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The Role of Stereotype Threats in Undermining Girls' and Women's Performance and Interest in STEM Fields

Jenessa R. Shapiro · Amy M. Williams

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Abstract In the present manuscript we draw on the Multi-Threat Framework to explore gender-related math attitudes and how they put girls and women at risk for stereotype threats. Gunderson et al. (2011) detail how negative stereotypes about women's math abilities are transmitted to girls by their parents and teachers, shaping girls' math attitudes and ultimately undermining performance and interest in science, technology, engineering, and math (STEM) fields. The social psychological phenomenon of stereotype threat complements this approach and demonstrates the additional ways in which gender-related math attitudes undermine girls' and women's interest and performance in STEM domains. Considering the phenomenon of stereotype threat also identifies how stereotypes and other gender-related math attitudes can undermine women's and girls' interest and performance in STEM domains even when women and girls have positive math attitudes.

Keywords Multi-Threat Framework · Stereotype threat · Gender stereotypes · Math attitudes · STEM

Introduction

In the target article, Gunderson et al. (2011) provide an excellent review of how negative stereotypes about women's math abilities are transmitted to girls by their parents and teachers—as early as preschool and elementary school—shaping girls' math attitudes and ultimately undermining performance and interest in science, technology, engineering, and math (STEM) fields. Gunderson and colleagues' approach offers a number of important avenues for future research to better understand girls' and women's gender-related math attitudes and to develop interventions that protect against reduced interest and performance in STEM fields. This is clearly an important set of research questions with a very fruitful direction for future research. Here we address a complementary line of research—the social psychological phenomenon of stereotype threat. The integration of stereotype threat research with the target article helps to illuminate the reach of gender-related math attitudes and their role in undermining girls' and women's interest and performance in STEM domains. Specifically, considering the phenomenon of stereotype threat can lead to an understanding of how stereotypes can undermine women's and girls' performance and interest in STEM domains even when women and girls have positive math attitudes.

J. R. Shapiro (✉) · A. M. Williams
Department of Psychology, University of California, Los Angeles, Los Angeles, CA 90095-1563, USA
e-mail: jshapiro@psych.ucla.edu

J. R. Shapiro
Anderson School of Management, University of California, Los Angeles, Los Angeles, CA 90095-1563, USA

Stereotype Threat

Stereotype threat is a concern or anxiety that one's performance or actions can be seen through the lens of a negative stereotype (e.g., Shapiro and Neuberg 2007; Steele et al. 2002)—a concern that disrupts and undermines performance in negatively stereotyped domains (Beilock 2008; Beilock et al. 2007; for a review see Schmader et al. 2008). For example, in a now-classic series of studies, African American (but not European American) students underperformed relative to their ability on difficult GRE-like tests when the tests were labeled as diagnostic of intellectual ability or when they were asked to report their

race before taking the test (Steele and Aronson 1995). The authors attributed these performance decrements to evaluation pressures created by the possibility of confirming negative stereotypes that African Americans lack intellectual ability. Spencer et al. (1999) found that women experience a similar outcome in the domain of math. In one experiment, men and women were randomly assigned to learn either that a difficult math test had shown gender differences in the past or that it had not shown gender differences in the past. When participants were told the test had not shown gender differences, men and women performed similarly on the test. However, when participants were told the test had shown gender differences, women performed significantly worse on the test compared to men.

In a demonstration of the potential influence of stereotype threat on high stakes testing, Danaher and Crandall (2008) analyzed data from an AP Calculus AB exam in which high school students were either asked to report their gender before they began the test or after they finished the test. This analysis found that when female students were asked to report their gender *before* completing the AP Calculus exam (thereby making gender salient prior to the test), their performance on the test was reduced by 33% as compared to female students asked to report their gender after taking the exam. This finding translates to an additional 5.9% of female test takers who would have achieved a passing exam score and as a result, earn college calculus credit.

