

Reducing adolescent girls' concerns about STEM stereotypes: When do female teachers matter?

Réduire la crainte des adolescentes liée aux stéréotypes en sciences : quand le rôle des femmes enseignantes est-il déterminant ?

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Abstract

In two experiments, we examined how teacher gender and stereotype threat cues affected adolescents' self-reported concerns about being negatively stereotyped in computer science courses. High-school students (Experiment 1: $N = 218$; Experiment 2: $N = 193$) read about two computer science courses, one with a competent male teacher and one with a competent female teacher, and were randomly assigned to one of three experimental conditions. In the stereotype threat condition, they read a paragraph that introduced negative stereotypes about girls' perfor-

Résumé

Dans deux expériences, nous avons examiné comment le sexe des enseignants et la menace du stéréotype affectaient les craintes rapportées par les adolescents d'être négativement stéréotypés lors de cours en sciences informatiques. Des élèves du secondaire (Expérience 1 : $N = 218$; Expérience 2 : $N = 193$) ont lu la description de deux cours de sciences informatiques, l'un dispensé par un enseignant compétent de sexe masculin et l'autre par un enseignant compétent de sexe féminin, et ont été assignés au hasard à l'une des trois conditions expérimentales suivantes. Dans la condition de

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mance; in the no gender difference condition, they read a paragraph that countered negative stereotypes; and in the baseline control condition, they read neither paragraph. In both experiments, girls reported more concerns about being negatively stereotyped than boys when the teacher was male versus female, and this effect was specifically driven by significant differences in the stereotype threat condition. When situational cues are threatening, female teachers (compared to male teachers) reduce girls' concerns about being negatively stereotyped, with implications for both theories of identity and educational practice.

menace du stéréotype, ils lisaient un paragraphe qui décrivait des stéréotypes négatifs sur les performances des filles ; dans la condition d'absence de différence entre les sexes, ils lisaient un paragraphe qui réfutait les stéréotypes négatifs ; dans la condition contrôle, ils ne lisaient aucun paragraphe. Dans les deux expériences, les filles ont rapporté plus de crainte que les garçons d'être stéréotypées négativement lorsque l'enseignant était un homme plutôt qu'une femme, et cet effet était spécifiquement lié aux différences dans la condition de menace du stéréotype. Lorsque la situation est menaçante, les enseignants de sexe féminin réduisent, par rapport aux enseignants de sexe masculin, les craintes des filles d'être stéréotypées négativement, ce qui a des implications pour les théories de l'identité et les pratiques éducatives.

Gender disparities in STEM (science, technology, engineering, and math) fields remain a troubling problem in American education. The presence of female teachers as role models for girls has been suggested as a way to help increase women's participation in STEM (Dasgupta, 2011). However, research on this topic has shown mixed results. While some studies demonstrate benefits of female teachers for female students (Asgari, Dasgupta, & Gilbert Cote, 2010; Bettinger & Long, 2005; Stout, Dasgupta, Hunsinger, & McManus, 2011), others show that male teachers can be equally effective (Canes & Rosen, 1995; Dynan & Rouse, 1997; Gilmartin, Denson, Li, Bryan, & Aschbacher, 2007).

In the current work, we investigate the situational factors that influence when female and male teachers have differing consequences for girls in STEM fields. In two experiments, we examined how teacher gender and stereotype threat cues affected adolescents' self-reported concerns about being negatively stereotyped in

computer science courses. We hypothesize that female teachers may be particularly important compared to male teachers in situations that activate stereotype threat for girls.

Stereotype threat and teacher gender

Stereotype threat refers to students' concerns about being judged through the lens of a negative stereotype (Steele, 1997). According to a pervasive North American stereotype, females have less ability and interest than males in STEM domains (Good, Aronson, & Inzlicht, 2003). One potential way to reduce the effects of negative stereotypes is to expose women to female role models. Role models are successful "experts" in the field, ranging from teachers to more advanced peers and other professionals (Lockwood, 2006; Stout et al., 2011). Within contexts in which stereotype threat is salient (such as female math majors about to take a difficult math test), female role models can provide benefits over male role models that include improved performance (Marx & Roman, 2002; Marx, Stapel, & Mueller, 2005; McIntyre, Paulson, & Lord, 2003) and more positive attitudes (Lockwood, 2006; Stout et al., 2011). Competent female teachers show that women can overcome these stereotypes and succeed in STEM (Lockwood, 2006), and may also signal to girls that their teacher will be less likely to endorse negative stereotypes about them (Wout, Shih, Jackson, & Sellers, 2009).

