

Multiple Social Identities and Stereotype Threat: Imbalance, Accessibility, and Working Memory

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In 4 experiments, the authors showed that concurrently making positive and negative self-relevant stereotypes available about performance in the same ability domain can eliminate stereotype threat effects. Replicating past work, the authors demonstrated that introducing negative stereotypes about women's math performance activated participants' female social identity and hurt their math performance (i.e., stereotype threat) by reducing working memory. Moving beyond past work, it was also demonstrated that concomitantly presenting a positive self-relevant stereotype (e.g., college students are good at math) increased the relative accessibility of females' college student identity and inhibited their gender identity, eliminating attendant working memory deficits and contingent math performance decrements. Furthermore, subtle manipulations in questions presented in the demographic section of a math test eliminated stereotype threat effects that result from women reporting their gender before completing the test. This work identifies the motivated processes through which people's social identities became active in situations in which self-relevant stereotypes about a stigmatized group membership and a nonstigmatized group membership were available. In addition, it demonstrates the downstream consequences of this pattern of activation on working memory and performance.

Keywords: stereotype threat, multiple social identities, working memory, social identity accessibility, choking under pressure

Have you ever felt the weight of expectations hanging around your neck? Expectations about what your parents want you to do or who your romantic partner wants you to be? What about situations in which there are expectations that you will fail, or are incapable of performing well, because of who you are or, more precisely, because of the social groups to which you belong? Focusing on this latter situation, *stereotype threat* research has examined how activating culturally shared negative stereotypes reduces the performance of stereotyped group members (e.g., Steele & Aronson, 1995). The main thrust of this work shows that making people aware, either blatantly or subtly, of negative stereotypes relevant to a social group to which they belong impairs individuals' performance in the stereotyped domain (Steele, 1997; Steele, Spencer, & Aronson, 2002).

In contrast to theories of ability based on, for example, genetic differences between groups (see Benbow & Stanley,

1980), stereotype threat research has shown that the situation—namely, performing in a domain that can confirm or disconfirm a negative stereotype about one's group—contributes to group differences on tasks as diverse as intelligence tests (e.g., Steele & Aronson, 1995), memory tests (e.g., Levy, 1996), mental rotation tasks (e.g., Wraga, Duncan, Jacobs, Helt, & Church, 2006), golf putting (e.g., Beilock, Jellison, Rydell, McConnell, & Carr, 2006), and math tests (e.g., Beilock, Rydell, & McConnell, 2007; Spencer, Steele, & Quinn, 1999). With the importance and impact of stereotype threat clearly established (e.g., Steele, 1997; Steele et al., 2002), the processes underlying stereotype threat on the basis of performance decrements have been examined in the past decade of research (see Schmader, Johns, & Forbes, 2008).

In the present work, we examined recent process accounts of stereotype threat to understand why stereotype threat occurs (Schmader et al., 2008). But, we advanced this process account in significant ways. Namely, we used this literature as a starting point to explain why there is reason for hope in reducing threat by capitalizing on the fact that (a) individuals can be categorized on the basis of any one of multiple social identities (Hugenberg & Bodenhausen, 2004; Macrae, Bodenhausen, & Milne, 1995) and (b) people often view themselves as a member of multiple social groups that are subject to positive or negative stereotypes about the performance domain in question. We concluded that the increased accessibility of a social identity that is associated with a positive stereotype in the domain being threatened should reduce the im-

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pact of stereotype threat when a social identity that is associated with a negative stereotype is also available.

First, however, we addressed why there would be an increase in the accessibility of a social identity that is associated with positive performance stereotypes when negative performance stereotypes in that same domain are also available. Social identity theory (SIT; Tajfel & Turner, 1986) provides a solid theoretical rationale and a set of empirical findings to address the issue of which of people's many social identities is activated at a given time. SIT is based on people's motivation to feel positively about the self. And, in large part, people fulfill this motivation through identifying with social groups. Of interest to stereotype threat research (e.g., Steele, 1997) is how people contend with having group memberships that do not contribute to greater self-esteem (e.g., group memberships associated with negative performance stereotypes). Tajfel and Turner (1986) described three alternative ways that people can deal with these situations. First, and of importance to the present work, people opt to leave a group that does not enhance the self, and this departure can be objective or subjective. Subjectively leaving the group occurs through lowering identification with the negatively viewed group and increasing identification with another group or increasing personal identification. There are two alternative strategies that people can use to deal with being a member of a negatively stereotyped group (either objectively or subjectively): They will either reinterpret group attributes to make them more acceptable (see Crocker & Major, 1989) or engage in social action to promote desirable changes for the group; although all of these strategies are valid, only the first strategy is examined here.

Subjectively leaving the group is important for understanding the possible interplay of identification and stereotype threat when multiple social identities, with conflicting performance stereotypes in the same domain, are present. That is, given the motivation to view the self positively (e.g., Dunning, 2001) and the malleability of people's active social identity (e.g., Hugenberg & Bodenhausen, 2004), we predict that when people have two applicable social identities, they will categorize themselves in line with the positive identity (i.e., they subjectively leave the negatively stereotyped group) to maintain self-esteem (e.g., Mussweiler, Gabriel, & Bodenhausen, 2000; Roccas, 2003a, 2003b). Moreover, research has shown that when two possible social identities are available, the activation of one identity serves to make that identity accessible and to inhibit the activation of the alternative social identity (e.g., Bodenhausen & Macrae, 1998; Hugenberg & Bodenhausen, 2004). Therefore, we predict that the social identity associated with a positively stereotyped group in a domain should be highly accessible, whereas the social identity associated with a negatively stereotyped group in that same domain should be inhibited, allowing people to clearly establish identification with the more positive social identity. We believe that this increased identification with the positively stereotyped social identity will reduce stereotype threat. Next, we detail how and why this process of identification can be used as leverage to design manipulations to alleviate stereotype threat.

A Process Account of Stereotype Threat for Women in Math

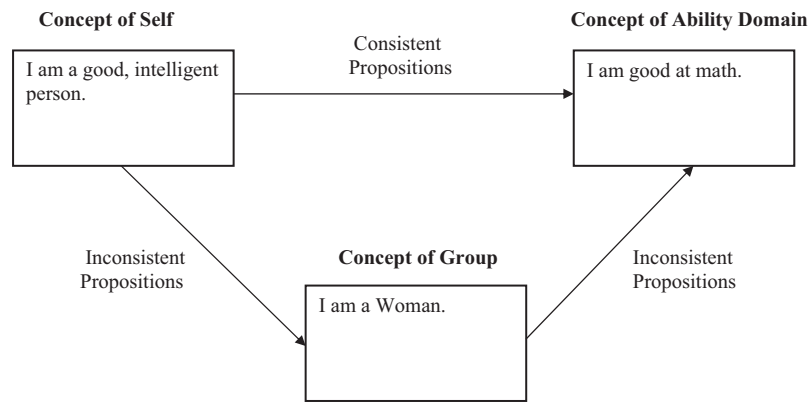
The process account of stereotype threat that guides the present work is most clearly described by Schmader et al. (2008). The

fundamental postulate of this model is that people typically view themselves positively and want to maintain this view of the self (Aronson, 1998; Baumeister, 1998; Dunning, 2001; Greenwald et al., 2002; Steele, 1988). Because of the drive to maintain the positivity and integrity of the self, what happens when people encounter a stereotype about a group they belong to that is negative—especially given that one's sense of self is in part determined by group membership (Baumeister & Leary, 1995)? As Schmader et al. (2008) outlined (see also Nosek, Banaji, & Greenwald, 2002), stereotype threat stems from cognitive imbalance that occurs when people's positive sense of self is inconsistent with the expectation that a social group to which they identify should fail in a given performance domain. For example, most women view themselves as capable, competent, and able to achieve. However, there is a pervasive stereotype that women are bad at math (e.g., Beilock, 2008; Beilock et al., 2007; Spencer et al., 1999). This creates a cognitive imbalance in women because, without activation of the female social identity, they expect to be competent at math. Yet, when the negative stereotype about women and poor math performance is made accessible by the activation of their female identity (e.g., Schmader, 2002; Shih, Pittinsky, & Ambady, 1999), this stereotype is directly contradictory to their positive expectations. The contradictory information about how the self will perform at math and how women will perform at math sets the stage for stereotype threat (see Figure 1, Panel A).

As Schmader et al. (2008) outlined, when the concept of the group (e.g., "I am a woman"), the concept of the self (e.g., "I am a good, intelligent person"), and the concept of the ability domain (e.g., "I am good at math") are inconsistent because of the predominant stereotype that women are bad at math (i.e., logically, given these propositions, one cannot be both a female and good at math; see Nosek et al., 2002; Sloman, 1996), it sets into motion a cascade of psychological processes that impair women's success at math problems. Research suggests that such imbalances lead to verbal ruminations or worries about performance and worries about confirming the pejorative stereotype, reducing working memory resources required to solve difficult math problems (Beilock et al., 2007; Cadinu, Maass, Rosabianca, & Kiesner, 2005; Croizet, Despres, Gauzins, Hugué, & Leyens, 2004; Schmader & Johns, 2003).