Consistent with Gunderson and colleagues' developmental approach, stereotype threat has also been explored from a developmental perspective, assessing the emergence of stereotype threat in younger girls (e.g., Huguet and Régner 2007, 2009). For example, Keller and Dauenheimer (2003) performed a study similar to Spencer et al. (1999) with children (about 15 years old) in a German secondary school. Here, a math test was administered to students in the same way they were accustomed to taking tests. However, there was one change: Half of the students learned the test had shown gender differences in the past (high stereotype threat condition) whereas the other half learned the test had not shown these differences (no-threat condition). Although the performance of girls and boys did not vary in the "no gender differences" condition (no-threat condition), when the students were told the test had shown gender differences in the past (stereotype threat condition), girls performed significantly worse than boys (see also Good et al. 2008, for a similar study in a college calculus class). Neuville and Croizet (2007) found a similar pattern of results among French third graders taking a math test in their classroom. These students were randomly assigned to color a picture of a girl with a doll or a boy with a ball (gender salient, high stereotype threat condition) or to color a picture of a landscape (low stereotype threat condition). On the difficult math problems, girls and boys performed similarly when gender was not activated by the coloring task (low stereotype threat condition); however, girls performed worse when gender was activated by the coloring task (high stereotype threat condition).

The findings reviewed above have been replicated a number of times in the laboratory and in the field in the United States (e.g., Stangor et al. 1998; McIntyre et al. 2003) and other countries that have similar math-gender stereotypes (e.g., Cadinu et al. 2005; Muzzatti and Agnoli 2007; Marx et al. 2005). However, to the extent that these stereotypes are not prevalent in a particular culture, these effects become more difficult to find, demonstrating the role that stereotypes play in eliciting stereotype threat and undermining women's math efforts. For example, in a study looking across cultures and mental rotation abilities, researchers found that differences in male and female mental rotation were correlated positively with gender equity and economic development, suggesting that gender egalitarianism may contribute to fewer stereotype-driven decrements in performance (Lippa et al. 2010). The present manuscript focuses primarily on research conducted in the United States in part because this is where the bulk of stereotype threat research has been conducted. However, these findings should generalize across cultures to the extent that the stereotypes are endorsed within that culture.

The studies reviewed above demonstrate the influence of stereotype salience on math performance, however, stereotype threatening situations also lead women to underperform on assessments of engineering, leadership, negotiation, political knowledge, and chess skills (e.g., Davies et al. 2005; Kray et al. 2001; Logel et al. 2009; Maass et al. 2008; McGlone et al. 2006). In addition, stereotype threat effects have been shown to emerge across a number of groups and the domains in which these groups are negatively stereotyped. For example, stereotype threat leads Latinos to underperform on academic tasks (Schmader and Johns 2003); older adults to underperform on memory tests (e.g. Levy 1996); Whites to perform worse on measures of racism (Frantz et al. 2004; Goff et al. 2008); and students who have a mental illness to underperform on rational thinking tests (Quinn et al. 2004).

What causes decrements in performance in stereotype threatening situations? As previously mentioned, stereotype threat is a disruptive concern (for a review see Schmader et al. 2008; Beilock et al. 2007). Stereotype threat does not typically lead to decreased motivation in testing situations. Instead, it most often gives rise to a greater desire to do well on a given task and disprove the negative stereotypes (Steele and Aronson 1995). Furthermore, research demonstrates that participants put forth more effort in stereotype threatening situations (Jamieson and Harkins 2007; 2009).

However, more effort does not always translate into better performance. Higher motivation to do well in situations where there are negative expectations can produce intrusive and distracting thoughts (for a review see Schmader et al. 2008). In one study, Cadinu et al. (2005) found that women experiencing stereotype threat were more likely to report negative math-related thoughts (and not other thoughts) compared to women in a no-threat condition. Moreover, the difference in the content of women's thoughts accounted for the lower performance in the stereotype threat condition. Consistent with these findings, recent models articulating the mechanisms underlying stereotype threat effects argue that in stereotype threatening situations, distracting concerns usurp the executive resources needed to successfully complete cognitively demanding tasks, such as difficult math and science problems (Schmader et al. 2008; Beilock et al. 2007; Schmader and Johns 2003).