However, in other situations, studies have found that teacher gender has little effect on high-school girls' motivation and achievement in STEM (e.g., Ehrenberg, Goldhaber, & Brewer, 1995; Martin & Marsh, 2005). Having support from either male or female role models *prior* to college often influences women to choose STEM majors when they reach college (Downing, Crosby, & Blake-Beard, 2005). Similar results have been found during college: College women who viewed their science professors as positive role models were more interested in science careers, regardless of the professor's gender (Young, Rudman, Buettner, & McLean, 2013). A study across many STEM and non-STEM departments at three universities found that increases in the proportion of female faculty did not predict subsequent increases

in the proportion of female students recruited to that department (Canes & Rosen, 1995).

The abovementioned research suggests that female teachers may be beneficial for women in comparison to male teachers specifically in situations where stereotype threat is salient. However, there has not yet been a direct experimental manipulation of both stereotype threat and teacher gender within a single study. Some studies have manipulated role model gender but not threat (Lockwood, 2006; Marx & Roman, 2002; Stout et al., 2011); others manipulated threat but not role model gender (Marx et al., 2005; McIntyre et al., 2003). Thus, we lack direct experimental evidence about how girls respond to female versus male teachers when they are or are not under threat. We suggest that female teachers are particularly helpful for girls compared to male teachers when negative stereotypes are activated, and that this has important implications for identity theory and educational policy and practice.

Adolescence as a critical age period for identity

Adolescence is a particularly critical age at which to examine issues about academic identity. Adolescents begin to make significant career choices (Weisgram & Bigler, 2006), and girls in high school have fewer career aspirations involving computers and technology than boys (Lupart & Cannon, 2002; Schulenberg, Goldstein, & Vondracek, 1991). Because adolescence is a key time to recruit girls into advanced STEM training and career paths (Barker, Snow, Garvin-Doxas, & Weston, 2006), it is useful to understand whether and under what circumstances female teachers can ensure more positive experiences for girls in STEM than male teachers.

There is strong evidence that children are significantly influenced by gendered stereotypes about STEM as detected both by explicit and implicit measures (e.g., Cvencek, Meltzoff, & Greenwald, 2011). Although adolescent girls may not confront negative STEM stereotypes daily (Ganley et al., 2013), girls are likely to eventually experience situations in which they must confront negative gender stereotypes, and teacher gender may be particularly influential for girls in these situations.

The current research

We focus on computer science due to the particularly low percentage of females; women earn approximately 18% of bachelor's degrees in computer science, one of the lowest percentages of any STEM field (National Science Foundation, 2013). Previous research has found that stereotypes about *computer scientists* (e.g., as male, technologically oriented, and socially awkward; Cheryan, Plaut, Handron, & Hudson, 2013) lower high-school girls' interest in computer science (Master, Cheryan, & Meltzoff, 2014). Here we examine a complementary piece of the puzzle: How stereotypes about *girls' ability* in computer science affect their concerns about being negatively stereotyped. These concerns are important because they provide a window into girls' thoughts about stereotypes and their own identity and may predict other meaningful STEM outcomes such as performance (Cohen & Garcia, 2005; Spencer, Steele, & Quinn, 1999).

Because performance in early courses can affect whether students choose to persist in STEM majors (Miyake et al., 2010), investigating factors that encourage girls in introductory courses is crucial to ensuring their future participation. In two experiments, we examine how teacher gender and stereotype threat cues affected adolescents' self-reported concerns about being negatively stereotyped in potential computer science courses. We hypothesize that when threatening cues become salient, female teachers may elicit fewer concerns than male teachers. But when girls are less concerned about negative gender stereotypes, we predict that female and male teachers should be equally effective.