Given that researchers' understanding of the processes involved in stereotype threat is increasing, one important question to address concerns how people deal with this imbalance to reduce stereotype threat effects. Consistent with a balance perspective, some of the most effective manipulations to date in terms of reducing stereotype threat deal directly with the imbalance between the concept of the self in a certain performance domain (e.g., math) and the concept of one's currently accessible social identity (e.g., gender). Relating this notion explicitly to SIT, consider the case of a female college student who is aware of the stereotype that college students (relative to same-age noncollege students) are good at math. In this case, increased identification with the positively stereotyped group (i.e., college students) and decreased identification with the negatively stereotyped group (i.e., women) will create balance between the concept of the group (e.g., "I am a college student"), the concept of the self (e.g., "I am a good, intelligent person"), and the concept of the ability domain (e.g., "I am good at math") (see Figure 1, Panel B). This is because college students (relative to nonstudents) are stereotyped as good at math. In this way, changes

Panel A (Female Identity Accessible)



Panel B (College Student Identity Accessible)

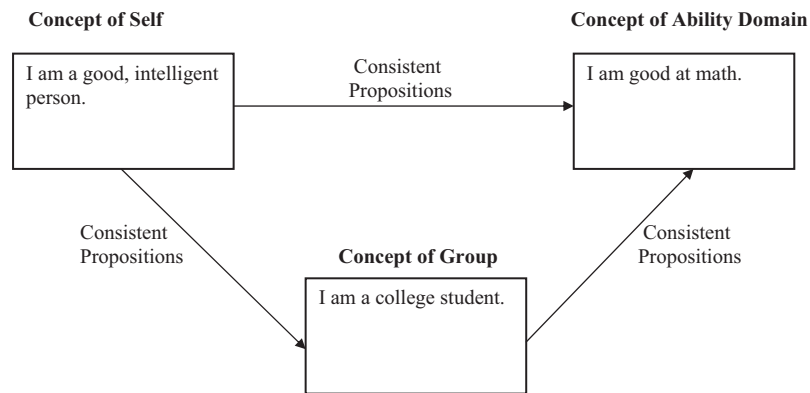


Figure 1. A: Cognitive imbalance between concept of self, concept of group, and concept of ability domain when the social category female is accessible and B: cognitive balance between concept of self, concept of group, and concept of ability domain when the social category college student is accessible.

in the accessibility of the active social identity can eliminate the inconsistency between propositions about the self, the group, and the domain that trigger the arousal and working memory decrements that translate into poor math performance.

There is evidence consistent with this claim. For example, women who were less gender identified did not show performance decrements (relative to men) in a math test even when they were aware of the stereotype that women are bad at math (Schmader, 2002). By having little identification with the social group female, these women had a valid propositional relationship between the concept of the self, gender, and performance in the domain. These women did not strongly associate themselves with their gender. Therefore, the negative stereotype associated with women did not apply to their ability in math, and their performance did not suffer.

In addition to showing that gender identification moderates stereotype threat, research has shown that stereotype threat-induced math decrements can be eliminated by (a) having women individuate themselves (make accessible their self-identity as opposed to their female group identity; Ambady, Parker, Steele, Owen-Smith, & Mitchell, 2004), (b) having women describe how overlapping traits can describe both men and women (Rosenthal &

Crisp, 2006), and (c) having highly identified women make self-concept maps with a large number of self-aspects (Gresky, Eyck, Lord, & McIntyre, 2005). Each of the above findings highlight that reducing the accessibility of the threatened social identity eliminates stereotype threat. We think this occurs because the imbalance between propositions about the self, the group, and the ability domain have been eliminated.

For example, Ambady et al.'s (2004) and Gresky et al.'s (2005) results are likely due to the elimination (or reduced importance/impact) of group propositions in the context of propositions about the self, the group, and the ability domain. When women were able to individuate themselves (either by making their self-identity salient or via drawing complex and unique self-concept maps), they perceived themselves less as women and more as individuals. With no "group" aspect left to create imbalance between expectations for self and the domain, stereotype threat does not occur. In Rosenthal and Crisp (2006), highlighting overlap between men and women likely eliminated stereotype threat by changing expectations of women's math abilities (i.e., changing propositions about the group; see McIntyre, Paulson, & Lord, 2003) to be more positive. Of importance, this past research can all be explained by

assuming that the above-mentioned manipulations that reduced stereotype threat did so by causing a reduction of the imbalance between propositions about the self, the group, and the ability domain.

More strongly in line with dissonance theories of imbalance (e.g., Aronson, 1998), it has been shown that reducing the impact (not the presence) of the imbalance between the concepts of the self, the group, and the ability domain also eliminates stereotype threat effects. For example, stereotype threat can be reduced by misattributing the arousal caused by this imbalance to an external event (Ben-Zeev, Fein, & Inzlicht, 2005), overriding the impact of the imbalance by affirming the self (Martens, Johns, Greenberg, & Schimel, 2006), or focusing attention away from the imbalance and onto external appraisals (Johns, Schmader, & Martens, 2005). In addition, it has been shown that people can revise their expectations about women's math ability by being presented with stereotype-inconsistent exemplars of high-achieving women (Marx & Roman, 2002; McIntyre et al., 2003). Again, note that all of these demonstrations of eliminating or reducing stereotype threat operate by dealing with the imbalance between propositions about the concepts of the self, the group, and the ability domain either directly or indirectly (see Schmader et al., 2008).

Multiple Social Identities and Stereotype Threat

The previous work on stereotype threat and imbalance between the concept of the self, the group, and the ability domain proposes that through modifying people's propositions about either the self (Schmader, 2002), modifying propositions about the group and the ability domain (Marx & Roman, 2002), or by making people's individual (as opposed to social) identity salient (Ambady et al., 2004), stereotype threat effects can be eliminated. However, there is another way to address imbalance between these propositions that has not been given full consideration. Specifically, people hold multiple social identities that may have contradictory stereotypes about ability for any one domain (e.g., Shih et al., 1999).

Although there is some research in which multiple identities and stereotype threat have been examined, it is surprisingly scarce, and it has not been connected to process models of stereotype threat. For example, Shih et al. (1999) showed that Asian women's math performance depended on which of two social categories, Asian or female, was made accessible by an identity manipulation. When the social category Asian was made accessible, math performance increased relative to a control group. When the social category female was made accessible, math performance decreased relative to a control condition. From a balance perspective (see Nosek et al., 2002; Schmader et al., 2008), Shih et al.'s findings of increased math performance when Asian females' ethnic identity was accessible could be due to a balance between people's propositions regarding the self, their group, and the ability domain (here, because being Asian is consistent with stereotypes of greater math ability). Likewise, decreased math performance when Asian women's gender identity was accessible could be the result of creating an imbalance between people's propositions between the self, their group, and the ability domain (because women are stereotyped as having lower math ability than men). However, Shih et al. (1999) did not examine what happened when both identities were simultaneously provided, and, therefore, they did not examine how the

availability of contradictory stereotypes impacts social identity accessibility or math performance.

More closely paralleling the present work, McGlone and Aronson (2007) found that telling female college students at elite private colleges that students at these prestigious schools are less vulnerable to the stereotype threat than students at less prestigious schools eliminates the impact of stereotype threat on math performance for women. Framing this research in the process model of stereotype threat described previously, one might assume that stereotype threat was averted by the increase in the relative accessibility of the social identity "elite" college student as opposed to the social identity female. However, there are several problems with this interpretation. First, there is no evidence that a social identity was activated and, more specifically, that an alternative social identity (i.e., "elite" college student) was activated. Second, there was no process evidence for why giving women this alternative identity impacted performance. Third, the researchers explained stereotype threat to participants, which has been shown to eliminate stereotype threat effects (see Johns et al., 2005). Finally, it is unclear whether this reduction in stereotype threat was due to making the negative stereotype (i.e., "females are bad at math") irrelevant or due to the activation of the elite college social identity related to a positive math stereotype. This latter point is important because these alternatives may occur via very different psychological mechanisms. For instance, activating an alternative social identity might serve to alter the content of the information that is currently accessible about the self in memory, whereas perceiving the stereotype as irrelevant might be because of disidentification with the negatively stereotyped group or the ability domain. A complete handle on the mechanism(s) by which stereotype threat is alleviated is important for designing the best interventions to curb unwanted and unwarranted performance decrements under threat.

In the present work, we examined how one might reduce the impact of stereotype threat, leveraging the idea that this phenomenon relies on an imbalance of people's concepts of the self, group, and domain. Expanding on the research of McGlone and Aronson (2007) and the framework of Schmader et al. (2008), we hypothesized that stereotype threat would be eliminated if people replace propositions about the concepts of the self, group, and ability domain with propositions garnered from another accessible social identity that carry opposite performance implications in the relevant task domain. Importantly, this route to eliminate stereotype threat differs from past work in which tactics such as self-affirmation (Martens et al., 2006), misattribution (Ben-Zeev et al., 2005), counterstereotypic exemplars (McIntyre et al., 2003), and individuation (Ambady et al., 2004) reduced stereotype threat by explaining away, overriding, or modifying imbalances of the self, group, and ability domain. Rather, the idea that activation of an alternative social identity with relatively more positive stereotypes in a domain implies that a whole new set of propositions are evoked. These new activated propositions should promote balance between the positive expectations of the self and group for an ability domain rather than altering people's perceptions of the self, group, and ability domain to achieve balance.

Again, consider the case of a female college student who is aware of culturally held beliefs that women are bad at math and that college students are good at math (relative to college-age women who are not attending college). We expect that women in this "multiple identities" condition will do as well as women for

whom any information about gender and student membership is not made salient (the control condition). Thus, we predict that even when a negative stereotype about an ingroup's performance in a particular domain is available, the presence of the positive stereotype about another ingroup's performance in that same domain will moderate the impact of stereotype threat on performance. But, why would such a result occur?

