



Do performance avoidance goals moderate the effect of different types of stereotype threat on women's math performance?



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ARTICLE INFO

Article history:

Received 6 February 2016

Revised 28 April 2016

Accepted 12 May 2016

Available online 14 May 2016

Keywords:

Stereotype threat
Academic achievement
Achievement goals
Gender stereotypes
Math achievement

ABSTRACT

Stereotype threat is considered to be a robust effect that explains persistent gender gaps in math performance and scientific career trajectories. Some evidence suggests stereotype threat effects are buffered by adoption of performance avoidance goals (Chalabaev, Major, Sarrazin, & Cury, 2012). With 590 American female participants, we closely replicated Chalabaev et al. (2012). Results showed no significant main or interaction effects for stereotype threat or performance avoidance goals, despite multiple controls. We conclude that effects of stereotype threat might be smaller than typically reported and find limited evidence for moderation by avoidance achievement goals. Accordingly, stereotype threat might not be a major part of the explanation for the gender gap in math performance, consistent with recent meta-analyses (Flore & Wicherts, 2015).

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1. Introduction

Despite research suggesting girls receive higher marks than boys across all subjects, including math and science courses, girls in the United States score lower than boys on the math section of the SAT (College Board, 2013; $d = -0.27$), and make up only 25% of the STEM (science, technology, engineering, and mathematics) workforce when women make up 47% of the overall workforce (National Math & Science Initiative, 2013). Given the importance of standardized tests for college admissions, the need for research to accurately identify the forces behind women's poorer performance on tests of math ability is imperative for optimal interventions and policy changes. The present research aimed to replicate the effect of stereotype threat on math performance and to determine how different types of stereotype threat impact performance. Few direct replications of stereotype threat have been published, and we aim to test this effect in a large online sample of American women. Further, we tested how threat interacts with performance avoidance goals, which are defined as aiming at avoiding poor performance relative to one's peers (Elliot & McGregor, 2001).

1.1. Different types of stereotype threat

One of the most prominent psychological theories used to explain the math-achievement gap is stereotype threat, which occurs when individuals are fearful of confirming negative stereotypes associated with their group. Steele and Aronson (1995) posit that "in situations where the stereotype is applicable, one is at risk of confirming it as a self-characterization, both to one's self and to others who know the stereotype" (p. 808). This theory was applied to the women in mathematics stereotype by Spencer, Steele, and Quinn (1999)—a landmark paper that illustrated the negative effect of framing a test as diagnostic of math ability or gender differences on female math performance. Many studies have used cues stemming from Spencer et al., ranging from test framings to threatening test administrators (Shapiro & Neuberg, 2007). Recent research has attempted to make sense of these different types of stereotype threat and how they distinctly impact performance.

Shapiro and Neuberg's (2007) multi-threat framework classifies threats based on the threat's source and target. The three sources of stereotype threat are self, outgroup (e.g., men), and ingroup (e.g., other women in mathematics). The two targets of threat are the self and the group (e.g., an individual woman is the self, the female gender as a whole is the group). The authors theorize that these threats have different effects on individuals; for example, group-as-target threats are believed to lead to more negative comparisons between the self and ingroup and outgroup members

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than self-as-target threats do. The current study focuses on two “self-as-source” threats: *group-concept threat* and *self-concept threat*. Group-concept threat targets the stereotyped group to which one belongs and differentiates the stereotyped group from the majority (e.g., men in mathematics). Group-concept threats thus confirm, to a woman in mathematics, that her *gender as a whole* is bad at math. Self-concept threat is the fear that one’s performance will confirm that *oneself* is bad at math. Unlike group-concept threat, self-concept threat targets one’s inherent attributes or skills, and self-concept threat does not require identification with the group (Shapiro & Neuberg, 2007). Using two threat manipulations, we aimed to experimentally test if self-concept threat or group-concept threat differentially affect math test performance and if these threats interact with variables believed to moderate the effect of stereotype threat (e.g., gender identity and math identity).

1.2. Threat and performance avoidance goals

In the last decade, stereotype threat research has shifted in focus from investigating the existence of stereotypes to examining the mechanisms that influence test performance for women (Shapiro & Williams, 2012). Performance avoidance goals have been identified as a potential consequence of stereotype threat for women in mathematics because individuals endorse those goals to avoid performing poorly in comparison to peers (Elliot & McGregor, 2001). For example, if a student aims to prevent scoring low on the SAT in comparison to her friends and other students she knows, she adopts a performance avoidance goal orientation. Performance avoidance goals and stereotype threat are associated with anxiety, fear of failure, and negative evaluations of self-competence, and thus they typically impair performance (Smith, Sansone, & White, 2007).