Experiment 1

High-school students were presented with two introductory computer science courses. The courses were identical except that one was taught by a male teacher and the other was taught by a female teacher. We experimentally manipulated whether threatening information about women's lower abilities in computer science was presented or refuted (in addition to a baseline control condition with no information), and examined how the interaction of stereotype threat cues and teacher gender

affected girls' and boys' concerns about negative stereotypes in the courses.

Method

Participants

Participants were 218 students at a public high school in the Northwestern United States (115 male, 95 female; eight students did not provide gender;¹ mean age = 16.22 years, $SD = 1.13$; age range: 14.50 to 19.42; 18 did not provide birthdate).² Thirty-seven percent were freshmen, 28% were sophomores, 23% were juniors, and 9% were seniors (3% did not provide this information). Participants were 31.2% White, 22.5% Latino/a, 21.6% Asian/Pacific Islander, 11.0% Multiple ethnicities, 6.4% Black, 1.8% Native American, and 0.9% Other (4.6% did not provide this information). There was no difference between male and female students in number of computer science courses taken, with many students (54%) reporting having taken no computer science classes (boys: $M = 0.77$, $SD = 0.97$; girls: $M = 0.60$, $SD = 0.98$), $t(198) = 1.20$, $p = .23$, $d = 0.17$. In the participating school, 65% of all students were eligible for free or reduced lunch. Following approval by the school's principal, 10 math teachers agreed to allow their students to participate, and letters were sent home to parents of all students in those teachers' classes. Students were recruited by using an opt-out information letter to parents, allowing for a high participation rate (84% of eligible students participated; the remaining students either opted-out with the letter, did not assent, or were absent).

Procedure

Participants completed a survey during their math class. They first read a description of two potential computer science courses they could take in high school; the description indicated that one teacher was male and one was female. Teacher gender was thus manipulated within-subjects. To ensure that teachers were seen as competent and therefore adequate role models (Lockwood,

1. Students who did not provide their gender were omitted from analyses involving gender in both experiments.

2. Data from one student who participated in both experiments was discarded from Experiment 1, which he completed after Experiment 2. All other students completed only one experiment.

2006), both were described as having a graduate degree in computer science and years of experience teaching this course. Teacher gender order was counterbalanced with half of the participants responding to questions about the male teacher's course first, and half responding to questions about the female teacher's course first.

Participants were randomly assigned to one of three experimental conditions: stereotype threat, no gender difference, or baseline control. In the *stereotype threat* condition, participants read that male students perform better than female students in math- and science-related courses due to biological, genetic differences, and that males perform better than females in the potential computer science courses (adapted from Dar-Nimrod & Heine, 2006). In the *no gender difference* condition, participants read that research has found no gap between male and female students in math- and science-related courses, and that males and females perform equally well in the potential courses. In the *baseline control* condition, there was no paragraph regarding gender and performance.

Participants then answered questions about each computer science course, followed by demographic questions. The primary measures involved stereotype threat concerns (see items below); participants also answered other questions not relevant to the primary purposes of this study (e.g., "How social do you think the students in this class are outside of class?").

For debriefing, all participants read material at the end of the survey that described the purpose of the study, listed a website where they could learn more about majoring in computer science, and thanked them for their participation. Participants in the stereotype threat condition read several additional sentences in capitalized, bold typeface, emphasizing that there are no gender differences in performance on math and science tests.

Dependent measures

Attention and manipulation checks. We included two multiple-choice attention checks: number of courses (two) and topic (computer science). We also included two multiple-choice

manipulation checks: teacher gender (one male and one female) and performance of students in the course (stereotype threat condition: males earn higher grades; no gender difference condition: males and females earn the same grades; baseline control condition: this question was omitted). Overall, 94% of participants passed the number of courses question, 94% passed the course topic question, and 97% passed the teacher gender question. In the stereotype threat condition, 92% passed the question about performance in these classes, and in the no gender difference condition, 97% passed the performance question. Thirteen students were excluded from analyses for missing the performance check question and/or missing more than one check question. The pattern of results remained the same if these students were included.

