PSYC 235: Research Methods in Psychology
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Positive, Math-Unrelated Priming and Women's Math Performance

by Jason Parad

Abstract

Stereotype threat occurs when negative stereotypes about group performance on a particular task are made salient, thereby negatively affecting group member performance. Specifically, research has demonstrated that stereotype-threatened women underperform on tests of mathematical ability (Spencer, Steele, & Quinn, 1999). A possibility for reducing stereotype threat in women was explored by having female participants (under stereotype threat) read either a passage about positive comparison targets in the math-unrelated domain of politics (i.e., competent female political figures) or a passage without comparison targets. Performance scores on a subsequent math test were then determined. We hypothesized that the presentation of positive, math-unrelated comparison targets would decrease threat and thus improve math performance scores. However, results indicated that the scores of the participants presented with the comparison targets did not significantly differ from those of participants not presented with the comparison target. The importance of the relationship between the domain of the positive comparison targets and the domain of the task at hand is considered.

Positive, Math-Unrelated Priming and Women's Math Performance

Negative stereotypes about group performance on a particular task, when made salient, have been shown to negatively affect group member performance. This phenomenon—known as *stereotype threat*—was first elucidated in relation to black students' poor performance on standardized tests of verbal ability (Steele & Aronson, 1995), and has since been extended to other stereotyped groups and performance domains. In particular, Spencer, Steele, and Quinn (1999) showed that women underperform on tests of mathematical ability when made aware of the "women-are-bad-at-math" stereotype. However, when the researchers specifically informed participants that the test was not expected to produce gender differences, female participants performed just as well as their male counterparts. Many later studies have replicated this finding (e.g. Brown & Josephs, 1999; Obrien & Crandall, 2003). Reducing the effect of stereotype threat in women taking math tests is clearly of vital concern. Tests of this kind determine not only women's eligibility for careers in science-related occupations, but also society's belief in women's overall competence (Huguet & Regner, 2007).

Research has only begun to consider ways in which the adverse effects of stereotype threat can be alleviated. Rydell and Boucher (2010), for example, have demonstrated that identification with a positive self-identity could mask the threat generated by a negative one. In their study, female participants experienced both negative and positive self-relevant stereotypes about math performance through priming of their social identities as women and as college students, respectively. Performance on a subsequent math test was then shown to be optimal when participants could identify with the positive self-identity as opposed to with the negative one.

Priming women with a favorable identity of a fellow group member—rather than with a favorable aspect of their own identities—also appears to alleviate stereotype theat. In an early study, Marx and Roman (2002) showed that female participants' performance on math tests was buffered from stereotype threat when a female experimenter with competency in mathematical ability administered the test. In another part of the study, female participants who merely learned about a female experimenter who was competent in mathematics also exhibited decreased stereotype threat. Taken together, these studies reveal that identifying with one's own or another group member's competence—specifically in mathematics—wards off stereotype threat during a mathematics test.

The question of whether stereotype threat can only be reduced by identification with domain-specific (i.e., math-only), positive social identities has also been addressed. In particular, Marx, Stapel, and Muller (2005) presented female participants with two successful female comparison targets, one of which excelled in mathematics and the other of which excelled in athletics. The results showed that participants who were presented with the mathematics comparison target—but not the athletics one—displayed reduced stereotype threat on a subsequent math test. The researchers consequently reasoned that stereotype threat effects are reduced only upon presenting participants with positive comparison targets that have succeeded in the domain of the task at hand (math).

The present study, however, endeavors to test the validity of this claim. In particular, the Marx *et al*. (2005) study made use of "athletics" as its math-unrelated comparison target domain. It is possible though that the domain of athletics might be too unrelated to that of mathematics, given that athletics is often perceived to require keen physical ability while mathematics is understood to require a mental one. And in most cases, people often believe those who possess

one of these abilities to effectively lack the other (Sailes, 1993). Accordingly, we propose that the presentation of positive comparison targets who have succeeded in domains falling between the extremes of athletics and mathematics may, in fact, alleviate stereotype threat in females during a math test.

In order to zone in on how similar the math-unrelated domain must be to math to achieve stereotype threat reduction, the current study utilized the domain of politics. First, politics was chosen because—much more similar to mathematics than athletics—there is a need for intellectual ability over physical skill. Second, the difference between politics and math is substantial enough (e.g., politicians and mathematics work on different world problems) that this study can be practically significant (as opposed to finding a positive effect with physics as the math-unrelated domain, for example). Third, political comparison targets (e.g. Hillary Clinton)—by virtue of their public roles in society—can be easily recognized by participants.

Drawing from the methodology used by Marx and Roman (2002), female participants under stereotype threat read either a passage about positive comparison targets in the math-unrelated domain of politics (i.e., competent female political figures) or a passage without comparison targets. Participants then took a math test, and their math performance scores were determined. Specifically, we hypothesized that the presentation of positive, math-unrelated (political) comparison targets would decrease threat and thus improve math performance scores. In this way, this study may shed light on the relative effectiveness of social comparisons made across differing domains, and thus broaden the framework for both theoretical and practical implications in stereotype threat reduction studies.