As mentioned earlier, we expect that people have a fundamental motivation to view the self positively and to strive for success in domains identified as important, such as math. We also know that social identity accessibility is activated or inhibited, depending on the situation, (Hugenberg & Bodenhausen, 2004; Macrae et al., 1995; Smith & Henry, 1996) and that the activation of certain positively stereotyped social identities as opposed to negatively stereotyped social identities has implications for stereotype threat (Shih et al., 1999). Furthermore, work on SIT demonstrates that people are motivated to activate social identities that allow them to view themselves in a positive light (e.g., Mussweiler et al., 2000; Roccas, 2003a, 2003b). Thus, when a woman is aware of the positive stereotype that college students are good at math and the negative stereotype that women are bad at math, the social identity of college student should become more accessible than the female social identity in order to maximize the integrity of the self (with the college student identity facilitated and the gender identity inhibited). This relative difference in accessibility (i.e., self-categorizing as a college student instead of a woman) should determine (i.e., mediate) the impact of stereotype threat on math performance. This is because to the extent that women's college student social identity is accessible, they will (a) not be categorized as women (Bodenhausen & Macrae, 1998; Hugenberg & Bodenhausen, 2004; Macrae et al., 1995; Roccas, 2003a, 2003b) and (b) not have imbalances between propositions of the self, group, and ability domain (Schmader et al., 2008).

Furthermore, we expect that greater accessibility of the positive stereotype-related social identity will eliminate the potential for imbalance between concepts of the self, group, and ability domain and thus keep working memory intact in a potentially threatening situation. This is in contrast to a situation in which only negative stereotype-related social identities are available and thus set into motion processes of verbal rumination and performance monitoring that impair working memory and thereby reduce performance in the stereotyped domain (Beilock et al., 2007; Cadinu et al., 2005; Schmader et al., 2008). In other words, categorization as a function of a social identity related to positive stereotypes about domain performance will eliminate stereotype threat despite the concurrent availability, but reduced activation, of a social identity for which there is a negative stereotype about performance.¹

Overview of Experiments

In the present work, we examined the prediction that introducing a self-relevant social identity with a positive (college students are good at math) and negative (women are bad at math) implication in the same ability domain (math) would moderate stereotype threat effects by affecting the cognitive balance between the self, one's own social categorization, and category-based associations related to the domain in question. For women in a math test situation, we expected that categorization of the self as a member of the social group *college students* would reduce categorization of

the self as *female* and therefore reduce the impact of negative stereotypes on working memory by providing balance between the concept of self, social identity, and implications for performance. However, categorization of the self as a woman should create a cognitive imbalance, resulting in a reduction in working memory resources and poorer performance (Schmader et al., 2008; Shih et al., 1999).

Female college students in Experiment 1 completed a math test after receiving no information about social identities or math performance stereotypes (control condition), information highlighting a group membership (i.e., female) associated with negative math performance ("gender identity" condition), information highlighting a group membership (i.e., college student) associated with positive math performance ("college identity" condition), or information highlighting both group memberships ("multiple identities" condition). We expected that only those in the *gender identity condition* would show relatively poorer math performance, whereas the activation of an alternative social identity in the *multiple-identities condition* would offset the deleterious effects of stereotype threat. We sought to demonstrate that imbalance in Experiment 2 between the concepts of the self, one's social identity, and the ability domain related to poorer performance in the face of stereotype threat. Specifically, we expected those in the gender identity condition to have their gender identity accessible, but those in the multiple identities condition would reveal relatively greater accessibility for their college student identity (by increased accessibility of the college student identity and inhibition of the gender identity). We expected that to the extent that female college students in the multiple identities condition had their college student social identity accessible (and thus not their female social identity accessible), they would be less likely to reveal stereotype threat effects in math despite the availability of a social identity associated with a negative performance stereotype.

In Experiment 3, we again manipulated the availability of different social identities and explored whether, relative to the gender identity condition, those in the multiple identities condition showed better performance on math tasks precisely because the accessibility of a social identity with positive implications for performance allowed female college students to retain the working memory capacity necessary for successful math performance. Fi-

¹ It should be noted that this explanation differs from an explanation that uses processes of stereotype lift (e.g., Walton & Cohen, 2003). Specifically, a stereotype lift explanation would make the same predictions for math performance—reduced stereotype threat when positive and negative stereotypes are available for the same performance domain—however, this amelioration of stereotype threat effects would be due to the impact of the positive and negative stereotype cancelling each other out. That is, according to a strict stereotype lift explanation, the presence of the negative stereotype would decrease performance, and the presence of the positive stereotype would increase performance, eliminating stereotype threat. Our account differs from a stereotype lift account by predicting that people will increase *identification* with the social identity that has positive implications for the stereotyped domain and decrease identification with the social identity that has negative implications for the stereotyped domain. It is the categorization of the self as being a member of the positively (as opposed to negatively) stereotyped group that eliminates stereotype threat, not simultaneous increased performance on the basis of the positive stereotype and decreased performance on the basis of the negative stereotype.

nally, we examined in Experiment 4 the real-world implications of mentioning identities associated with positive stereotypes in the demographics section appearing before a math test. Specifically, we examined whether stereotype threat effects on math performance could be caused by a subtle manipulation of indicating gender (Danaher & Crandall, 2008) and eradicated by concurrently presenting an item in which participants also indicated their status as a college student.

Experiment 1

We examined the impact of activating social identities associated with positive (college students are good at math) and negative stereotypes (women are bad at math) about math performance in Experiment 1. Female college students completed a math task after reading about the purported purpose of the study. In a between-subjects design, participants were told (a) nothing that highlighted the applicable social identities of college students or women—*control condition*, (b) the positive stereotype that college students are good at math—*college identity condition*, (c) the negative stereotype that women are bad at math—*gender identity condition*, or (d) both the positive stereotype that college students are good at math and the negative stereotype that women are bad at math—*multiple-identity condition*. When female college students were only exposed to a negative stereotype about women's math ability, we predicted that their performance on a math task would suffer because their female identity would be accessible (e.g., Schamder, 2002; Schmader et al., 2008; Shih et al., 1999). However, if females' college student social identity is made accessible by exposure to a positive stereotype about college students' math ability, we expected that they would perform relatively better on a set of difficult math problems compared with those who only received a negative stereotype about women in math. This result is predicted because the college student social identity gives rise to consonance between concepts of the self, group, and ability domain, even under conditions when multiple social identities are available to them.

Method

Participants and design. Female ($N = 112$) undergraduates at the University of Missouri participated for research credit. They were randomly assigned to a 2 (college student stereotype: absent, present) \times 2 (gender stereotype: absent, present) between-subjects factorial design.

Procedure. Participants were seated at a computer in a private room and asked to complete a problem-solving task. The first screen of information presented by the computer program thanked them for their time and participation. A second screen of information presented the ostensible reasoning for the research, which served to highlight group memberships associated with positive (i.e., college student) and negative (i.e., female) self-relevant math stereotypes.

Manipulations of math stereotypes. Participants received one of four sets of instructions to manipulate the availability of self-relevant social identities and their math-related stereotypes, corresponding to the 2×2 design of the study. Specifically, participants were told that the experiment was investigating why some people are better at math than others (wording was adapted from

Aronson et al., 1999, p. 37; see also, Beilock et al., 2007). In the control condition (college student and gender stereotypes absent), no reference was made to gender or college student status. Specifically, participants read the following:

In this laboratory, we have been researching differences in the ability to solve a number of different types of math problems. As you probably know, math skills are crucial to performance in many important subjects in college. Yet surprisingly little is known about the mental processes underlying math ability. This research is aimed at better understanding what makes some people better at math than others. Your performance on the math problems you are doing today will be compared to other students from across the nation.

In the gender identity condition (college student stereotype absent, gender stereotype present), participants were informed that the research was investigating why women are generally worse at math than men. Participants read the same description as the control group, but they also were given the additional information:

As you also may know, at most schools male students outnumber female students in math majors and majors with math as a prerequisite, and there seems to be a growing gap in academic performance between these groups. A good deal of research indicates that males consistently score higher than females on standardized tests of math ability. But thus far, there is not a good explanation for this. The research you are participating in is aimed at better understanding these differences. Your performance on the math problems you are doing today will be compared to other students from across the nation. One specific question is whether males are superior at all types of math problems or only certain types.

In the college identity condition (college student stereotype present, gender stereotype absent), participants were informed that the research was investigating why college students are better at math than those who are not in college. In this condition, participants read the same description as the control group but were also told the following:

As you also may know, a large amount of research shows that college students consistently score higher than non-college on standardized tests of math ability. But thus far, there is not a good explanation for this. The research you are participating in is aimed at better understanding these differences. Your performance on the math problems you are doing today will be compared to other college-age individuals from across the nation. One specific question is whether college students are superior at all types of math problems or only certain types.

Finally, in the multiple-identities condition (college student and gender stereotype present), participants were told that the research was investigating why women are generally worse at math than men and why college students are generally better at math than those not in college.² Participants read the same description as the control group, but they were also told the following:

As you also may know, at most schools male students outnumber female students in math majors and majors with math as a prerequi-

² Past research in our lab has shown that counterbalancing order of the college student and gender stereotypes did not impact math performance (Rydell, Beilock, McConnell, & Holt, 2005), thus the order of stereotype presentation in the multiple-identities condition was not counterbalanced.

site, and there seems to be a growing gap in academic performance between these groups. A good deal of research indicates that males consistently score higher than females on standardized tests of math ability. As you also may know, a large amount of research shows that college students consistently score higher than non-college on standardized tests of math ability. But thus far, there is not a good explanation for this. The research you are participating in is aimed at better understanding these differences. Your performance on the math problems you are doing today will be compared to other college-aged individuals from across the nation. One specific question is whether college students and males are superior at all types of math problems or only certain types.