In addition to hindering performance, stereotype threat can also negatively influence career aspirations. For example, women subtly reminded of their gender report less interest in math fields compared to arts-oriented fields (Steele and Ambady 2006). In another study, Davies et al. (2002) showed women participants television commercials that depicted women stereotypically (e.g., a woman salivating over the opportunity to try a new brownie mix) or counter-stereotypically (e.g., a woman speaking intelligently about health care concerns); the stereotypic commercials have been shown to elicit stereotype threat in women. Women in the stereotype threat condition—the women viewing the stereotypic commercials—were less likely to report interest in quantitative majors and career paths (e.g., engineer, mathematician, computer science, statistics, accountant, physics) compared to verbal majors and career paths (author of novels, linguistics, journalist, communications, political science, editor). In contrast, women in the control condition—the women viewing counter-stereotypic commercials—did not report a difference in interest regarding the quantitative and verbal majors and career paths.

The Situational Nature of Stereotype Threat

Gunderson et al. (2011) identify environmental factors—specifically, parents and teachers—that contribute to the gender-related math attitudes held by women and girls. A consideration of stereotype threat complements this approach because stereotype threat also emerges as a result of situational factors. Consistent with then-President of Harvard University Lawrence Summers's comments in 2005 suggesting that women may be underrepresented in STEM fields due to gender differences in availability of aptitude at the high end of STEM intelligence, many have pointed to cultural or even biological factors as driving gender disparities. However, stereotype threat points to a very different driver of gender disparities in performance and interest in STEM fields: Environmental cues that make negative stereotypes salient. As a result, there are many aspects common to academic environments that can produce stereotype threat, from being in the numerical minority (e.g., being the only woman in an engineering class; Inzlicht and Ben-Zeev 2000; Sekaquaptewa and Thompson 2003) to interacting with someone who likely holds negative stereotypes (Logel et al. 2009). As an example of the power of the situation, one study recruited Asian women as participants because Asian women have two identities that carry with them very different implications for math performance. That is, Asians are stereotyped as having strong abilities in math, yet women are stereotyped as having weak abilities in math. Thus, before completing a math test, researchers randomly assigned participants to complete a demographics prompt that either had them focus on their gender, their race/ethnicity, or neither (a control condition). The focus of the demographics section differentially influenced participants' performance: Asian women who answered questions about their gender performed worse than participants in the control condition, whereas Asian women who answered questions about their race performed better than participants in the control condition (Shih et al. 1999).

As another example of the situational nature of stereotype threat, researchers have turned to White males. Across most stereotype threat research examining gender in the context of math, White males are relatively unaffected by stereotype threat manipulations; indeed, given that men are stereotyped as stronger than women in math contexts, they tend to perform slightly better on standardized math tests when gender or gender stereotypes are made salient (a phenomenon called "stereotype lift," Walton and Cohen 2003). However, if stereotype threat is a situational phenomenon that emerges regardless of a long history of stigmatization, White men should experience stereotype threat in situations where White males are stereotyped as weaker in math skills: Situations in which they are compared to Asians. Consistent with this prediction, when White men were reminded that Asians are stereotyped as stronger in math than Whites, White men underperformed on a math test relative to a control condition (Aronson et al. 1999).

