because it suggests that if we can get more women into these majors and beyond, they could do very well in the current job market.

When we talk about the underrepresentation of women in pSTEM, it can be easy to simply say girls and women just aren't interested in these fields. If they aren't interested, why try to change their minds? After all, they must be more interested in the fields they *do* choose. But what is often overlooked is how our interests are shaped by the stereotypes and social influences around us. When the scales are tipped against pSTEM before girls even have the opportunity to choose, it's not a fair choice. Stereotypes can affect the experiences, beliefs, and academic choices of women and girls. These stereotypes can act as barriers that push them away, and prevent them from exploring their potential passion for these fields. But the research described here offers hope that we can counter the stereotypes and close these gender gaps.

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