Math problems. Following the college student and gender stereotype manipulations, participants completed 15 math problems (modeled after those used on standardized tests) used in past stereotype threat research (Schmader & Johns, 2003). All of the questions were difficult word problems that involved relatively high-level math skills and logical ability. Participants chose their answer from five possible solutions that were presented underneath the problem and labeled from *a* to *e* for each of the 15 math problems. Participants had unlimited time to answer the math questions, but had to give a response to every math question presented. Specifically, the math problems were presented in a random order, and participants had to give an answer to a problem in order to advance to the next question.³ Furthermore, participants were informed of these rules for the math test and the number of math problems to be completed in the instructions to the test. Because participants always completed the same number of problems, the number of problems answered correctly served as the dependent variable. After completing the math test, participants were debriefed and thanked.

Results

As Table 1 reveals, a 2 (college student stereotype) \times 2 (gender stereotype) analysis of variance (ANOVA) on the number of math problems answered correctly revealed the predicted interaction, $F(1, 108) = 7.08, p = .01, \eta_p^2 = .062$. Simple effects analyses showed that when participants were not given gender-stereotypic information (i.e., gender differences in math were not highlighted), math performance was equally good regardless of presentation of the college student stereotype, $F(1, 53) = 0.31, p = .58, \eta_p^2 = .006$. However, when participants were given gender stereotypes (i.e., gender differences in math were highlighted), those who received the college student stereotype performed better than those who did not receive the college student stereotype, $F(1, 55) = 10.49, p = .002, \eta_p^2 = .160$. Indeed, the only relative decrement in performance observed were for those in the gender identity condition, with the other three conditions showing significantly greater performance ($ps < .05$), but not differing among themselves.

Discussion

The results of Experiment 1 showed two results of interest. First, replicating past research (e.g., Beilock et al., 2007; Spencer et al., 1999), women facing stereotype threat (i.e., the gender identity condition) performed more poorly than those in the control condition. Second and more important, concurrently highlighting par-

ticipants' membership in social groups with a positive and with a negative stereotype about math performance eliminated the impact of stereotype threat. In other words, in the multiple-identities condition, the math performance deficits observed when mentioning gender (i.e., the gender identity condition) were offset by concurrently mentioning one's membership in the group college students, revealing a buffering effect to traditional stereotype threat outcomes.

Earlier, we suggested that when people are presented with two social identities that have contradictory implications for their performance in a domain, they will tend to view the self as a member of the group with positive implications for performance (Mussweiler et al., 2000; Roccas, 2003a, 2003b). This occurs, at least in part, to minimize imbalance between concepts of the self, one's social group, and the ability domain. And, as a result, poor performance under stereotype threat is alleviated. Experiment 1 provides evidence that this idea is tenable. In Experiments 2 and 3, we examined why presenting a self-relevant social identity associated with a positive stereotype eliminates the impact of stereotype threat. We do this at the level of social identity accessibility (i.e., which social identity is most strongly activated in memory) in Experiment 2 and at the level of working memory (i.e., the resources compromised by stereotype threat; see Beilock et al., 2007; Schmader & Johns, 2003) in Experiments 3.

Experiment 2

Our account for Experiment 1's results is that the accessibility of specific social identities is what plays a critical role in determining whether stereotype threat is realized when both college student and gender identity are made salient. Specifically, we expect that in the multiple-identities condition, participants' college student social identity would be more accessible than their female social identity, presumably in the service of minimizing imbalance between concepts of the self, one's social group, and the ability domain (Schmader et al., 2008). As a result, performance does not suffer under threat.

To examine this prediction, we measured the relative accessibility of the female identity and the college student identity in Experiment following the manipulations used in Experiment 1. We expected several findings: (a) Those in the gender identity condition should have greater accessibility of their female social identity than those in the control condition. (b) Those in the college identity

³ Allowing participants unlimited time to answer all of the questions has both positive and negative consequences. It affords greater control in understanding math performance because all participants attempted and answered the same math questions, thus performance was equated in terms of the mathematical concepts tested. Giving participants the option to skip questions and limiting the time they had to complete the test would have required us to relinquish some control to the participants in exactly what aspects of math they were tested on, causing the test to differ somewhat from participant to participant. However, it is likely that participants had to guess on several of the questions, which has the downside of being different from the strategy for standardized tests (where guessing is discouraged because it can lower math scores, but see Experiment 4). In addition, some participants may have spent more time on the problems, leading to better performance. This motivational explanation, however, seems untenable because the amount of time taken to complete the math questions did not differ across conditions (all $F_s < 1$ for Experiments 1–3).

Table 1
Number of Math Problems Answered Correctly as a Function of College Student and Female Stereotype Conditions in Experiment 1

Variable	Experimental condition							
	Control		College identity		Gender identity		Multiple identities	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Number of items correct	6.52 _a	1.71	6.09 _a	2.14	4.04 _b	1.89	6.53 _c	1.96

Note. Means within a row that do not share a common subscript differ significantly, using Fischer's protected least squared differences test ($p < .05$).

condition should have greater accessibility of their college student identity than those in the control condition. (c) Participants in the multiple-identities condition should show facilitation of their college student identity (greater accessibility) and inhibition (reduced accessibility) of their gender identity compared with the control condition. (d) Finally, we expect that the differences in accessibility of the gender identity relative to the college student identity should predict math performance. That is, as participants' accessibility of their gender identity increased relative to their college student identity, math performance should be lower. Such a finding would demonstrate that differential social identity activation can explain why presenting people's college student identity at the same time as their gender identity eliminates stereotype threat effects.

Although people have many possible social identities, there is considerable evidence that people are categorized into only one social identity at any given moment (Macrae et al., 1995; Shih et al., 1999). And in the present work, activating participants' college student social identity instead of their female social identity should address the imbalanced propositions that women can have between their self, their gender, and performance in the relevant domain when their female social identity is accessible, and as a result, help to maintain positivity for the self.

Method

Participants and design. Female undergraduates ($N = 98$) at the University of Missouri participated for research credit. They were randomly assigned to a 2 (college student stereotype: present, absent) \times 2 (gender stereotype: present, absent) between-subjects factorial design.

Procedure. Experiment 2 largely replicated Experiment 1's procedures (e.g., participation in private rooms at a computer). This included using the same manipulations of college student and gender stereotypes. However, there were some exceptions (described in the *Female versus college student accessibility task* and *Math problems* sections).

Female versus college student accessibility task. After reading the purported purpose for the research, participants completed an identity accessibility task. Specifically, to examine the relative accessibility of their female and college student identities, participants completed a me/not me task. This task consisted of 80 trials in which a target word was presented at the center of the computer monitor and participants indicated whether the word was related to the self (me) (by pressing the *m* key on the keyboard) or unrelated to the self (not me) (by pressing the *n* key on the keyboard). The response latencies for different types of target words were the

dependent variable of interest. Specifically, there were three types of words presented: 5 female words (*gal, girl, woman, female, lady*), 5 college student words (*pupil, scholar, student, Missouri student, undergraduate*), and 8 unrelated words (e.g. *feather, drop, ghost, grip, lid, prone, stump, understate*). Each female word and each student word was presented four times each (20 total presentations for each word type), and each of the 8 unrelated words were presented five times each for a total of 40 unrelated word trials. The response latencies for the unrelated words did not differ as a function of the manipulations and thus are not discussed further. In addition, only the results for response latencies from the female and college student words in which a me response was given to ensure that these words were indeed associated with the self (for this sample, a me response was given 98% of the time for female words and 94% of the time for college student words) are reported.

After applying a log transformation to reduce the positive skew of response latencies, three scores were calculated. First, the accessibility of the college student identity was assessed by examining the response latencies for the college words. Second, the accessibility of the gender identity was assessed by examining the response latencies for the female words. Third, participants' difference score, or relative accessibility of their gender identity compared with their student identity, was calculated by subtracting the response latency for female words from the response latencies for the college student words. Greater difference scores indicated that participants' female identity was relatively more accessible than their college student identity.

Math problems. Following the college student and gender stereotype manipulation and the me/not me task, all participants completed the same 10 math problems (selected from the 15 used in Experiment 1). This reduction in the number of problems administered was necessary to fit the time constraints of the experimental session. As in Experiment 1, all questions were answered by selecting one of five possible solutions that were presented underneath each problem, labeled from *a* to *e*. As in Experiment 1, participants were forced to answer all of the questions presented and given unlimited time to do so. After participants completed all of the problems, they were debriefed and thanked.

Results

Math performance. We conducted a 2 (college student stereotype) \times 2 (gender stereotype) ANOVA on the number of math problems answered correctly. As Table 2 illustrates, the predicted interaction was observed, $F(1, 94) = 8.36, p = .01, \eta_p^2 = .082$. Replicating Experiment 1, simple effects analyses revealed that

Table 2

The Number of Math Problems Answered Correctly, the Accessibility of the Female Identity, the Accessibility of the College Student Identity, and the Relative Accessibility of the Social Category Female (Compared With the Accessibility of the College Student Identity) as a Function of College Student and Female Stereotype Conditions in Experiment 2

Variable	Experimental condition							
	Control		College identity		Gender identity		Multiple identities	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Number of items correct	3.92 _a	1.53	4.00 _a	1.89	1.96 _b	1.48	4.00 _a	1.76
College words	822 _a	152	750 _b	173	829 _a	106	753 _b	198
Female words	754 _a	125	773 _a	188	694 _b	90	853 _c	172
Difference score	68 _a	172	-23 _b	195	135 _c	89	-100 _d	183

Note. Accessibility and difference scores are presented in milliseconds. Means within a row that do not share a common subscript differ significantly, using Fischer’s protected least squared differences test ($p < .05$, one-tailed). Response latencies are presented in real time metrics for ease of comparison. Difference score = (response time College words – response time Female words).

when participants were not given the gender stereotype, performance was equally good regardless of the presentation of college student stereotype, $F(1, 48) = 0.03, p = .87, \eta_p^2 = .001$. However, when participants were given the gender stereotype, those who also received the college student stereotype performed better than those who did not, $F(1, 46) = 18.71, p < .001, \eta_p^2 = .289$. As seen in Experiment 1, math performance in the gender identity condition was significantly poorer than in the three other conditions (all $p < .05$), which did not differ from one another.