Implications for Intervention

Because stereotype threat is situational in nature, interventions can focus on removing these situational barriers as a way in which to buffer against the negative effects of

stereotype threat. The development and testing of theoretically driven stereotype threat interventions has been the focus of recent research, primarily due to the real-world costs associated with underperformance relative to one's abilities on high stakes tests (Walton and Spencer 2009). Here we review some of the stereotype threat interventions that have received empirical support. One stereotype threat intervention that has yielded successful outcomes is self-affirmation. Self-affirmation involves reflecting on important aspects of one's life that are different from the threatening domain or engaging in an activity that makes salient important values that are different from the threatening domain (Steele 1988). For example, Martens et al. (2006) randomly assigned college participants to complete a difficult math test that was described as either diagnostic (stereotype threat) or non-diagnostic (no threat control) of math abilities. In addition, women were randomly assigned to a self-affirmation condition (write about a personally important value unrelated to math) or a control condition (write about a personally unimportant value unrelated to math). Replicating traditional stereotype threat effects, Martens and colleagues found that women performed worse on the challenging math test when it was described as diagnostic of their abilities compared to when it was described as non-diagnostic. However, stereotype threatened women who affirmed a valued attribute (different from math) before taking the test performed at similar levels compared to women in the no threat control condition. Thus, engaging in a self-affirmation task protected these women from the negative effects of stereotype threat. Research in field settings has found similarly positive effects for self-affirmation. For example, Miyake et al. (2010) administered a self-affirmation task in a college-level introductory physics class at the beginning of the semester and again prior to the first midterm exam. Although men outperformed women on exam scores in the control condition, this gap was significantly smaller in the affirmation condition. Indeed, women's modal exam grades were significantly higher in the affirmation, compared to the control, condition.

A second intervention that has received a great deal of support for its ability to buffer against stereotype threat is the presentation of role models (e.g., Stout et al. 2011). For example, Marx and Roman (2002) demonstrated that women performed better on a challenging math exam when led to believe that a female (versus male) experimenter had created the math questions. That is, seeing another individual who was similar to themselves (i.e., the test creator was a woman) and who disconfirmed the stereotype about female math ability—this experimenter was competent and skilled in the domain of math—served to buffer the female students from stereotype threat effects. Similarly, McIntyre et al. (2003) demonstrated that when college students read biographies of successful women (versus successful corporations) in the fields of architecture, law, medicine, and invention prior to completing a GRE-like math test, the female participants in the successful women condition significantly outperformed the female participants in the successful corporations condition, and performed similarly to male participants in both conditions. Role models are argued to reduce stereotype threat because seeing a successful ingroup member relieves the burden of personally representing women in these negatively stereotyped contexts (Marx et al. 2005).

In addition, several studies have examined how reducing intergroup boundaries or creating a superordinate identity may influence individuals' performance when under stereotype threat. For example, when females were prompted to think about characteristics that both men and women share prior to taking a difficult math exam, their performance increased significantly relative to the control condition in which participants were not asked to do anything before the math test (Rosenthal and Crisp 2006). The authors conclude that females came to see themselves as more similar to males as a result of the intervention and, thus, were not preoccupied with group stereotypes. Similarly, research has manipulated whether female students are given the opportunity to think of themselves as elite private college students or college students who are good at math (McGlone and Aronson 2006; Rydell et al. 2009). In these contexts, construing oneself in terms of the positively stereotyped social identities—college students—buffered women against the negative effects of stereotype threat.

Another empirically supported stereotype threat intervention involves teaching about the phenomenon of stereotype threat. For example, in one study, participants were randomly assigned to one of three conditions: (1) a control condition (no threat) that described a math task as a problem-solving exercise, (2) a stereotype threat condition that explicitly stated that gender differences were under evaluation, or (3) a teaching intervention condition that included the stereotype threat information plus information about the stereotype threat phenomenon itself (Johns et al. 2005). Consistent with expectations, participants in the teaching intervention condition performed at levels equivalent to the control condition (no threat) and significantly better than participants assigned to the stereotype threat condition. The rationale behind why this intervention is successful is that knowledge about stereotype threat and the fact that it elicits anxiety is helpful, as women can then correctly attribute their anxieties to stereotype threat and not to poor ability (Johns et al. 2008).

