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Negative Exposure: Watching Another Woman Subjected to Dominant Male Behavior During a Math Interaction Can Induce Stereotype Threat

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Abstract

This research examined whether simply watching videos of a man behaving dominantly toward a woman during a math-related interaction hurts women's math performance. Men and women watched videos of male–female interactions related to math (stereotype-relevant) or studying (stereotype-neutral) in which the male was dominant, the female was dominant, or the two were equally dominant. Women who watched a video of a dominant male in a math interaction showed reduced math performance and had greater worries about confirming negative in-group math stereotypes than when the video showed a studying interaction; however, women who watched a video of a man and woman equal in dominance or a dominant female did not show such performance decrements and worries. These effects did not occur for men. This work suggests that brief video exposure to male dominant behavior aimed at a female in a math context can lead women to experience stereotype threat and underperform.

Keywords

stereotype threat, gender, math performance, dominance

Historically, men have outnumbered women in fields of science, technology, engineering, and mathematics (STEM). Over the last few decades, women's representation in STEM fields has steadily increased; however, women continue to experience difficulties obtaining advanced academic and industry positions in STEM, due in part to women being less likely to receive the undergraduate-level (most notably in technology and engineering fields) and graduate-level degrees necessary for such placement (National Science Foundation, 2011). Understanding women's pursuance of degrees and success in these domains is certainly complicated. One complication is the pernicious threat that can pervade performance environments and negatively impact women's performance, with considerable research showing that women have the requisite ability to learn and perform in STEM fields, but the academic situation they face can sometimes prevent an accurate demonstration of their abilities (e.g., Spencer, Steele, & Quinn, 1999).

Research on stereotype threat (see Inzlicht & Schmader, 2012, for a review) has helped us understand the experience women face when performing in STEM disciplines, especially in the domain of math. Stereotype threat occurs when an individual becomes aware of a negative stereotype about their in-group's ability (e.g., ''women are bad at math''), leading them to worry about confirming the stereotype with their performance in that domain (e.g., Steele & Aronson, 1995). Extensive research has demonstrated that women experiencing stereotype threat perform worse at math than women not experiencing threat and men (see Schmader, Johns, & Forbes, 2008). Even subtle cues in a testing situation can trigger stereotype threat. For example, being outnumbered by men (Inzlicht & Ben-Zeev, 2000), overhearing an in-group peer experiencing threat (Cohen & Garcia, 2005), interacting with a sexist man (Logel et al., 2009), and indicating one's gender on a demographic survey (e.g., Rydell, McConnell, & Beilock, 2009) can all lead women to underperform in math.

Work on these subtle stereotype threat cues has begun to shed light on the complex situation women face in these types of performance settings. However, there is still relatively little research examining how more incidental forms of threat, where the threatening cue is more passive (i.e., is not directly targeted at the perceiver) and where the cue could potentially occur frequently in the real world, impact negatively stereotyped individuals. The current work begins to explore one such form

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of more passive threats that may occur by examining whether simply witnessing certain types of social interactions can evoke stereotype threat when they take place in stereotyped domains. Specifically, we chose to focus on interactions that may occur, and may occur regularly, in the course of women's everyday lives (e.g., at home, in the office, and at school): seeing a man, whether he is aware of his actions or not, acting dominantly toward a woman. When these interactions take place in contexts in which women are negatively stereotyped, such as math contexts, the dominance behaviors exhibited in the interaction may provide important information to female viewers regarding whether or not they belong and will be negatively evaluated in similar situations (e.g., Cheryan, Plaut, Davies, & Steele, 2009; Cohen & Garcia, 2008; see also Murphy & Taylor, 2012). When these cues signal to women that they do not belong or might be negatively evaluated in a math context, they may experience stereotype threat (e.g., Inzlicht & Ben-Zeev, 2000; Murphy, Steele, & Gross, 2007; Sekaquaptewa & Thompson, 2002, 2003; Steele, 1997); that is, they can experience negative thoughts, arousal, and ruminations that lead women under threat to suffer reductions in the working memory capacity needed to solve difficult math problems (Schmader et al., 2008). Thus, simply witnessing a female actor subjugated in a stereotype-relevant situation by, for example, a man telling the woman what to do or exhibiting dominant nonverbal behavior (e.g., open posture, gesturing, and not looking while listening) toward her in a math classroom could lead female perceivers to feel threatened and display impaired math performance.