Methods

Participants

Seventeen female undergraduate psychology majors at Yale College, aged 19-21 years old, participated for credit toward a course on methods in psychology. Participants were assigned to a *no comparison target* condition ($N = 10$) or a *positive, math-unrelated comparison target* condition ($N = 7$) in a between-subjects design.

Procedure

Participants were asked to complete a 15-minute diagnostic assessment—administered in paper form—of both their critical reading and mathematical abilities. Participants were instructed that no points would be deducted for incorrect or omitted answers, consistent with the grading criteria of the American Colleges Test (ACT), a widely employed, standardized college placement test. Prior to the assessment, participants were asked to specify their genders (to induce stereotype threat; Jordan & Lovett, 2007) along with their ages, class years, majors, and dorm residences (to mask the importance of specifying one's gender). The critical reading section contained three paragraphs, each describing a popular college major, with two open-ended comprehension questions. The questions served to ensure that the participants read all of the paragraphs. (Of note is that the content of these paragraphs was chosen so as to be broad in scope.) The mathematics section contained 10 questions adapted from a sample standardized college aptitude test. Questions were multiple-choice and of varying topics and difficulty. Participants were asked to finish the critical reading section before beginning the mathematics section.

Design

In the *no comparison targets* condition, the three critical reading paragraphs discussed the popularization of the health studies, international relations, and communications majors, respectively, in American colleges. No comparison targets were introduced. In the *positive,*

math-unrelated comparison targets condition, the third critical reading paragraph (see appendix) was changed so as to discuss the major of women's and gender studies, rather than communications. In this way, the increasing success of female politicians such as Hillary Clinton and Nancy Pelosi could be emphasized. The field of politics thus served as the math-unrelated domain in this study.

The dependent measure of interest was the participant's math performance score—the number of questions answered correctly out of 10—on the mathematics section.

Results

In order to test the hypothesis that stereotype-threatened female undergraduates would perform better on math tests with a positive, math-unrelated comparison target than without a comparison target, an independent samples *t*-test was conducted. This hypothesis was not supported given that the math performance scores for female undergraduates presented with the positive, math-unrelated comparison targets ($M = 6.14$, $SD = 1.68$) in comparison to those not presented with a comparison target ($M = 6.10$, $SD = 2.02$) were not significantly different, $t(15) = -0.05$, $p = .48$ (one-tailed; see Fig. 1).

Discussion

Our results suggested that providing females with the positive, domain-unrelated comparison targets of female politicians (as compared to no comparison target) did not decrease stereotype threat during a subsequent math test. We thus reject our hypothesis that positive comparison targets in the domain of politics can aid in threat reduction. More broadly, the results may suggest that positive comparison targets in any math-unrelated domain will not facilitate a decrease in stereotype threat.

Marx *et al*. (2005) had shown that a positive comparison target in the athletic domain did not aid in threat reduction in women performing a task in the mathematic domain. In particular, the present study looked at the domain of politics—one that falls much closer to that of mathematics, by virtue of these two domains being associated with high intelligence, than to that of athletics, a domain instead associated with high physical skill. The null finding of the present study, though not conclusively, suggests that the results of Marx *et al*. may be far-reaching, applying to domains that are not necessarily in such stark contrast (e.g., politics and mathematics). Future work should thus try to assess the domain-relatedness required for a favorable threat-reduction effect. It is possible that only targets in the domains of the natural sciences such as chemistry, biology, physics, geology, etc.—rather than all domains in the realm of academia, for example—could bring about desirable, gender-equalizing performance effects.

Of note is that Marx and Roman (2002) showed that being in the presence of or learning about a female experimenter who was competent in mathematics buffered female math-test takers from stereotype threat. In light of this study, the null findings hint at the possibility that only role models who are competent in the domain of (or a domain very close to) the task at hand can foster threat reduction. The implications of such a claim would be many and significant. In just one example, the expertise of the various female high-school teachers that proctor standardized college aptitude tests would differentially affect the math performance of female students.

The null finding also adds commentary to the study by Rydell and Boucher (2010), which found that female college students performed better and worse when their college (good-at-math) identities and female (bad-at-math) identities were primed, respectively. If positive, math-unrelated comparison targets do not aid in threat reduction, as the present study suggests, then

priming one's own positive, math-unrelated identities may not either. Accordingly, it may be the case that no matter how successful women are in math-unrelated domains—or how much these women are made aware of their successes—they will still underperform on math tests in stereotype-threat inducing situations. The burden of a single negative stereotype may thus far outweigh the "benefit" of any number of positive stereotypes.

Notably, the dependent measures in this study were both reliable and valid. As mentioned, the utilized math questions were adapted from a widely used college-aptitude test, which is believed to be a reliable measure of one's mathematical reasoning ability. Similarly, the validity of using this test to measure one's mathematical ability has been generally accepted in society.