Stereotype threat concerns. We created a four-item *stereotype threat concerns* scale based on items used in previous studies with high school and college students (Cohen & Garcia, 2005; Marx et al., 2005), including: “How much would you worry that your ability to do well in this class would be affected by your gender?” “If you took this class, how anxious would you be about confirming a negative stereotype about your gender?” “If you took this class, how much would you worry that people would draw conclusions about your gender based on your performance?” and “If you took this class, how much would you worry that people would draw conclusions about you, based on what they think about your gender?” We assessed internal consistency using Cronbach’s alpha, which indicated high reliability (e.g., Clark & Watson, 1995): male teacher: $\alpha = .89$; female teacher: $\alpha = .87$.

Results and discussion

A $2 \times 2 \times 3$ (Participant gender \times Teacher gender \times Threat condition [stereotype threat, no gender difference, or baseline control]) mixed-model analysis of variance (ANOVA) on stereotype threat concerns revealed a significant main effect of participant gender, $F(1,183) = 6.05$, $p = .015$, $d = 0.42$, and a significant interaction between participant gender and teacher

gender, $F(1,183) = 5.43, p = .021$,³ see Figure 1. Simple effects revealed that girls reported more concerns than boys with the male teacher (girls: $M = 3.00, SD = 1.55$; boys: $M = 2.25, SD = 1.34$), $F(1,183) = 10.10, p = .002, d = 0.52$, but not with the female teacher (girls: $M = 2.63, SD = 1.44$; boys: $M = 2.31, SD = 1.34$), $F(1, 183) = 1.49, p = .22, d = 0.23$.⁴ Planned post-hoc comparisons to test the teacher gender difference revealed that female and male teachers differed significantly only for girls in the stereotype threat condition, $F(1,183) = 7.23, p = .008, d = 0.41$; all other $ps > .20, ds < 0.24$. These results suggest that adolescent girls are sensitive to threatening cues in STEM courses, and that female teachers evoke fewer concerns compared to male teachers when these cues are salient.

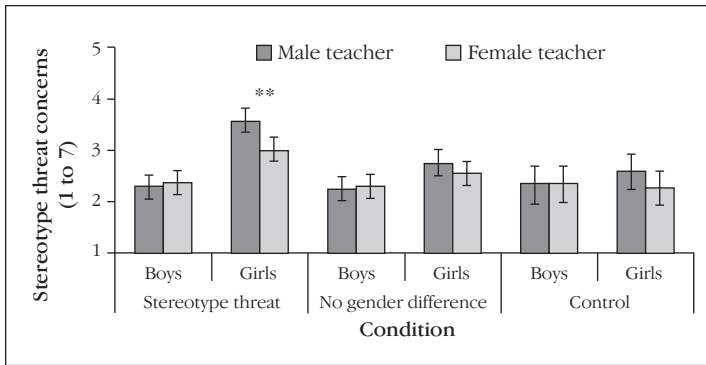


FIGURE 1: Stereotype threat concerns in Experiment 1. Error bars are ± 1 standard error. $**p < .01$.

3. The remaining interactions were non-significant: participant gender and condition: $F(2,183) = 1.49, p = .23$, teacher gender and condition: $F(2,183) = 0.36, p = .70$, and participant gender, teacher gender, and condition: $F(2,183) = 0.43, p = .65$.

4. We also examined whether order affected participants' responses. A $2 \times 2 \times 3 \times 2$ (Participant gender \times Teacher gender \times Threat condition \times Order [male teacher first, female teacher first]) mixed-model ANOVA revealed only a significant interaction between order and teacher gender, $F(1,177) = 7.29, p = .008$. No other interactions with order were significant, $F_s < 1.03, ps > .31$. Simple effects revealed that both girls and boys across threat conditions reported significantly more stereotype threat concerns for the male teacher compared to the female teacher when they rated the male teacher's course first, $F(1,177) = 9.48, p = .002, d = 0.26$, and not when they rated the male teacher's course second, $F(1,177) = 0.54, p = .46, d = 0.05$. A similar interaction with order was also found in Experiment 2. This order effect is not directly relevant to our main argument, but may have been due to the male teacher's course seeming less threatening to both girls and boys after considering a course taught by a female teacher.