Accessibility of the college student identity. To examine the accessibility of the college student identity, we submitted response latencies for the college words to a 2 (college student stereotype) \times 2 (gender stereotype) ANOVA. As Table 2 shows, there was only a main effect of college student stereotype, $F(1, 94) = 5.20, p = .025, \eta_p^2 = .054$, in which those who had received this stereotype (i.e., the positive stereotype only and the conflicting stereotypes conditions) showed greater accessibility for college student identity than those who did not (i.e., the control or the negative stereotype-only condition, see Table 2).

Accessibility of gender identity. To examine the accessibility of gender identity, we submitted response latencies for the female words to a 2 (college student stereotype) \times 2 (gender stereotype) ANOVA. We observed the predicted two-way interaction, $F(1, 94) = 5.36, p = .02, \eta_p^2 = .054$. Simple effects analyses revealed that when participants were not given the gender stereotype, gender identity was activated to the same extent regardless of the presentation of college student stereotype, $F(1, 48) = 0.18, p = .87, \eta_p^2 = .004$. However, when participants were given the gender stereotype, those who received the college student stereotype showed less activation of gender identity than those who did not receive the college student stereotype, $F(1, 46) = 15.95, p < .001, \eta_p^2 = .257$.

In addition, we conducted two specific contrast effects to examine facilitation and inhibition of the female words in response to the manipulations. The first contrast test showed that the control condition and the college identity condition had significantly slower reaction times to the gender me/not me words than the gender identity condition, $t(94) = -1.96, p = .05, d = -0.40$, supporting facilitation of the female identity when only gender stereotypes were available. A second contrast test showed that those in the control condition and the college identity condition

had significantly faster reaction times for the female words than those in the multiple-identities condition, $t(94) = -2.39, p = .02, d = -0.49$, indicating inhibition of the female identity when both the college student and gender stereotypes were available (see Table 2).

Relative accessibility of female and college student social identities. To examine whether the relative accessibility of the female social identity to the college student social identity was impacted by our manipulations, we submitted the difference score (for which greater scores indicated relatively greater accessibility for female than for college student identity) to a 2 (college student stereotype) \times 2 (gender stereotype) ANOVA. As Table 2 illustrates, the interaction obtained, $F(1, 94) = 8.36, p = .01, \eta_p^2 = .064$. Simple effects analyses showed that when gender stereotypes were absent, those who did not receive the college student stereotype (control group) had their female social category more accessible than those who received positive stereotypic information about college student performance in math (college student identity group), $F(1, 48) = 3.09, p = .05, \eta_p^2 = .060$. However, when participants were presented with gender stereotypes, those who also received college student stereotypes (multiple-identity group) were much more likely to have their college student identity activated relative to their female identity, whereas those who did not receive positive stereotypic information showed the opposite pattern (gender identity group), $F(1, 46) = 31.96, p < .001, \eta_p^2 = .410$. This shows that participants were especially likely to identify as college students (as opposed to women) in the multiple-identities condition.

However, we had two more specific hypotheses involving the difference score. First, we predicted that the difference score would be positive and greater (indicating relatively greater accessibility for female than for college student identity) in the gender identity condition than in any of the other three experimental conditions. Supporting our hypothesis, the gender identity condition was relatively more accessible than the control condition. It did, $t(47) = -1.71, p = .04$, one-tailed, $d = -0.50$. Moreover, the difference score for the gender identity condition was greater than the difference score for the multiple-identities condition, $t(47) = 5.65, p < .001, d = 1.65$, and the college identity condition, $t(47) = -3.63, p < .001, d = -0.98$. So, there does seem to be evidence that the gender identity (relative to the college student

identity) is facilitated in the gender identity condition as opposed to other three experimental conditions.

We also expected that the difference scores would be negative and smaller in the college identity condition, showing that the college identity (relative to the female identity) actually was activated in the college identity condition. To examine this, we compared the control condition (i.e., people's relative activation of the female identity compared with the college identity without any manipulations) with the positive stereotype-only condition (people's relative activation when the college identity is primed), where we saw a significant decrease in the activation of gender identity relative to college identity in the latter condition, $t(47) = -1.78, p = .03$, one-tailed, $d = -0.52$. Thus, there is evidence that the college identity is relatively more accessible when college student stereotypes were presented (compared with when no stereotypes are presented), consistent with a priming effect. This conclusion is bolstered by our earlier finding showing facilitation of college words in the college identity condition relative to the control and gender identity conditions.

Mediational analyses. To examine whether changes in the relative activation of participants' gender identities in comparison to their college student identities could account for the impact of our experimental manipulations on math performance, we conducted multiple regression analyses to examine the mediational role of relative female social identity accessibility for the relation between the college student and gender stereotypes interaction and math performance. The conditions necessary to conduct mediational analyses were present (Baron & Kenny, 1986). Specifically, as shown in the previous analyses, the independent variable (i.e., the interaction between the college student and gender stereotype manipulations) made a unique contribution in predicting the dependent variable (i.e., math performance) when the main effects of college student and gender stereotypes were included in the regression (required to interpret the interaction term correctly). As also shown above, the independent variable (the interaction term) made a unique contribution in predicting the mediator variable (i.e., relative accessibility of the female social identity), again when the main effects of positive and negative stereotypic information were included in the regression. In addition, the mediator variable also predicted the dependent variable ($\beta = -.54, p < .001$).

Participants had their math performance simultaneously regressed on the manipulation of college student stereotype, the manipulation of gender stereotype, the interaction of these manipulations (the product term), and the relative accessibility of the female social identity difference score. As seen in Figure 2, this multiple regression revealed that when relative accessibility of the female social identity was included, the relation between the interaction of college student and gender stereotypes and math performance was reduced but still significant ($\beta = .17, p = .04$). A Sobel test demonstrated that relative accessibility of the female identity accounted for a significant amount of variance in the relation between math performance and the interaction between college student and gender stereotypes ($z = 2.14, p = .03$). This finding indicates that the relative accessibility of the participants' gender identity (compared with their college student identity) was a significant, but not complete, mediator of the relation between math performance and the interaction between college student and gender stereotypes.

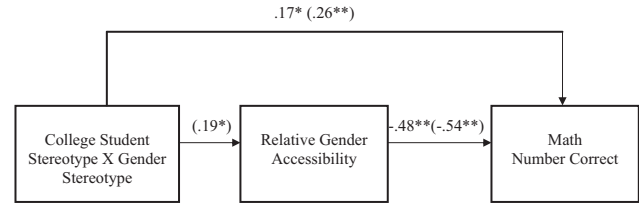


Figure 2. Meditational results showing that the relative activation of the gender identity (relative to college student) mediated the relation between the interaction of college student and gender stereotype conditions and math performance in Experiment 2 (values inside the parentheses represent the direct relations between variables, values outside the parentheses represent indirect relations). * $p < .05$. ** $p < .01$.

Additional analyses. The above mediational analyses provide strong support for our expectations that the relative accessibility of one's membership in the social group associated with a positive math performance stereotype affects math performance under threat. In addition to the overall zero-order correlation between relative accessibility of the social category female and poorer math performance mentioned above ($r = -.54, p < .001$), there was a significant negative correlation between relative accessibility of the female identity and math performance within all of the experimental conditions (control condition, $r = -.58, p = .002$; college identity condition, $r = -.43, p = .03$; gender identity condition, $r = -.51, p = .01$; multiple-identities condition, $r = -.45, p = .03$). These findings reveal the strong and pervasive negative relation between the accessibility of a social identity related to gender stereotypes and math performance, regardless of the manipulation of college student and gender stereotypes.

Discussion

Experiment 2 replicated Experiment 1 by showing that when a social identity associated with a gender stereotype was accessible, its impact on performance was moderated by whether a social identity associated with a college student stereotype was also available. Those in the gender identity condition performed poorest on the math test. However, when these women also had stereotypes about college students in the same domain activated, the impact of the available gender stereotype on math performance was eliminated. More important, Experiment 2 showed that this effect could be accounted for in large measure by differences in the relative accessibility of the women's gender relative to college student identification. Although participants in the multiple-identities condition had the opportunity to self-categorize on the basis of on gender (just like those in the gender identity condition), these women showed stronger activation of their college student identity relative to their female identity, and the magnitude of this differential activation played a significant role in determining how well they performed on the math problems. Furthermore, those in the multiple-identities condition also showed inhibition of their female identity. Thus, when female college students were exposed to concurrent stereotypes applicable to the relevant math domain, they appeared to show a motivated response, identifying with the social group that promoted a balanced set of propositions regarding concepts of the self, one's social group, and the ability domain in question and inhibiting the social group that would promote

cognitive imbalance and negativity for the self. Accordingly, performance did not suffer for these women under threat.

Although Experiment 2 documents one of the processes that underlies the impact of stereotypes on performance (i.e., motivated social identification among multiple social identities), it did not examine why the relative accessibility of the college student identity resulted in better performance in the face of stereotype threat. In other words, what is it about math problem solving that is compromised for those who cannot avail themselves to a more positive social group membership? We examined this question in Experiment 3.