However, individuals who adopt performance-avoidance goals are in a state similar to those completing tasks that are inherently threatening, and theory suggests that matching goal orientation to task characteristics boosts performance (Cesario, Higgins, & Scholer, 2008). Stereotype threat (particularly group-concept threat) emphasizes social comparisons, a feature that is an integral component of performance-avoidance goals. Grimm, Markman, Maddox, and Baldwin (2009) posit that an avoidance goal orientation matches a stereotype threat situation better than an approach goal orientation does; this fit may then lead stereotyped individuals to use cognitive strategies that help them avoid negative outcomes and perform as well as non-threatened individuals.

This matching effect has been tested and found in studies on stereotype threat for women in math. Chalabaev, Major, Sarrazin, and Cury (2012) operationalized stereotype threat through a “math ability” cue (self-concept threat) in one study and a “gender differences” cue (group-concept threat) in a second study, in accordance with Spencer et al.’s (1999) manipulations. Both of Chalabaev et al.’s studies demonstrated that inducing a performance-avoidance goal produces better performance under stereotype threat on a math test when compared to no goal, an effect subsequently detected by others (Deemer, Smith, Carroll, & Carpenter, 2014).

1.3. The present study

Given the theoretical links between stereotype threat and performance-avoidance goals and the evidence supporting their interaction, we sought (1) to test this interaction in a large-scale, pre-registered replication, using Chalabaev et al.’s (2012) basic design, and (2) to extend their design to directly compare two types of threat from Shapiro and Neuberg’s (2007) framework. Additionally, we tested for differences in magnitude of effect

between self-concept and group-concept threat with various moderators (detailed below). We predicted that we would find a stereotype threat by performance avoidance goal interaction, such that women under threat would perform better on a math test with a performance avoidance goal compared to no goal. We also predicted that the effect of group-concept threat would be stronger when compared to self-concept threat. We tested these hypotheses with an all-female sample, because the performance of males is not inhibited by stereotype threat in the domain of mathematics (Walton & Cohen, 2003).

Replications of stereotype threat studies are relatively uncommon, and we aimed to test this effect in a larger sample than the vast majority of research in this area (Stoet & Geary, 2012). Policy-makers and social psychologists point to stereotype threat as a major force behind the gender gap in STEM, although there are few tests of stereotype threat in this domain on samples of non-undergraduates (Flore & Wicherts, 2015). By conducting a highly-powered test of stereotype threat in a diverse sample, this study will provide insight into the generalizability of stereotype threat, and it will test the extent to which threat can impact performance in an online setting.

2. Method

2.1. Pilot study & design

We pre-registered our design and analysis plan (see <https://osf.io/kms6g>). In order to measure math performance under differing conditions of stereotype threat, we used 10 released questions from the GRE quantitative reasoning section, also used in Chalabaev et al. (2012). We ran a pilot study testing math ability with three tests of different degrees of difficulty (i.e., sixth grade, tenth grade, and the GRE) to ensure that these questions were appropriately difficult for the intended audience of female Mechanical Turk workers. The GRE was best suited to enable the detection of stereotype threat, as per Spencer et al. (1999), because the other two tests were not difficult enough; see the online supplemental materials, also available at <https://osf.io/jze8c/>, for more detailed results of the pilot study.

In order to determine the appropriate sample size for hypothesis tests, we conducted a sensitivity analysis using R Statistical Software (Version 3.1.1), specifically the *pwr* package (Champerly, 2012). The analyses revealed that with 600 participants (100 in each condition) and 80% power, assuming $\alpha = 0.05$, the study could reliably detect an effect of $d = 0.40$. With the same number of participants and 90% power assuming $\alpha = 0.05$, the study could detect an effect of $d = 0.46$.

We therefore aimed to collect 600 participants. Hypotheses were tested in a 3 (Type of Threat: Self-Concept Threat, Group-Concept Threat, No Threat) \times 2 (Goal: Performance Avoidance vs. No Goal) between-subjects design.

2.2. Materials

2.2.1. Stereotype threat and achievement goal manipulations

Participants received one of six prompts, in the form of audio instructions. In the neutral (no threat), no goal condition, participants were told, “You are going to perform a problem solving test.” In the math ability (self-concept threat), no goal condition, participants were told, “You are going to perform a math test.” In the gender differences (group-concept threat), no goal condition, participants were told, “Previous research has sometimes shown gender differences in math ability...the test you are about to take has been shown to produce gender differences.” In all three performance avoidance goal conditions, participants were additionally

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