The aim of the current experiment is to provide an initial examination of the effect of exposure to dominant interactions on women's math performance, primarily attempting to demonstrate that exposure to these interactions in a math context can evoke stereotype threat and lead to reduced math performance. To do this, we created videos of male–female dyadic interactions in which the interaction took place in a stereotype-relevant (i.e., math) or a stereotype-neutral (i.e., studying) context and the man was dominant (and the woman was submissive), the woman was dominant (and the man was submissive), or the man and woman were equal in dominance. We hypothesized that women who viewed the male-dominant math video would show impaired math performance and report the greatest worry about confirming the stereotype (i.e., threat-based concern [TBC]; Marx, 2012). However, we predicted that if men and women are equal or the woman is dominant in the observed interaction, women would be protected from stereotype threat. As watching dominant behavior of any kind in a math context (i.e., regardless of the gender of the actor who behaves dominantly) could provide a potential alternative explanation as to why women might underperform at math, we included the female-dominant video to examine this alternative explanation. Nonetheless, we did not expect to see performance differences for women in response to watching the female-dominant video. Moreover, because men should not experience stereotype threat, we did not expect men to show differences in math performance or TBC as a function of the video they watched.

Our research advances the relatively small literature on subtle stereotype threat cues and performance in several ways. Cohen and Garcia (2005) showed that when a participant overheard an in-group confederate expressing worries and concerns about their performance in a stereotyped domain, this led to a type of social identity threat called "collective threat." The key term in these experiments is "collective": The participant, though not personally receiving threatening information, experiences the stereotype threat cue via an in-group peer (i.e., voiced concerns by a confederate or a digital recording about doing poorly on a math task coming from another cubicle in the lab) from within the same environment (i.e., in the same lab). This leads participants to worry about how the in-group peer's potential performance will reflect upon the in-group, resulting in reduced self-esteem and performance. The participant's experience in our experiment, on the other hand, is very much removed from the experience of the actor in the videotaped interaction: The videotaped interaction does not take place in the same physical environment as the participant's math test, which clearly occurred in the past, and the woman in the video does not express worries about her math performance or even take a math test. Thus, there is no clear reason for our participants to worry about how the potential performance of the woman in the video might reflect upon the in-group. Given this, there is little reason to believe that participants watching videos in our experiment would experience collective threat. Women in our experiment may instead perceive the behavioral cues displayed in the male-dominant math videos as signaling that they do not belong or will be negatively evaluated in these types of math contexts, leading to identity threat or stereotype threat (Walton & Cohen, 2007). Therefore, our work could demonstrate that women need not have all of the specific conditions for collective threat met (i.e., overhearing and being in the same place at the same time as an in-group peer who is worried about her performance in a stereotyped domain) nor worry specifically about how an in-group members' performance will reflect upon the in-group (i.e., experience collective threat) in order to exhibit impaired math performance, thus highlighting just how subtle stereotype threat cues can be and still lead to the experience of threat.

Our work also adds significantly to the work reported by Logel et al. (2009), who examined how sexist male engineering students interacted differently with highly domain-identified female engineering students than nonsexist male engineering students. In their experiment that is most similar to ours (Experiment 3), male confederates displayed nonverbal behavior consistent with how sexist men act toward women (in a live interaction) and the female interaction partners' (i.e., the participants') behavior was free to vary. In contrast, in our videos we manipulate male and female behavior to model well-studied dominance behaviors (Hall, Coates, & LeBeau, 2005) that emerge for both partners in dyadic interactions when one partner displays dominance (e.g., Tiedens & Fragale, 2003). Viewers, therefore, will be provided with a fuller understanding of the actor's relationship from our videos, and the resulting threat that may occur from watching these videos should impact female viewers even if they are not highly identified with the domain of math. Moreover, while it is possible that dominance contributes to sexist attitudes, measures of these two constructs were combined in Logel et al.'s experiments, making it difficult to determine which aspects of the male confederates' behaviors were responsible for women's performance in their work. In fact, some of the sexist behaviors in that work were inconsistent with dominance. For example, sexist men in their studies looked often at their female partner, primarily at her body, whereas our dominant men exhibited a specific looking pattern associated with dominance (not looking at their female partner when listening, but looking her in the eyes when talking; i.e., high visual-dominance ratio; Dovidio & Ellyson, 1982). Thus, our interactions clearly manipulated dominance, not sexism. This distinction is particularly important in rooting out and protecting against threats to performance in classrooms and the workplace, where dominance may be more likely to be overlooked, justified, or even encouraged compared to sexism, as the assertiveness and authority that come with dominance can also be associated with competence.