Experiment 3

We sought to document how the availability of multiple social identities impacts the cognitive substrates governing math problem solving. Recent research has demonstrated that stereotype threat effects in the math domain are due, in part, to compromises of working memory capacity (e.g., Beilock, 2008; Beilock et al., 2007; Schmader & Johns, 2003; for confirmatory evidence in similar evaluative situations, see Beilock & Carr, 2005; Beilock, Kulp, Holt, & Carr, 2004). For example, Beilock et al. (2007) provided evidence that stereotype threat elicits intrusive thoughts (e.g., concerns about reifying group stereotypes), which compromise the working memory resources (and especially phonological or verbal aspects of this system) required to solve many forms of difficult math problems. In the present experiment, we examined whether those in the multiple-identities condition, who receive both college student and gender stereotypes, might not experience the compromises of working memory typically observed when women's gender stereotypes are available.

We used the same manipulations of college student and gender stereotypes as those in Experiments 1 and 2, and we examined their impact on working memory and math performance. We expected that participants in the gender identity condition would show poorer working memory capacity presumably because of intrusive thoughts and verbal ruminations associated with being under stereotype threat (Beilock et al., 2007; Cadinu et al., 2005), which, in turn, would impair math performance. In this condition, gender identity should be accessible (see Experiment 2) as well as the imbalance between concepts of self, group, and ability domain. However, we expected participants in the multiple-identities condition, because of their greater identification with being a college student, would show no relative decrements in working memory capacity because the accessibility of the college student identity would presumably reduce intrusive thoughts and worries about the stereotype that women are bad at math. This should result in consonance between propositions about the self, group, and ability domain, and thus math performance should not suffer. Those in the control condition and in the college identity condition were also expected to show relatively better math performance than the gender identity condition (replicating Experiments 1 and 2) and not reveal compromised working memory capacity because gender stereotypes were not made salient to them.

Method

Participants and design. Female ($N = 57$) undergraduates at the University of Missouri participated for research credit. They

were randomly assigned to a 2 (college student stereotype: absent, present) \times 2 (gender stereotype: absent, present) between-subjects factorial design.

Procedure. As in the first two experiments, participants were seated at a computer in a private room. First, they received the same instructions to manipulate the availability of stereotypes for college students and women regarding math performance. All individuals then performed a working memory task (see the *Working memory task* section) described as a problem-solving task that was unrelated to math ability. Finally, everyone answered all of the 10 difficult math problems given in Experiment 2.

Working memory task. A shortened version of the verbal ("vowel counting") task used by Schmader and Johns (2003; modeled after Turner & Engle, 1989) assessed working memory capacity. In this task, participants were first asked to count the number of vowels in a simple sentence and report that number in a response box below the sentence. After giving their answer to the vowel counting portion of the trial, participants then saw a word presented for 1 s that they were instructed to remember for recall. Each trial consisted of the two activities completed consecutively: vowel counting followed by a word to memorize. After a certain number of trials unbeknownst ahead of time to participants (i.e., a set), individuals were asked to recall all of the words presented in that set (i.e., since the last time of recall). Participants were presented with seven sets that were composed of either four or five trials per set (three sets had four trials, four sets had five trials, the order of presentation was randomly determined). Thus, participants could recall up to 32 words correctly (i.e., 1 per trial). Working memory was primarily examined by looking at the number of words recalled, with greater recall indicating greater working memory capacity (see Conway et al., 2005). However, accuracy on the vowel counting task was also examined for working memory capacity differences between conditions. In a dual-task paradigm, such as the current working memory task, deficits in either counting or word memory could indicate that working memory was compromised (Turner & Engle, 1989). Accuracy of vowel counting was examined by looking at the absolute value of the number of vowels counted in comparison to the actual number of vowels presented in each sentence. Greater scores on the vowel counting task (i.e., greater deviation in one's count from the actual number of vowels presented, irrespective of whether one's count was above or below the actual number of vowels present) indicated lower working memory capacity.

Results

Math performance. An ANOVA on the number of math problems answered correctly revealed the anticipated two-way interaction, $F(1, 53) = 6.01, p = .02, \eta_p^2 = .102$ (see Table 3). Simple effects analyses revealed that when participants were not given gender stereotypes, performance was equally strong regardless of the presentation of college student stereotypes, $F(1, 26) = 1.07, p = .31, \eta_p^2 = .038$. However, when participants were given the gender stereotype, those who received college student stereotypes performed better than those who did not receive college student stereotypes, $F(1, 26) = 6.24, p = .02, \eta_p^2 = .193$. Consistent with Experiments 1–2, math performance in the gender identity condition was significantly poorer than in the three other conditions (all $ps < .05$), which did not differ from one another.

Table 3
Number of Math Problems Answered Correctly and Working Memory Capacity (Number of Words Correctly Recalled and Number of Vowel Counting Errors) as a Function of College Student and Female Stereotype Conditions in Experiment 3

Variable	Experimental condition							
	Control		College identity		Gender identity		Multiple identities	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Number of items correct	5.00 _a	1.85	4.36 _a	1.44	3.21 _b	1.52	4.64 _a	1.50
Words recalled	27.60 _a	3.18	29.36 _a	3.00	23.43 _b	2.50	28.43 _a	2.21
VCE	3.59 _a	3.47	2.50 _a	4.07	2.92 _a	2.72	4.14 _a	2.93

Note. VCE = vowel counting errors. Means within a row that do not share a common subscript differ significantly, using Fischer’s protected least squared differences test ($p < .05$).

Working memory capacity. We examined the number of words correctly recalled on the working memory task in a 2×2 ANOVA. As Table 3 reports, this analysis revealed a significant interaction, $F(1, 53) = 4.91, p = .03, \eta_p^2 = .085$. Simple effects analyses showed that when participants were not given gender stereotypes, working memory capacity (as assessed by the number of words recalled) did not differ as a function of the presentation of college student stereotypes, $F(1, 27) = 2.33, p = .14, \eta_p^2 = .08$. However, when given gender stereotypes, those who did not receive college student stereotypes (i.e., multiple-identities condition) recalled fewer words than those who received college student stereotypes (i.e., gender identity condition), $F(1, 26) = 31.41, p < .001, \eta_p^2 = .547$. Working memory capacity in the gender identity condition was significantly lower than in the three other conditions (all $ps < .05$), which did not differ from one another. Thus, the condition in which the poorest math problem performance was produced (i.e., the gender identity condition) was also the condition in which the lowest working memory capacity was revealed, as assessed by the word recall analyses.

We also examined the accuracy of vowel counting in a 2×2 ANOVA. This analysis showed no significant effects ($F_s < 1.70, ps > .19, \eta_p^2_s < .031$).

Mediational analyses. To examine whether decrements in working memory capacity (based on the number of words recalled) could account for the impact of the stereotype manipulations on math performance, we conducted multiple regression analyses to examine the mediational role of working memory capacity for the relation between the college student and gender stereotypes interaction and math performance. The conditions necessary to conduct mediational analyses were met. Specifically, as shown above, the independent variable (i.e., the interaction between college student and gender stereotype manipulations) made a unique contribution in predicting the dependent variable (i.e., math performance) when the main effects of college student and gender stereotypes were included in the regression equation. Also, the independent variable (the interaction term) made a unique contribution in predicting the mediator variable (i.e., working memory capacity) when the main effects of positive and negative stereotypic information were statistically controlled. In addition, the mediator variable also predicted the dependent variable ($\beta = .55, p < .001$). Thus, participants had their math performance simultaneously regressed on the manipulation of college student stereotypes, the manipulation of gender stereotypes, the interaction of these manipulations, and on

working memory capacity. As Figure 3 shows, this multiple regression revealed that when working memory capacity was included, the relation between the interaction of college student and gender stereotypes and math performance was no longer significant ($\beta = .29, p = .14$). A Sobel test demonstrated that working memory capacity accounted for a significant amount of variance in the relation between math performance and the interaction between college student and gender stereotypes ($z = 1.96, p = .05$). Thus, working memory capacity fully mediated the relation between math performance and the interaction between college student and gender stereotypes.

Discussion

Experiment 3 further elucidated the processes by which the availability of a social identity associated with positive stereotypes eradicates the impact of a social identity associated with a negative stereotype. Concurrently providing women with two applicable social identities, one associated with positive stereotypes in a performance domain (i.e., college students are good at math) and one associated with negative stereotypes in a performance domain (i.e., women are bad at math; the typical condition that evokes stereotype threat), once again eliminated the aversive impact on performance typically seen in stereotype threat research (e.g., Beilock et al., 2007; Spencer et al., 1999). Whereas Experiment 2 established that the introduction of conflicting stereotypes led participants to adopt the social identity associated with positive performance (i.e., being a college student instead of a woman), Experiment 3 showed why this shift in identification impacts math

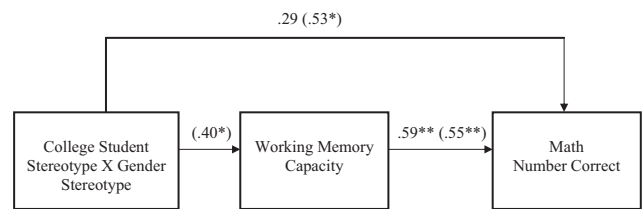


Figure 3. The mediational results showing that working memory capacity mediated the relation between the interaction of college student and gender stereotype conditions and math performance in Experiment 3 (values in parentheses represent the direct relations between variables, values outside the parentheses represent indirect relations). * $p < .05$. ** $p < .01$.

performance. Specifically, when the social identity available to these women was associated with a negative performance stereotype, their working memory capacity was compromised, and performance suffered (see also, Beilock et al., 2007; Croizet et al., 2004; Schmader & Johns, 2003). However, the availability of an additional identity associated with positive performance did not lead to working memory depletion, and accordingly, performance did not suffer despite the fact that one's gender was also highlighted. Thus, Experiments 2 and 3 show the processes, both in terms of social identity accessibility and working memory capacity, through which stereotype threat for women in a math task can be eliminated by introducing an additional social identity associated with a positive performance stereotype.