At the same time, a number of severe limitations in the present study must also be considered. For one, although the math performance scores of the participants who were presented with the positive, math-unrelated comparison targets could be compared to those of the participants who were not presented with these comparison targets, there was no third group to ensure that our experimental conditions actually induced stereotype threat. Accordingly, our null results could be due to either the poor induction of stereotype threat or the non-effect of our experimental manipulation. The latter possibility is discussed in detail above, but there are also reasons to entertain the former possibility. First, a number of studies have shown and thus used only particularly challenging tasks to induce stereotype threat (Spencer *et al*., 1999; Marx *et al*., 2005). The present study, however, tested college-level students with questions designed primarily for high school juniors. A second possible contributor to ineffective stereotype threat induction was that participants were told that incorrect and omitted answers would not incur a

penalty. This instruction might have eased participant anxiety and thus reduced stereotype threat (Spencer *et al*., 1999; Osborne, 2001).

The generalizability of the study results is also severely restricted by participant demographics. First, as psychology majors who completed this study in their psychology classes, participants might have been highly disinclined to identify with individuals (female politicians) in a domain irrelevant to both their interests (psychology) and the task at hand (mathematics). Perhaps presenting participants with a psychology-related comparison target or using participants of all majors would have yielded different results. Second, as psychology majors (in which high mathematical ability is not of day-to-day necessity), many participants might have been largely unconcerned with their performance and thus largely unaffected by stereotype threat (O'Brien & Crandall, 2003). Third, the psychology classes in which this study was completed had more than twice the number of female students as male students. Given the work of Inzlicht and Ben-Zeev (2000), which demonstrated that women show no sign of threat when completing a math test among only other women, participants in this study might have been buffered from performance deficits. Future work should ensure that tests are completed individually, rather than in a group. Given these many limitations, developing more refined studies using domain-unrelated comparison targets will be of great importance in elucidating the specific ways in which stereotype threat can be alleviated. In addition, the psychological barriers that impede women's performance on math tests and entrance into scientific careers can be minimized.

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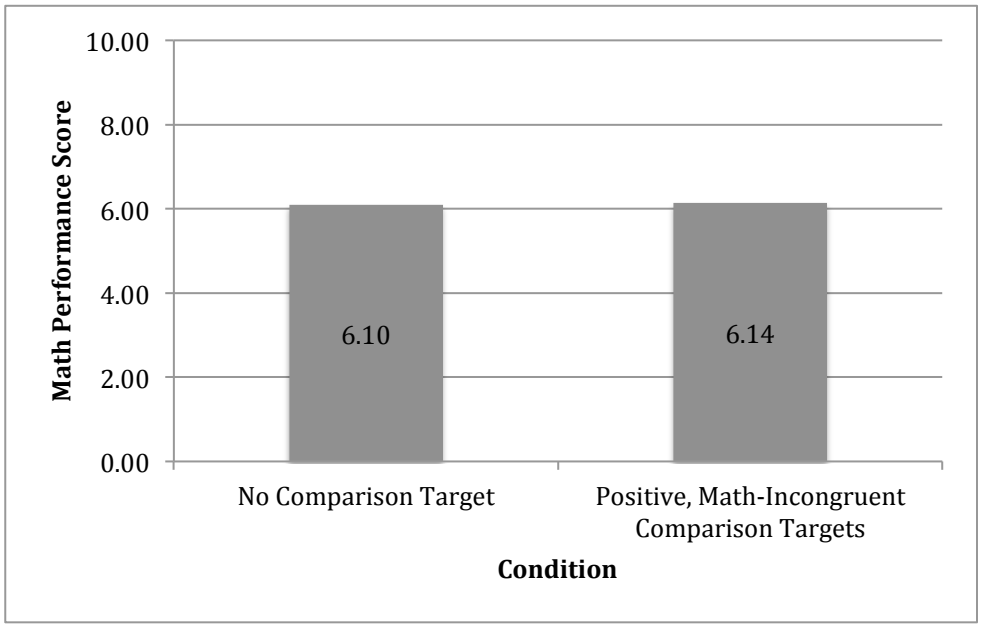
Figure 1. Math Performance Scores for Female Undergraduates under Stereotype Threat.



Appendix

Third Paragraph in the Positive, Math-Unrelated Comparison Targets Condition

Additionally, stemming from the triumphs of the Civil Rights movement of the 1960s, and driven by the ever-strengthening campaign to eradicate the injustices of a traditionally male-dominated society, Women's and Gender Studies are becoming increasingly important to the students of the modern age. Framed in the context of today's dynamic political society, Women's and Gender Studies serve to address and explore the often-controversial issues surrounding the role of women in modern society, and the critical stumbling-blocks of a heritage built upon patriarchal tradition. Spurred by the incredible strides of female public figures such as Secretary of State Hilary Clinton, First Lady Michelle Obama, and Speaker of the House Nancy Pelosi, the critical issues of justice, empowerment, and social equality addressed by the Women's and Gender Studies major has made it one of the most highly influential and sought-after fields of University study to date.