Thus, recent research targeting stereotype threat interventions demonstrates that just as simple situational cues can spur the harmful effects of stereotype threat, simple

interventions targeting these situational cues can protect women from stereotype threat.

Different Types of Stereotype Threats: The Multi-Threat Framework

Up to this point in the manuscript we have treated stereotype threat as a singular construct, and this is consistent with the bulk of the stereotype threat literature to date. However, recent conceptualizations of stereotype threat have argued that the treatment of stereotype threat as a broad umbrella concept obscures important distinctions that have implications for identifying who is at risk for stereotype threat, what situational factors will bring about stereotype threat, and what interventions will be most effective at remediating the negative effects of stereotype threat (Shapiro and Neuberg 2007). A multi-threat approach to stereotype threat articulates important distinctions among different forms of stereotype threats—distinctions that are relevant in the context of how gender-related math attitudes serve to generate risk for stereotype threat.

The Multi-Threat Framework (Shapiro and Neuberg 2007; Shapiro 2011) identifies six qualitatively distinct stereotype threats that emerge from the intersection of two dimensions—the target of the stereotype threat (who one's actions will reflect upon: the self/group) and the source of the stereotype threat (who can judge these actions: the self/outgroup others/ingroup others). Each of these stereotype threats can emerge independently or in conjunction with the others. Although each of the stereotype threats can have similar negative influences on women's and girls' performance and interest in STEM domains, it is important to differentiate between these stereotype threats because they are elicited by unique factors, are moderated and mediated by different variables, and can require different interventions to overcome (Shapiro and Neuberg 2007). The source dimension of this framework is particularly relevant to gender-related math attitudes and the transfer of these math attitudes. Below we define and describe the distinctions between self-as-source and other-as-source stereotype threats and detail how these distinctions complement and extend Gunderson et al. (2011) approach.

Self-As-Source Stereotype Threats

When in a stereotype-relevant situation, one's performance has the possibility of confirming, in one's own mind, that the stereotype is true of one's own, or the group's, abilities. Thus, for self-as-source stereotype threats, the distracting concern in a stereotype-relevant situation emerges as a function of what one might personally take away from this performance. For example, if Jennifer is taking a math test, she might fear a poor performance on this test will support the hypothesis lurking within the recesses of her own mind that she is, by virtue of her gender, less skilled in math than her male classmates. Similarly, she might fear an inadequate performance on this math test will confirm the stereotype, in her own mind, that women (as a whole) are less competent in STEM domains compared to men. Thus, this particular form of stereotype threat is influenced by the math attitudes that are the focus of Gunderson et al. (2011) analysis: For self-as-source stereotype threats to emerge, Jennifer must believe that there is some possibility that the stereotype could be true (Shapiro and Neuberg 2007; Shapiro 2011).

Thus, an implication of the transfer of negative math attitudes from parents and teachers to girls is that this transfer can put girls at risk for self-as-source stereotype threats. This suggests that the development of children's gender-related math attitudes and the internalization of the gender-math stereotypes should create an additional burden while taking diagnostic math tests. That is, as girls develop these negative math attitudes, including endorsing the stereotypes associated with women and math, diagnostic tests become more threatening because they have the potential to confirm this stereotype in their own minds about their own, or women's, abilities (e.g., Schmader et al. 2004). Preventing the development of these gender-related math attitudes will not only protect against the math anxieties and other deleterious consequences reviewed by Gunderson et al. (2011), but will also protect against self-as-source stereotype threats.

Other-As-Source Stereotype Threats

In contrast to self-as-source stereotype threats, other-as-source stereotype threats emerge as a function of perceptions of how others might assess one's performance. That is, when in a stereotype-relevant situation, one's performance has the possibility of confirming, in another person's mind, that the stereotype is true about one's own, or one's group's, abilities. For example, Jennifer might fear a poor performance on a math test will enable a teacher, peer, or parent to see her as stereotypic and thereby treat her in an unfavorable manner. Similarly, she might fear being a bad ambassador for women; that this performance will confirm math-gender stereotypes in the minds of a teacher, peer, or parent. Distinct from self-as-source stereotype threats, for other-as-source stereotype threats to emerge, one does not need to believe the stereotype could be true. Instead, Jennifer must believe that *others* endorse these negative stereotypes (Shapiro and Neuberg 2007; Shapiro 2011).