Experiment 4

Although Experiments 1–3 demonstrated and explained the impact of the activation of social identities that are associated with positive and negative self-relevant stereotypes on math performance and working memory, it remains to be seen whether one can use these insights to engineer an effective stereotype threat reduction strategy in a more real-world setting. For example, it would be compelling if an intervention could be administered to women performing on a standardized math test that served to reduce poor performance under evaluative conditions. On the basis of the findings of Experiments 1–3, we would expect that activating a social identity associated with positive performance in a relevant domain when a social identity associated with negative performance in that same domain is also available (i.e., isomorphic to our multiple-identities condition) would reduce stereotype threat effects.

Therefore, following the research of Steele and Aronson (1995), we sought to evaluate this proposal by inducing female college students to engage in categorizations about the self before completing a standardized math test. Steele and Aronson (1995) showed that when African Americans reported their race on a demographic questionnaire prior to taking a standardized test, they performed more poorly on that test than did those who did not report their race because their reports aroused stereotype threat. Research on women and math performance has shown that simply reporting one's gender reduces women's math performance (Dana-har & Crandall, 2008). In Experiment 4, we manipulated which demographic questions were asked so as to leverage our findings from the first three experiments to eliminate poor performance under threat in a more real-world testing situation. Specifically, participants were either asked or not asked to (a) indicate their gender and (b) indicate their status in school prior to completing a math test. On the basis of the findings of Experiments 1–3, we expected that when women were given the opportunity to indicate their status as college students on these demographic questions, this would undercut stereotype threat effects typically seen when women indicate their gender.

Method

Participants and design. Female ($N = 80$) undergraduates at the University of Missouri participated for research credit. They were randomly assigned to a 2 (indicate gender: absent, present) \times 2 (indicate school status: absent, present) between-subjects factorial design.

Procedure. Participants were seated at a desk in a private room and asked to complete a paper-and-pencil problem-solving task. They had 20 min to complete a packet labeled "Quantitative Examination CTA #478B" on the cover page (see Schmader & Johns, 2003). Participants completed the cover page, containing our manipulations, before beginning the timed examination. The cover page had a space for participants to fill in the date, but other demographic questions varied by condition. Those in the *indicate gender-present* condition reported their gender by checking one of two boxes on the cover page, one labeled *male* and the other labeled *female* (all participants indicated that they were female). In addition, those in the *indicate school status* condition were asked to indicate their highest education level from four response boxes presented on the cover page and labeled "Currently in College," "High School Graduate," "Graduate Equivalency Diploma (GED)," or "High School Dropout" (all participants indicated that they were currently in college). The order of the questions was counterbalanced for those in the *indicate gender-indicate school status* condition (the order of the questions did not show any significant effects on any of the measures and is not mentioned further).

Participants could complete up to 30 math questions in the 20-min period. No participant finished the exam in the 20 min provided. The questions were taken directly from Schmader and Johns (2003) and, as in Experiments 1–3, were difficult math questions for which participants are asked to choose the correct answer by selecting from one of five response options presented. Unlike Experiments 1–3, and in an effort to equate this test as much as possible with real-world testing situations in which one can skip questions, participants were not forced to answer all of the questions. Math performance was assessed by calculating the number of questions answered correctly and the number questions attempted.

Results

To examine the role of indicating one's group membership for social identities associated with positive and negative stereotypes, we conducted a 2 (indicate gender) \times 2 (indicate school status) ANOVA on the number of questions answered correctly and the number of questions attempted. As Table 2 indicates, for the number of problems answered correctly, there was a significant two-way interaction, $F(1, 76) = 8.82, p = .004, \eta_p^2 = .104$. Simple effects analyses for those in the indicating school condition (i.e., the group associated with positive performance) showed no difference in the number of questions answered correctly as a function of whether they reported their gender, $F(1, 38) = 0.01, p = .93, \eta_p^2 = .000$. However, for those who did indicate their gender (i.e., those who indicated their membership in a group associated with negative performance), those who also indicated their school status (i.e., could also identify with a group associated with a positive stereotype) answered more questions correctly than those who did not indicate school status, $F(1, 38) = 15.10, p < .001, \eta_p^2 = .284$. Participants in the indicate gender demographic condition (i.e., those most subjected to stereotype threat) answered fewer questions correctly than did those in any of the other experimental conditions (all $ps < .05$), which did not differ significantly from one another (see Table 4).

Table 4
Number of Items Answered Correctly as a Function of Indicating Gender and School Status Before the Quantitative Exam in Experiment 4

Variable	Demographic information given							
	No information		School status		Gender		Gender and school status	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Number of items correct	9.95 _a	1.70	9.90 _a	1.61	7.35 _b	1.95	9.65 _a	1.78
Number of items attempted	13.40 _a	1.90	13.45 _a	1.82	12.65 _a	1.84	13.20 _a	1.59

Note. Means within a row that do not share a common subscript differ significantly, using Fischer's protected least squared differences test ($p < .05$).

For the number of questions attempted, there were no significant effects ($F_s < 1.46$, $p_s > .24$, $\eta_p^2 = .006$), suggesting that the differences in number correct did not reflect reduced attempts, but rather poorer performance on the math problems attempted.⁴

Discussion

Experiment 4 showed the implications of our research highlighting the accessibility of a social identity associated with positive performance in a relevant domain by using a subtle intervention derived from the findings of Experiments 1–3. Similar to past work (e.g., Danahar & Crandall, 2008), having female college students indicate their gender on a demographic questionnaire prior to completing a math task impaired their performance. However, in addition we showed that including a question on the demographic questionnaire having participants concurrently indicate their membership in a social group associated with positive stereotypes about math performance eliminated this gender effect. Thus, simply reporting that one is a member of a positively stereotyped group in the relevant domain eradicated the poor performance produced by stereotype threat. It appears that stereotype threat caused by demographic questions asking about one's gender or ethnicity could potentially be offset by also having demographic questions containing group memberships that serve to cast people's expected performance in a more positive light.

General Discussion

In the present work, we examined how the availability of multiple social identities that have conflicting stereotypic implications for domain-specific performance affected stereotype threat. In particular, we assessed the impact of concurrently highlighting both a self-relevant negative stereotype (as in past work) and a self-relevant positive stereotype about female college students' math ability on math test performance. In Experiments 1–3, we manipulated the salience of gender stereotypes (emphasizing the negative stereotype that women are bad at math) and of college student stereotypes (emphasizing the positive stereotype that college students are good at math) to observe the consequences for math performance in a between-subjects factorial design. Replicating past stereotype threat research, we showed that in the gender identity condition, female college students' math performance suffered (see Beilock et al., 2007; Spencer et al., 1999; Steele et al., 2002). However, when a positive self-relevant stereotype was presented alongside the negative stereotype (the multiple-identities

condition), math performance did not suffer and was identical to the control condition or the college identity condition. Across these studies, we showed that concurrently presenting conflicting positive and negative stereotypes about female college students' math ability eliminated the detrimental impact of stereotype threat on math performance.

In Experiment 2, we showed that the reason for better math performance in the multiple-identities condition, despite the concurrent presentation of gender stereotypes, was greater accessibility of the college student social identity relative to the female social identity. This relatively greater accessibility for one's college student identity should serve to eliminate the imbalance between the concepts of gender, math performance, and positive self-evaluation (i.e., "I am a woman, women are poor at math, being good at math is desirable"). Thus, by identifying with one's college student status, these women were able to experience balanced concepts between being a college student, math performance, and a positive view of the self (i.e., "I am a college student, college students are good at math, being good at math is desirable"). When facing multiple social identities with conflicting implications for performance in the particular domain in question, these women adopted the identity that served to maintain a positive view of the self (see Mussweiler et al., 2000; Roccas, 2003a, 2003b). This is in contrast to the gender identity condition in which women did not have the option to adopt a more positive social identity, and accordingly, their performance suffered—presumably as a consequence of the imbalance between the concepts of the self, group, and ability domain in question (Schmader et al., 2008).

Of importance, meditational analyses showed that the relative accessibility of the female identity accounted for math performance across conditions. Specifically, the manipulations of college student and gender stereotypes had their impact on math performance by changing the relative accessibility of the female identity such that its greater accessibility (relative to the college student identity)

⁴ The observant reader likely noticed that accuracy improved substantially in Experiment 4 (compared with the previous experiments). This is likely due to differences in the math exam. Specifically, in Experiments 1–3, the 15 or 10 most difficult math questions were selected from those used by Schmader and Johns (2003), whereas all 30 questions were used in Experiment 4. More important, in Experiment 4, participants could choose which questions to answer or ignore, could return to a previous question, could change their answers, and were not forced to answer all the math problems presented (none of these strategies were options in Experiments 1–3).

accounted for poorer math performance. These meditational results support our claims that presenting a positive stereotype eliminates inconsistencies in the concepts of the self, group, and ability domain. Moreover, within each condition—even the control condition in which neither college student nor gender stereotypes were mentioned—the more one's female identity was active relative to their college student identity, the worse her math performance.