Experiment 1 found that girls were more concerned about negative stereotypes than boys when the teacher was male, but not when the teacher was female. These differences are particularly evident when cues to threat are high. In Experiment 2, we sought to replicate these findings while also testing another stereotype threat manipulation.

Experiment 2

The purpose of Experiment 2 was three-fold. A first purpose was to replicate the pattern of results in Experiment 1. A second was to examine whether the effect would generalize using a different stereotype threat manipulation that was more relevant to the computer science courses that students were evaluating. A third purpose was to ensure that effects would generalize beyond verbal descriptions of the teachers. Because students often make judgments about teachers based on their appearances (e.g., with teacher photographs posted on school websites and in conjunction with course descriptions), we used photographs of teachers. We predicted that teacher gender would moderate girls' concerns about negative stereotypes only when stereotype threat was salient.

Method

Participants

Participants were 193 students at the same public high school as Experiment 1 (97 male, 93 female; three students did not provide gender; mean age = 16.14 years, $SD = 1.29$; age range: 14.58 to 19.58; 16 did not provide birthdate). Fifty percent were freshmen, 8% were sophomores, 22% were juniors, and 17% were seniors (3% did not provide this information). Participants were 36.3% White, 24.9% Latino/a, 14.5% Asian/Pacific Islander, 14.0% Multiple ethnicities, 5.7% Black, 0.5% Native American, and 2.1% Other (2.1% did not provide this information). Boys reported having taken significantly more computer science classes than girls (boys: $M = 0.98$, $SD = 1.27$; girls: $M = 0.50$, $SD = 0.82$), $t(183) = 3.05$, $p = .003$, $d = 0.45$. Recruitment was the same as Experiment 1; 85% of eligible students participated.

Procedure

The procedure was identical to Experiment 1, with two exceptions. First, we used a different stereotype threat manipulation related to the specific course (adapted from Rydell, McConnell, & Beilock, 2009). In the stereotype threat condition, they read, "As you may know, there seems to be a growing gap between male and female students in academic performance in math- and science-related courses. A good deal of research indicates that males consistently earn higher grades than females in computer science courses. In both Class A and Class B, male students perform better than female students." In the no gender difference condition, they read, "As you may know, there is no longer a gap between male and female students in academic performance in math- and science-related courses. A good deal of research indicates that males currently earn the same grades as females in computer science courses. In both Class A and Class B, male and female students perform equally well." In the baseline control condition, there was no paragraph regarding gender and performance.

Second, teacher gender was manipulated with photographs, instead of in the course description. Two sets of photos were used, and order of the male/female teacher photos was counter-balanced. (Photo set had no main effect or interactions on stereotype threat concerns, $ps > .10$.) To create these sets, 12 photographs were obtained from an internet search for "assistant professor." An independent group of college students ($N = 25$; 13 males and 12 females) rated the 12 photos (using scales ranging from 1 = *not at all* to 7 = *extremely*). The four target photos were selected because there was no difference between the male and female photos in terms of perceived warmth (males: $M = 3.82$, $SD = 1.04$; females: $M = 4.10$, $SD = 1.02$), attractiveness (males: $M = 3.26$, $SD = 1.28$; females: $M = 3.56$, $SD = 1.18$), competence (males: $M = 4.62$, $SD = 0.93$; females: $M = 4.78$, $SD = 0.80$), or smartness (males: $M = 4.94$, $SD = 0.89$; females: $M = 4.88$, $SD = 0.75$), $ts < 1.51$, $ps > .14$, $ds < .27$.