Method

Participants and Design

Female ($n = 133$) and male ($n = 101$)[1] undergraduates were randomly assigned to a 3 (dominance: equal-dominance, female-dominant, male-dominant) $\times$ 2 (topic: studying, math) between-subjects factorial.

Materials and Procedure

Interaction Videos. The videos contained scripted dyadic interactions between a male and a female actor sitting across from each other and engaged in a conversation. All versions of the video lasted approximately 45 s and the general content was carefully matched across experimental conditions.

To manipulate dominance, we varied who displayed behavioral dominance cues in the interaction with the nondominant actor displaying relatively submissive behaviors (Burgoon & Dunbar, 2005). Three nonverbal behaviors were used to indicate greater dominance (Hall et al., 2005): greater visual dominance ratio, increased gesturing, and greater use of relaxed postures. The nondominant actor exhibited a lower visual dominance ratio, little gesturing, and closed/erect postures. In addition, the dominant actor used several verbal command statements (e.g., "You need to . . . "). In the male-dominant condition, the man displayed these verbal and nonverbal behaviors toward the woman, whereas in the female-dominant condition, the woman displayed these dominant behaviors toward the man. In the equal-dominance condition, the man and the woman's behaviors were matched for, and relatively low in, dominance.

In all of the interactions, actors discussed forming a study group. To manipulate stereotype-relevance, the topic of the study group was about math (stereotype-relevant) or about studying in general (stereotype-neutral).[2]

Procedure. Participants were told they would be participating in a small number of (presumably) unrelated experiments examining how they process and utilize information. The first experiment they completed was aimed at understanding how people process visual information. They learned they would watch a video of two people forming a math study group (math conditions) or a study group (studying conditions) and were told they would be asked questions about the video later in the experiment. Participants watched the video twice. Then, as part of an ostensibly unrelated experiment in which they worked on "quantitative problems," they had 20 min to complete 30 Graduate Records Exam (GRE) math problems (Schmader & Johns, 2003). Finally, participants completed a 3-item TBC measure ($\alpha = .88$; e.g., "I worry that my ability to perform well on math tests is affected by my gender.") and indicated their gender.

Results

Math Performance

To assess math performance, we calculated a percent correct math score for each participant by dividing the number of problems answered correctly by the total number of problems attempted. A 3 (dominance) $\times$ 2 (topic) $\times$ 2 (gender) analysis of variance (ANOVA) showed the predicted three-way interaction, $F(2, 222) = 4.04$, $p = .019$, $\eta_p^2 = .035$ (see Figure 1). For women, the dominance by topic interaction was significant, $F(2, 127) = 7.52$, $p = .001$, $\eta_p^2 = .106$, with women performing worse on the math test when the male-dominant interaction was about math than about studying, $F(1, 127) = 16.25$, $p < .001$, $\eta_p^2 = .113$. There were no differences in math performance for women as a function of topic in the equal-dominance or female-dominant conditions, Fs < 2.19, ps $> .13$. The dominance by topic interaction was not significant for men, $F(2, 95) = .21$, $p = .81$, $\eta_p^2 = .004$.