Gunderson et al. (2011) primarily focused on girls' gender-related math attitudes and the transfer of these attitudes from their parents and teachers. However, other-

as-source stereotype threats point to a different, and equally harmful aspect of parent and teacher math attitudes: The role of parents and teachers as potential sources of stereotype threats. That is, the knowledge that one's performances and actions are visible to parents and teachers who may endorse math-gender stereotypes puts women and girls at risk for other-as-source stereotype threats, which can harm performance, confidence, self-efficacy, and interest in these domains. Thus, other-as-source stereotype threats can undermine the efforts of women and girls even if they have been able to resist the transfer of gender-related math attitudes and the internalization of the negative stereotypes and even if they possess strong, positive math attitudes.

What is the Value of Considering Stereotype Threats in Conjunction with Math Attitudes?

Considering the role of stereotype threats in the context of math attitudes complements Gunderson et al. (2011) approach and highlights a set of additional factors that serve to undermine women's achievement and advancement in STEM domains. Gunderson et al. (2011) reviewed recent research demonstrating that teachers' and parents' own math anxieties influenced girls' gender-related math attitude development (e.g., Beilock et al. 2010). They proposed that the teachers' math confidence likely played a role in girls' performance in these classes. A consideration of the stereotype threats generates a number of different hypotheses regarding the role of teachers' math confidence.

Gunderson et al. (2011) speculate that female teachers' math confidence will buffer against the negative effects of teachers' math attitudes on girls' performance. This should likely be the case. Indeed, stereotype threat research demonstrates that teachers and experimenters who are of the same group and who are competent protect against stereotype threat (Dasgupta and Asgari 2004; Marx and Roman 2002; Wout et al. 2009). However, the Multi-Threat Framework also points to a place where female teacher confidence may be threatening (Shapiro 2011): Ingroup-as-source stereotype threats. That is, when one considers the most likely candidate to serve as a source of stereotype threats, the dominant group (e.g., men, in the context of gender-math stereotypes) typically comes to mind because they are believed to hold and apply stereotypes. However, ingroup members can serve as sources of stereotype threats for different reasons. Recall Jennifer from earlier. Jennifer's concern when taking the math test can reflect fears of disappointing her female teacher and/or fears that this poor performance would lead this female teacher to see her as stereotypic. Thus, women can serve as a source of stereotype threats for other women: A math confident woman who cares about the image of women in STEM fields or about a woman's reputation in STEM domains may pose an ingroup-as-source stereotype threat for this woman as she takes, or participates in, a diagnostic STEM task. This possibility suggests that the influence of female teacher math confidence can be helpful or harmful for girls' own gender-related math attitudes and performance. Further exploration of these possibilities is important for future research.

Gunderson et al. (2011) pose the question of whether math confident male teachers will have a positive effect on girls. The Multi-Threat Framework suggests that male teacher confidence, like female teacher confidence, will likely differentially influence girls' and women's performance as a function of other factors, such as how this confidence manifests and what it communicates. On the one hand, if this confidence communicates inclusion and belonging for women, male teacher confidence should have a positive influence on girls' and women's performance (e.g., Walton and Cohen 2007; Cheryan et al. 2009; Cheryan et al. 2011). However, recent research demonstrates that males exhibiting confident behaviors—positioning themselves closer to the participants, sitting with an open posture (shoulders back, knees wide apart), looking at the participant often during the interaction, and maintaining a confident facial expression—serve to elicit stereotype threat in female participants taking an engineering test (Logel et al. 2009). Thus, some forms of confidence may undermine girls' gender-related math attitudes and performance. In particular, situations in which male teacher confidence communicates (or is perceived to communicate) a possibility of stereotype endorsement are likely to increase the perceived probability of being stereotyped by this teacher (Wout et al. 2009), an important eliciting factor for other-as-source stereotype threats.