Dependent measures

Attention and manipulation checks. Participants completed the same four checks as Experiment 1. Overall, 92% of participants passed the number of courses question, 96% passed the course topic question, and 97% passed the teacher gender question. In the stereotype threat condition, 99% passed the performance question, and in the no gender difference condition, 92% passed the performance question. Seven students were excluded from analyses for missing the performance check question and/or missing more than one check question. The pattern of results remained the same when including these students.

Stereotype threat concerns. Participants completed the same stereotype threat concerns scale as in Experiment 1: male teacher: $\alpha = .86$; female teacher: $\alpha = .86$.

Results and discussion

A $2 \times 2 \times 3$ (Participant gender \times Teacher gender \times Threat condition [stereotype threat, no gender difference, or control]) mixed-model ANOVA on stereotype threat concerns revealed a significant main effect of participant gender, $F(1,167) = 6.42, p = .012, d = 0.39$, and a significant interaction between participant gender and teacher gender, $F(1,167) = 7.19, p = .008$, see Figure 2.⁵ Simple effects revealed that girls reported greater stereotype threat concerns than boys with male teachers (girls: $M = 3.08, SD = 1.52$; boys: $M = 2.31, SD = 1.38$), $F(1,167) = 11.74, p = .001, d = 0.53$, but not with female teachers (girls: $M = 2.61, SD = 1.33$; boys: $M = 2.39, SD = 1.50$), $F(1,167) = 1.15, p = .29, d = 0.16$. As in Experiment 1, planned post-hoc comparisons to test the teacher gender difference revealed that the teacher gender difference was significant only for girls in the stereotype threat condition, $F(1,167) = 13.50, p < .001, d = 0.54$; all other F s $< 2.75, p$ s $> .10, d$ s < 0.30 .

5. There was also a marginally significant main effect of teacher gender, $F(1,167) = 3.34, p = .07, d = 0.14$, and a marginally significant interaction between teacher gender and threat condition, $F(2,167) = 2.42, p = .09$, in which students in the stereotype threat condition reported significantly greater stereotype concerns for male teachers than female teachers, $F(1,167) = 7.85, p = .006, d = 0.31$, but there was no difference in the no gender difference condition, $F(1,167) = 0.09, p = .76, d = 0.04$, or the control condition, $F(1,167) = 0.54, p = .46, d = 0.08$. The three-way interaction between participant gender, teacher gender, and threat condition was non-significant, $F(2,167) = 0.42, p = .66$.

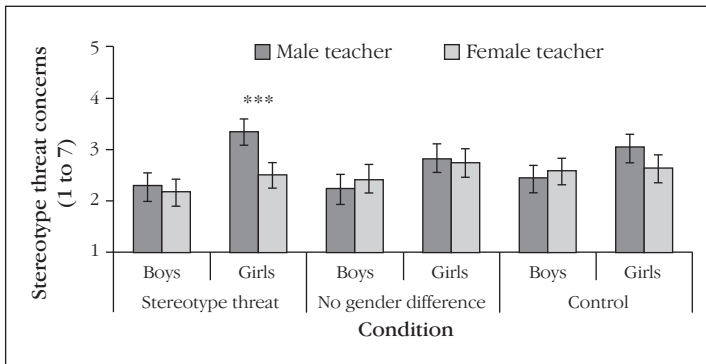


Figure 2: Stereotype threat concerns in Experiment 2. Error bars are ± 1 standard error. *** $p < .001$.

General discussion

Two experiments revealed that female teachers evoked fewer concerns from girls about negative stereotypes than male teachers, especially when threatening cues, or cues that signaled the strong likelihood that they would be judged through the lens of negative gender stereotypes, were present. These results held when stereotype threat was manipulated in two ways: broadly in terms of general math and science ability (Experiment 1) and also more specifically in terms of performance in the particular course (Experiment 2). The same results were also obtained when teacher gender was manipulated in two different ways: in the written course description and with photographs. These experiments are the first to manipulate both stereotype threat and teacher gender in the same study, revealing consistent effects on girls' concerns about negative stereotypes.