We also examined the effect of gender, dominance, and topic on the number of problems answered correctly and the total number of problems attempted in separate ANOVAs. We found the expected three-way interaction for the number of problems answered correctly, $F(2, 222) = 4.24$, $p = .016$, $\eta_p^2 = .037$. For women, the dominance by topic interaction obtained, $F(2, 127) = 4.87$, $p = .01$, $\eta_p^2 = .071$, with women showing worse math performance in the male-dominant condition when the interaction was about math ($M = 5.23$) than about studying ($M = 9.42$), $F(1, 127) = 11.01$, $p = .001$, $\eta_p^2 = .08$. Again, women's math performance did not differ as a function of topic in the equal-dominance or female-dominant condition, Fs < 1.23, $p > .28$. The dominance by topic interaction was not significant for men, $F(2, 95) = .95$, $p = .39$, $\eta_p^2 = .02$. For the number of problems attempted, only the two-way interaction of gender and dominance was significant, $F(2, 222) = 3.26$, $p = .04$, $\eta_p^2 = .029$, with men ($M = 15.65$)

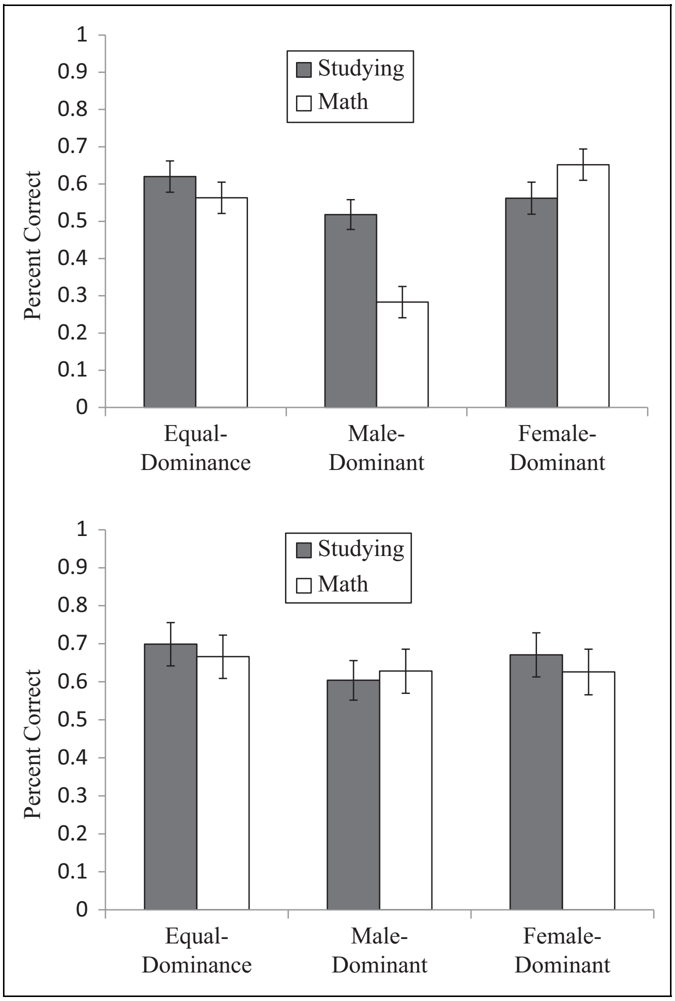

Figure 1. Percentage of math problems answered correctly for women (top panel) and men (bottom panel) as a function of dominance and topic of the interaction video. Error bars indicate standard error.