Experiment 3 elucidated the cognitive mechanisms through which activating social identity impacts performance. As seen in past work, the gender identity condition, which showed the poorer math performance, also had the lowest working memory capacity (e.g., Beilock et al., 2007; Schmader & Johns, 2003; Schmader et al., 2008). In the multiple-identities condition, however, working memory capacity was not compromised despite having the gender stereotype highlighted. As a result, math performance did not suffer. Once again, having an alternative, positive self-relevant social identity protected female college students from the stranglehold that stereotype threat has on the working memory capacity necessary to complete demanding cognitive tasks.

In Experiment 4, we examined whether the subtle presentation of a positive stereotype in a more real-world setting could eliminate the impact of stereotype threat during a testing session. We showed that asking female college students to indicate only their gender in the demographics section led to poorer math performance, once again replicating previous work (Danaher & Crandall, 2008). However, those who indicated both their gender (associated with a negative math stereotype) and their school status (associated with a positive math stereotype) did not show poor performance on the math test. Drawing on the results of Experiments 2 and 3, it seems likely that when indicating only their gender, participants' female identities became more accessible. As a result, there was an imbalance between concepts of the self, group, and ability domain that reduced the working memory resources needed for successful performance. And similarly, when both gender and school status questions were asked, it seems likely that participants' availed themselves to their more positive college student identity, supporting consonance between concepts of the self, group, and ability domain and allowing them to devote valuable and limited working memory resources to the computation of the difficult battery of math problems put forth to them.

Implications for Stereotype Threat

The present work has several implications for theorizing about the processes underlying stereotype threat as well as attempts to reduce its impact. First, the present work provides the most direct test to date of the prevailing process model for how stereotype threat affects women's math performance (Schmader et al., 2008). Consistent with the conceptualization of stereotype threat as caused by imbalance between concepts of the self, group, and ability domain, in the present work, when an alternative categorization for the self was available that could eliminate this imbalance, stereotype threat effects were not observed. When one is faced with both positive and negative stereotypes relevant to performance, the social identity associated with positive stereotypes about behavior is most likely to be adopted (Roccas, 2003a), and, as a result, performance does not suffer. By documenting the relative activation of social identities and how this activation

relates to performance, we provide causal support for their role in stereotype threat impairment (or the lack thereof).

On a more tangible level, stereotype threat effects due to the accessibility of a social identity with negative stereotypic implications for a performance domain occurred because working memory capacity was reduced (Beilock et al., 2007; Schmader & Johns, 2003). As outlined by Schmader et al. (2008), the imbalance between concepts of the self, group, and ability domain impacts the working memory available to devote to stereotype-relevant tasks that rely heavily on this executive control process (e.g., math performance). We found strong support for this contention in the present work. However, we also showed an important moderator. When social identities were available with positive and negative stereotypic implications for an ability domain, working memory resources were not compromised, and math performance was not reduced. The working memory capacity savings afforded by the accessibility of the social identity related to a positive stereotype in the multiple-identities condition accounted for increased math performance relative to conditions in which this positive stereotype-related identity was absent. Thus, it seems that the accessibility of a competing social identity associated with positive stereotypes about an ability domain preserves working memory, which in turn improves performance in cognitively demanding activities. More broadly, these findings suggest that the activation of social identities with consonance between concepts of the self, group, and ability domain are a powerful weapon in combating the deleterious consequences of stereotype threat.

To date, no research has systematically examined what happens when a positive and negative self-relevant stereotype are simultaneously available about an ability domain. In addition to demonstrating the moderating effect of a positive self-relevant stereotype on stereotype threat, our work shows why, in terms of both identity accessibility and working memory capacity, this moderation occurs. Even though Shih et al. (1999) showed that priming led to increased accessibility of the primed social identity (i.e., female stereotypes were more accessible in the negative stereotype condition, and Asian stereotypes were more accessible in the positive stereotype condition), these researchers did not show that this increased accessibility was related to performance within the experimental conditions. Thus, this research is the first to show that identity accessibility serves to mediate stereotype threat effects. Similarly, research on individuation (Ambady et al., 2004; Gresky et al., 2005) or multiple social identities (Rosenthal & Crisp, 2006) assumes that there is a decrease in the accessibility of the threatened identity and that this decrease is the reason why stereotype threat is eliminated in these experiments, but this past work has not demonstrated the presumed cause. Thus, our present research establishes this process, serving to validate some of the claims of earlier research. However, the present work does a lot more by establishing that the process is even more complicated and more interesting than originally thought. Not only does the reduction of the accessibility of the social identity female lead to better performance when both a positively and a negatively stereotyped social identity are available, the positively stereotyped social identity is facilitated, and the negatively stereotyped social identity is inhibited. Our work documents not only this mechanism but also its impact on working memory, and in turn math performance. In summary, we identify the motivated processes through which people's social identities become active, enhance self-esteem, and

serve to influence people's expectations, working memory capacity, and ultimately their actual performance.

Issues and Limitations in Applications to Testing

Research on stereotype threat seems ripe for translation into interventions that improve the performance of stereotyped group members. And, we believe, this research has implications for standardized testing. To the extent that standardized test scores are impacted by negative group stereotypes (see College Board, 2005; for evidence that men outperform women by an average of 34 points on the scholastic aptitude test), our work shows that simple demographic questions that foreground positive social identities (i.e., status as a college student) can increase performance when demographic questions that activate social categories that have negative implications for performance are also presented (i.e., indicating gender). In theory, this is a good resolution to "even the playing field" by reducing stereotype threat during testing. However, finding a social identity that has clear positive implications for everyone is not easy. For instance in Experiment 4, our positive stereotype manipulation would only work for college students. In fact, there is the possibility that this manipulation would create stereotype threat effects for those who had not finished or attended college because it would supply a negative as opposed to a positive stereotype about math ability. Therefore, caution should be exerted when trying to apply this type of manipulation because it is most likely to work only in highly specified and homogeneous populations. However, future research would benefit from examining how to express membership in a group with positive overriding expectations in a performance domain without alienating or hurting the performance of others.

Stereotype Lift and Choking Under Pressure

These results also have implications for research on stereotype lift (Walton & Cohen, 2003). Experiments 1–3 are consistent with the findings of Shih, Ambady, Richeson, Fujita, and Gray (2002) in showing that stereotype lift is less likely to occur if the manipulation of social category related to performance is explicit. In Experiment 4, we should have been more likely to see stereotype lift effects because our manipulations were somewhat more subtle, yet we still did not observe it. There are a couple of issues to consider when interpreting the present research in light of stereotype lift. First, stereotype lift effects are quite small and rarely detected in any one experiment (Walton & Cohen, 2003). Second, stereotype lift is generally considered to occur when a negative expectancy about one group (e.g., women are bad at math) has implications for the performance of an outgroup (e.g., men are good at math). As such, supplying female college students with positive information about their performance if they are college students may have a different impact than inferring positive ability from negative stereotypes about an outgroup (e.g., the outgroup may be less clearly defined for them).

One might also wonder why we did not see any evidence of "choking under pressure" when we made salient women's college student identity. Indeed, in Shih et al. (2002), when Asian characteristics were explicitly primed in Asian students in a math testing situation, a choking effect occurred. That is, explicitly presenting stereotypical Asian words to Asian students led to

poorer math performance relative to a condition in which non-Asian words were presented. Although there are certainly a set of complex issues related to when the activation of positive identities lead to choking under pressure versus stereotype lift effects, one reason why we likely did not find evidence of choking in the present work may have to do with the severity of the positive performance stereotype to which participants were exposed.

In situations commonly characterized as highly pressure inducing, there are often unreachable or, at least, high-level performance goals (e.g., 20% improvement in performance over and above an already stable baseline performance level or explicit awareness that others have achieved a goal performance level one is trying to obtain; see Beilock & Carr, 2001; Beilock et al., 2004). This type of situation may produce fears and worries related to being unable to achieve the goals in question. As a result, working memory is compromised, and poor performance ensues. This may be true with respect to the explicit priming of an Asian stereotype in the Shih et al. (2002) work as well. Here, Asian students may worry about living up to the high-level math performance that is stereotypical of their social group, and, consequently, their performance may suffer. In contrast, most college students likely accept that they are at least marginally proficient in math (at least more so than their peers who choose not to attend college). As a result, worries about being unable to live up to the college student stereotype may be limited, and poor performance is mitigated. Future research should examine these issues in more detail to understand fully stereotype lift effects, choking effects, and their interrelations.

Conclusion

In four studies, the present work replicated the traditional gender stereotype threat effect for women (i.e., women for whom gender was highlighted showed poorer math performance). More important, these experiments demonstrated that providing an alternative social identity associated with a positive stereotype about math ability (i.e., college students are good at math) at the same time as presenting a social identity associated with a negative stereotype about math ability (i.e., women are bad at math) eliminated stereotype threat effects in female college students. These women showed greater accessibility for their student identity (relative to their female identity), retained working memory capacity, and performed better on math problems than women who faced stereotype threat without an additional identity that was more positive for the domain in question. Thus, it appears that when women have the opportunity to identify with multiple social categories, they will adopt those that promote a view of a positive and competent self. This work also demonstrates important ways to minimize the deleterious consequences of negative self-relevant stereotypes while at the same time evaluating and supporting recent models of the phenomenon. Clearly, stereotype threat is an important societal issue, and the present work sheds light on its underlying processes and provides one relatively straightforward means to combat it. Because people are members of many different social groups that often provide both positive and negative stereotypes about performance, the present work suggests ways that people can be flexible in their social identities in order to achieve and succeed in important domains.

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