These findings have implications for educational practice, and for STEM industries and organizations. First, they suggest that female teachers may be most valuable compared to male teachers when stereotype threat is salient. In such cases—for example, when there are known or assumed gender differences in performance in a subject—schools should work to ensure that there are sufficient female teachers available. However, when threat cues are contradicted or not salient, male teachers seem just as effective as female teachers in keeping girls' concerns low. Second, these

findings indicate that male teachers must tread carefully in situations when negative stereotypes are salient and work to reduce the effects of those stereotypes, more so than female teachers. In efforts to reduce stereotype threat, both male and female teachers in STEM disciplines may wish to discuss reasons *other than ability differences* for women's underrepresentation in STEM (Dar-Nimrod & Heine, 2006), and encourage girls to choose these career paths. Other effective interventions to reduce stereotype threat include explicit conversations about how math and science ability can be increased through effort (Blackwell, Trzesniewski, & Dweck, 2007), or encouraging all students to affirm important values in the classroom (Miyake et al., 2010). These interventions may be especially useful for male teachers to diffuse stereotype threat in their classrooms.

There is an important caveat to bear in mind. Although female teachers in these studies were more effective than male teachers in minimizing girls' stereotype threat concerns, that does not mean that *all* female teachers will be better than *all* male teachers in addressing these concerns. The female teachers in these experiments were explicitly labeled as competent and experienced. Female teachers who appear to have low ability in the relevant domain may not be effective in reducing threat. Anxiety from female teachers about their ability may negatively impact girls' learning, which may increase girls' concerns about the implications of their own performance (Beilock, Gunderson, Ramirez, & Levine, 2010). Girls may also worry that female teachers who are not perceived as competent will confirm the negative stereotypes about their group.

Larger theoretical implications: Generalizing to other STEM stereotypes

How do we connect the current findings with other recent work demonstrating that stereotypes of the people in the field can deter girls from STEM (Master et al., 2014)? We suggest that there are two important types of stereotypes that have strong effects on girls' outcomes in STEM: negative stereotypes about *ability* (classic stereotype threat), and stereotypes about the *kind of people who belong* in STEM. Both types of stereotype-related

threats involve social identity threats—the threat of being judged, devalued, or treated negatively due to holding a “disadvantaged” identity in a setting (Steele, Spencer, & Aronson, 2002), but they are nonetheless distinguishable (Cheryan & Plaut, 2010).

First, girls in North America must contend with negative stereotypes about their *ability* in STEM fields (Good et al., 2003; Steele, 1997). Girls are aware of such stereotypes from an early age, and these stereotypes can have a powerful influence on their self-concept development (e.g., Cvencek et al., 2011; Cvencek, Meltzoff, & Kapur, 2014; see also Shenouda & Danovitch, 2014). The stereotypes may induce stereotype threat, thus resulting in a negative impact on girls’ academic achievement (Good et al., 2003; but see also Ganley et al., 2013; for a review, see Régner, Steele, Ambady, Thinus-Blanc, & Huguet, 2014) and motivation in STEM fields (Thoman, Smith, Brown, Chase, & Lee, 2013). The current findings indicate that female teachers can help to counteract these effects compared to male teachers, particularly when girls are threatened by negative stereotypes about their *ability*.

Second, stereotypes about *the people who belong* in STEM fields also deter girls from these fields (Cheryan, Plaut, Davies, & Steele, 2009). Many STEM fields, especially computer science, are stereotyped in American culture as “geeky” and masculine. These stereotypes can cause girls to feel that they do not belong in these fields. Indeed, previous research has found that making “geeky” STEM stereotypes salient decreases adolescent girls’ interest in taking courses in computer science, due to a feeling that they do not belong (Master et al., 2014). Environments that reflect these stereotypes decrease adult women’s expectations of success and interest in entering computer science (Cheryan, Meltzoff, & Kim, 2011; Cheryan et al., 2009), and peer role models who exhibit these stereotypes decrease women’s expectations of success and interest in STEM (Cheryan, Siy, Vichayapai, Drury, & Kim, 2011). Nonetheless, the gender of the role model per se, without taking into account other characteristics such as competence or stereotypicality, may not help to counteract the negative effects of these stereotypes about the people who belong in the field. Crucially, it has been demonstrated that female role models who simply embody the prevailing stereotypes can be less effec-

tive than male role models who do not (Cheryan, Drury, & Vichayapai, 2013; Drury, Siy, & Cheryan, 2011). Working to present non-stereotypical depictions of STEM environments and non-stereotypical role models may increase girls' sense of belonging and motivation to enter these fields.