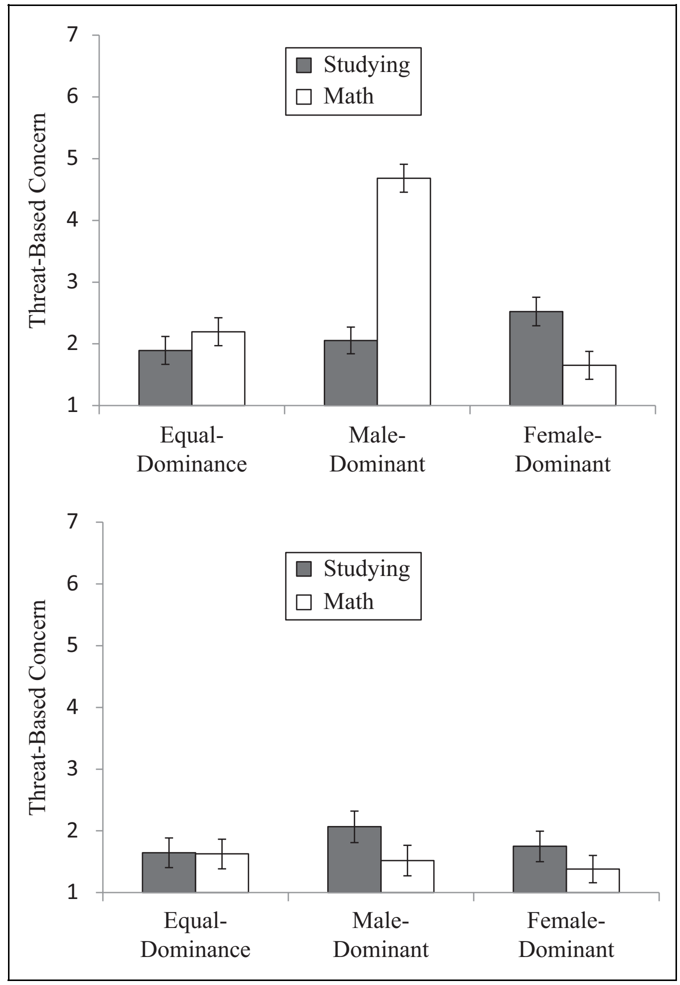

Figure 2. Threat-based concern for women (top panel) and men (bottom panel) as a function of dominance and topic of the interaction video. Error bars indicate standard error.

attempting fewer problems than women ($M = 19.48$) in the equal-dominance condition, $F(1, 222) = 6.28$, $p = .013$, $\eta_p^2 = .027$. Importantly, the three-way interaction for the number of problems attempted was not significant, $F(2, 222) = .27$, $p = .76$, $\eta_p^2 = .002$; thus, differences in math performance were not likely due to differences in motivation or effort.

TBC

The effect of gender, dominance, and topic on TBC scores was examined. The predicted three-way interaction obtained, $F(2, 222) = 16.51$, $p < .001$, $\eta_p^2 = .129$ (see Figure 2). The interaction of dominance and topic on TBC was significant for women, $F(2, 127) = 31.53$, $p < .001$, $\eta_p^2 = .332$. There was no difference as a function of topic on TBC scores for women in the equal-dominance condition, $F(1, 127) = .90$, $p = .35$, $\eta_p^2 = .007$, whereas in the male-dominant conditions, women's TBC scores were higher in the math condition than the studying condition, $F(1, 127) = 70.45$, $p < .001$, $\eta_p^2 = .36$. In the female-dominant condition, there was an unexpected difference in women's TBC scores, with higher scores when the interaction topic was studying than when the topic was math, $F(1, 127) = 7.28$, $p = .008$, $\eta_p^2 = .05$. There were no significant effects of dominance, topic, or their interaction on TBC for men, Fs < 2.50, ps $> .11$.

Discussion

The goal of the current work was to begin to explore the consequences of quite subtle and passive forms of stereotype threat for women in math. Our findings show that simply being exposed to certain types of social interactions can lead women to experience stereotype threat. Specifically, we found that when watching a video in which a woman was subjected to dominant behavior by a man in a math context, female participants showed reduced math performance and reported greater worry about confirming the negative stereotype. However, when women watched a video in which the man and woman were equal in dominance or the woman was dominant over the man, female participants were protected from stereotype threat and did not exhibit these math performance decrements and associated worries. These effects were specific to the stereotyped group, as they did not occur for men.

While the primary purpose of the current experiment was to provide an initial demonstration of the effect that exposing women to male-dominant interactions that occur in a stereotyped context can lead the female viewers to experience stereotype threat, it is important to think about how these effects occur. Given the research on stereotype threatening environments (see Murphy & Taylor, 2012), we believe that a similar process may be unfolding as women watch the interaction videos in our experiment. That is, when women enter situations in which their group membership might be particularly relevant, such as a stereotyped domain, women look for cues that indicate if the situation is one in which they may not belong or will be negatively evaluated (Cohen & Garcia, 2008). If they find evidence that confirms this hypothesis, they may experience stereotype threat (e.g., Inzlicht & Ben-Zeev, 2000; Murphy et al., 2007; Sekaquaptewa & Thompson, 2002, 2003) and the negative affective and cognitive consequences that accompany threat (e.g., Schmader et al., 2008).