A multi-threat approach also makes predictions regarding who is most likely at risk for the undermining effects of stereotype threat. Gunderson et al. (2011) suggest that when skill is ambiguous, as is the case for middle-achieving individuals, these individuals are most at risk for the negative effects of gender-related math attitudes held by teachers and parents. The rationale is that stereotypes provide information that helps observers understand ambiguous behaviors. As a result, if a female student's abilities are ambiguous and a teacher holds math-gender stereotypes, then this teacher is more likely to draw on stereotypes, treat students consistent with these stereotypes, and ultimately facilitate a self-fulfilling prophecy.

However, stereotype threat research points to a different population as being most at risk for the undermining nature of stereotypes: high ability and high achieving individuals. Because stereotype threat is a concern regarding how one's performance will be interpreted, stereotype threat emerges

when people care about this domain and their performance in the domain (Steele 1997). Thus, stereotype threat effects tend to emerge within individuals who score the highest on quantitative SAT tests, are in the most advanced STEM classes, and care the most about these abilities (e.g., Good et al. 2008; Schmader 2002; Spencer et al. 1999). This research suggests that in some circumstances, especially those in which girls or women believe their parents and teachers hold negative gender-related math attitudes and stereotypes, risk for other-as-source stereotype threats should increase among those who are high in math ability and achievement.

And, finally, a consideration of stereotype threat in conjunction with gender-related math attitudes highlights avenues for intervention. For example, if interventions eliminate girls' negative math attitudes—the primary direction for intervention proposed by Gunderson et al. (2011)—this would still leave girls vulnerable to some of the harmful effects of stereotypes. Specifically, a focus only on girls' personal math attitudes would overlook other-as-source stereotype threats, or the stereotype threats that emerge out of concerns regarding others' beliefs about one's math abilities. As an example, Good and Aronson (1998) found that women enrolled in an advanced calculus class believed there were no gender differences in calculus abilities, yet they still reported that other people think men are significantly better at calculus than women. Thus, interventions will need to target both personal gender-related math attitudes and the implications of knowing that others have gender-related math attitudes.

Conclusion

What role do environmental factors play in undermining women's interest and performance in STEM fields? As Gunderson et al. (2011) detail, parents' and teachers' gender-related math attitudes—including their stereotypes and anxieties—can transfer to girls and play a critical role in girls' development of math attitudes and interests. However, stereotype threat research argues that broad situational cues can also communicate gender-relevant math attitudes. Specifically, the transfer of gender-related math attitudes to girls can put them at risk for self-as-source stereotype threats, stereotype threats rooted in the concern that a performance could confirm in one's own mind that the stereotypes are indeed true of oneself or the group. In addition, knowledge of gender-related math attitudes can also put girls at risk for a different set of stereotype threats: other-as-source stereotype threats. Other-as-source stereotype threats emerge out of a concern regarding potentially being seen through the lens of a negative stereotype by others or the possibility that one will poorly represent the group. What is important to note about these particular stereotype threats is that they do not require the internalization of the stereotypes or even the endorsement of the stereotypes by others. Instead, other-as-source stereotype threats emerge when one believes others might hold the stereotypes.

Thus, the consideration of stereotype threat research illuminates the wider reach of gender-related math attitudes. Furthermore, the Multi-Threat Framework serves as a useful tool to unpack how teacher and parent gender-related math attitudes and behaviors can influence girls' gender-related math attitudes. A consideration of environmental factors that allow gender-related math attitudes to undermine girls' interest and performance in STEM domains will facilitate the development of theoretically driven interventions that helps to close the gender gap in STEM fields.

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