At a broader theoretical level, we suggest that girls considering STEM fields face two distinct types of stereotype-related social identity threats. Stereotypes about girls' *ability* in STEM may lead girls to worry about confirming these negative stereotypes. Stereotypes about the *people* in STEM may lead them to worry that they do not *belong*. Both of these stereotypes have the potential to harm their performance and reduce their motivation in these fields.

We have focused here on how these types of threats affect females, but the ideas can usefully be generalized to other social identities. Perceived threats can apply to any group for which there are: (a) negative stereotypes about that group's ability in a particular domain, and (b) stereotypes about the people who belong in the domain that exclude members of that group. For example, these factors apply to Black and Latino students with respect to STEM. There are negative stereotypes about the academic abilities of Black and Latino students (Aronson, Fried, & Good, 2002), which may lead to stereotype threat effects in math and science domains. The members of STEM fields such as computer science are stereotyped as Asian and White (Margolis, Estrella, Goode, Holme, & Nao, 2008; Cvencek, Nasir, O'Connor, Wischnia, & Meltzoff, 2014), so Black and Latino students may feel that they do not fit the stereotype of who belongs in STEM. Future research should examine how both types of stereotypes may affect these underrepresented groups.

Competent female teachers may benefit girls in multiple ways. In addition to serving as role models, their gender may also serve as a cue to "identity safety" (Murphy & Taylor, 2012; Steele et al., 2002), sending a signal to girls that they will not be stereotyped based on gender in that environment. In-group members are less likely to induce stereotype threat compared to out-group members (Wout et al., 2009). There is no reason why individual male teachers could not provide cues to identity safety (e.g., by

explicitly refuting the stereotype) and therefore also buffer girls against threat. Future research should aim to distinguish specific mechanism(s) by which female teachers may protect girls' concerns in stereotype threat situations—(a) by serving as successful role models, (b) by creating identity-safe spaces, (c) or both. Future research should also examine how individual male teachers may be able to tap into those processes as well.

Future research should also examine these issues with younger age groups, prior to adolescence. Elementary and middle school may offer valuable opportunities to increase girls' motivation in math and science (Tai, Liu, Maltese, & Fan, 2006). Offering girls chances to participate in STEM-related activities (such as computer programming games) and meet competent female role models may help them be motivated to see themselves as scientists (Bryan, Master, & Walton, 2014), and pave the way for continued motivation in these fields. Future research should also examine the importance of female role models at different ages. Some research suggests that young girls are less susceptible to negative stereotypes about their ability than are adult women (e.g., Ganley et al., 2013). Thus, it may be useful for girls to have role models they see as “like me” (Meltzoff, 2013) in ways other than gender; for example, younger girls may be prompted to identify with STEM teachers based on characteristics that are not reducible to gender alone (e.g., shared interests), thereby fostering motivation in those courses.

Future research could also examine individual differences in how susceptible girls are to each type of stereotype (ability vs. social belonging), and create more targeted interventions (e.g., Shapiro, Williams, & Hambarchyan, 2013). There is reason to believe that some individuals may be more concerned about ability stereotypes, and some may be more concerned about stereotypes about the kind of people who belong in STEM fields. As a first step towards using these distinctions to design targeted interventions, we suggest that girls who are particularly concerned about ability stereotypes may benefit most from interventions involving role models or self-affirmations.

Despite pervasive negative stereotypes about the ability of girls in STEM, many girls and women are successful in, and enjoy, STEM

activities, classes, and careers. However, negative gender stereotypes are among a host of psychological and institutional factors that deter others who would otherwise reap benefits from greater involvement in STEM. Counteracting stereotypes is important for encouraging girls' future participation in STEM, with measurable benefits for all of society.

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