In our experiment, women were told that the interaction they were about to watch was about forming a study group (neutral context) or a math study group (stereotyped context). Thus, it is possible that women in the math study group condition were particularly vigilant for cues in the videotaped interaction that might indicate if women did not belong or would be negatively evaluated (i.e., identity threatening) in similar contexts. When female viewers saw the equal dominance or female-dominant math videos, even though they may have been vigilant for identity cues when watching the video, the behaviors in these videos likely served as cues disconfirming that the situation was identity threatening, thus protecting them from stereotype threat. In contrast, when the math video showed the man ordering the woman around and expressing his dominance nonverbally (i.e., male-dominant video), these behaviors likely signaled to female viewers that this was an identity threatening environment, thereby evoking stereotype threat and the associated worries, ruminations, and arousal that have been shown to diminish working memory capacity (Schmader et al., 2008) and leading women to show the impaired math performance and greater reported TBC found in our experiment. It will be important for future research to further examine exposure to dominant behavior between men and women and to begin examining the mechanisms underlying the effects of exposure to these types of interactions in order to better understand how stereotype threat plays out in real-world settings. Exposure to these types of interactions may represent common experiences for women who simply spend time in places where math-related conversations transpire (e.g., a math class or a university library). Continuing to study effects and mechanisms of exposure to dominant interactions will be critical in generating interventions that might be efficacious in protecting and preventing women from the negative consequences of such subtle forms of stereotype threat.

The main findings from this research, that the dominance of a male actor's behavior toward a female actor while in a stereotype-relevant domain can affect the feelings and performance of women who merely watch this behavior, have interesting implications for women's everyday experiences of stereotype threat. First, threatening cues that occur outside of a performance environment (i.e., those not specifically related to math ability in the testing situation) or that do not impact an individual directly (e.g., threatening interactions may not need to involve an individual to impair one's performance or one's own ability need not be in question) may carryover to hurt later math performance. Second, simply witnessing an interaction in a math context, even if the discussion content of the interaction is not itself math-related, may lead women to experience stereotype threat (e.g., if a man is behaving dominantly toward a woman in a math classroom, but while talking about his weekend plans). Third, when women are exposed to other women who are dominant or equal with men during math-related interactions, they are less vulnerable to threat. This buffering effect may be especially effective because it may not require some of the additional conditions found in past research to be necessary to protect women from stereotype threat (as is often necessary for the positive effects of female role models; e.g., Marx & Roman, 2002). That is, women were protected from stereotype threat in our experiment without the woman in the video necessarily being successful in the math domain and without having to consciously reflect on how the woman in the video related to the self. Thus, allowing women to not only take on dominant roles but also encouraging equality between men and women in math settings should protect other women from stereotype threat.

Other work in the stereotype threat literature that has looked at the impact exposure to videos has on women's math performance has found that women who watch videos of commercials of a woman acting stereotypically activates general gender stereotypes for both men and women, but only women subsequently show reduced math performance and interest in math-related careers (Davies, Spencer, Quinn, & Gerhardstein, 2002). While our work and that of Davies and colleagues (2002) used videos as the primary manipulation, our research differs from theirs in two key ways: the content and type of exposure and the processes implied by our effects. The two stereotypic videos used in Davies et al. are actual professionally produced commercials from television, one of which shows a woman "drooling" over a new kind of brownie mix and the other depicts a woman "bouncing on her bed with joy" over a new acne product (p. 1619), whereas our videos were created to represent relatively everyday interactions with others that women may encounter in math (or study) contexts. Thus, Davies et al. focus only on the woman in the video (there were no men in their stereotypic videos) and how she represents a sort of caricature of stereotypic femininity outside of the negatively stereotyped domain of math. In contrast, our work focuses on the dynamic relationship between both women and men, which occurs in social interactions in different types of very specific contexts and situations (i.e., stereotype-relevant vs. stereotype-neutral), and is particularly interested in the impact of the dominant and submissive behaviors that may play out in interactions in these types of relatively naturalistic scenarios.

The effects demonstrated by Davies et al. (2002) appear to be due to an indirect priming process, with watching commercials of a woman acting stereotypical in situations unrelated to the stereotyped domain of math activating broad gender stereotypes (e.g., women as intuitive, gullible, and wasteful) for women who later seemingly apply this stereotype activation, which presumably also includes activation of the stereotype that women are bad at math, when they subsequently take a math test. This indirect process of applying a general gender stereotype to their later math performance may be why Davies et al. do not find performance differences as a function of the math test's purported diagnosticity (a manipulation that typically incurs performance effects when the test is "diagnostic" but eliminates stereotype threat-based performance effects when the test is "nondiagnostic"; e.g., Steele & Aronson, 1995). In contrast, we demonstrate a more direct process through which stereotype threat is elicited. Women who are exposed to videos of a man acting dominantly toward another woman worry about the gender-math stereotype and underperform on a math test only when the videotaped interaction takes place in a situation where gender-based stereotypes about math are relevant: a mixed-gender math study group. Furthermore, we believe that performance decrements for women who watched a dominant male and subordinate female discuss a math study group may be due to women perceiving these behaviors as cues that they do not belong or will be negatively evaluated in similar math situations; thus, the stereotype-relevant context of the interaction is critical. If our results were due to stereotype priming, a process similar to Davies et al., we might expect that showing a submissive (i.e., potentially stereotypic) woman in our videos would lead women watching this video to show reduced math performance, regardless of the topic of the interaction. However, our effects were specific to the dominant videos related to the stereotyped domain of math and did not occur for women watching videos where a dominant male and submissive female discussed a generic study group.

Conclusion

Our research illuminates how pernicious stereotype threat can be. Simple exposure to interactions between men and women is enough to induce stereotype threat in women observing such interactions, even those who are not highly math identified (cf. Logel et al., 2009). However, this work also demonstrates the potentially far-reaching benefits of encouraging equality and female leadership in the classroom; it can protect others from threat. By understanding the impact of observing these interactions in and out of the classroom, we can hopefully put women in the position to be more successful in STEM fields.

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Notes

1. Due to an experimenter error, the male-dominant condition was oversampled ($n = 94$). To equate the number of men across conditions, we randomly selected 35 participants from the male-dominant condition for the final analysis. Using the full sample does not change the results.
2. To validate the dominance manipulation, 130 women and 84 men were randomly assigned to condition in a 3 (dominance: equal-dominance, female-dominant, male-dominant) × 2 (topic: studying, math) × 2 (actor set: 1, 2) design, with actor set as a within-subjects factor. Women rated the actors on dominance on a scale ranging from 1 (*very slightly or not at all*) to 5 (*extremely*) and attractiveness on a scale ranging from 1 (*not at all attractive*) to 6 (*very attractive*) after watching each video. Because of the strong positive correlations between the actor sets on ratings of dominance and attractiveness, we collapsed across actor set on both measures. Dominance ratings showed the expected two-way interaction, $F(2, 202) = 551.32$, $p < .001$, $\eta_p^2 = .845$. The man ($M = 3.99$) was rated as more dominant than the woman ($M = 2.03$) in the male-dominant condition, $F(1, 211) = 545.65$, $p < .001$, $\eta_p^2 = .723$, and the woman ($M = 4.25$) was rated as more dominant than the man ($M = 2.03$) in the female-dominant condition, $F(1, 211) = 572.65$, $p < .001$, $\eta_p^2 = .731$. The woman ($M = 3.32$) in the video was also rated slightly more dominant than the man ($M = 2.99$) in the nondominant condition, $F(1, 211) = 16.36$, $p < .001$, $\eta_p^2 = .072$, but this difference in dominance between male and female actors was substantially smaller than in the other two dominance conditions of interest. Importantly, the three-way interaction of dominance, dominance ratings, and gender was not significant, $F < 1$, showing that men and women did not perceive the male and female actors differently in terms of dominance. Attractiveness ratings showed lower order effects, but the four-way interaction was not significant, $F < 1$, making it unlikely that the attractiveness of the actors affected performance in our experiment.

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