

Methods of Mitigating the Effects of Stereotype Threat on Female Students' Mathematics Performance in a High School Geometry Classroom

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Abstract: *This action research study looked at stereotype threat in a single high school geometry classroom. The study examined three methods of mitigating the effects of stereotype threat, and whether those methods were being implemented in the classroom. Stereotype threat has been found to have an effect on female students' mathematics performance. This study sought to determine if the students and teacher were aware of the stereotype by surveying the class, and if the teacher did anything to lessen the effects of stereotype threat that may be happening in his classroom. The results found that while the teacher and the majority of the students were not aware of the stereotype or stereotype threat, that positive strategies used by an effective teacher can still be methods for lessening the effects of stereotype threat even when that is not the motivation behind their implementation.*

Keywords: stereotype threat, stereotype, mathematics performance

INTRODUCTION

Stereotype threat is a phenomenon which occurs when negative stereotypes about a group to which an individual belongs can have an impact on their performance and goals in a certain field (Quinn, Steele, & Spencer, 1999). This is especially prevalent in academia: if a student is aware of a stigma of a minority group of which they are a member, they may be more likely to judge all academic situations on whether or not the stereotype may be confirmed by their actions (Quinn et al, 1999). This can cause the student to perform worse on assessments and examinations, thereby seeming to confirm the negative stereotype about their group.

There has been a widely established stereotype that women are less proficient at mathematics than their male classmates. For example, this stereotype has been reinforced by studies which determined that when male and female students who perform equally on assessments that can be considered easy or on target for them are assessed at a more advanced level, male students tend to outperform female students (Quinn et al, 1999). Hypotheses about the cause of these performance disparities suggest that male students perform better than female students in mathematics as a result of inherent genetic differences, thinking that males are genetically predisposed to have stronger mathematics ability (Benbow & Stanley, 1980).

REVIEW OF THE LITERATURE

In a 1999 study, researchers Spencer, Steele, and Quinn argued that gender differences in mathematics were the result of stereotype threat, where female students' mathematics performance was directly affected by anxiety as a result of the widely perpetuated stereotype. Their research did confirm the hypothesis that stereotype threat can undermine women's mathematics performance. This anxiety can also have a direct correlation between stereotype threat and the concept of "math anxiety," where students have such fear of mathematics that they tend to feel anxious when confronted with math, and perform worse on mathematics assessments and examinations. (Carey et al, 2016.)

Thus, it is imperative for teachers who want to ensure the success of their own female students in mathematics to try to lessen the impact of stereotype threat in their classroom. Several methods of mitigating the effects of stereotype threat haven been studied, three of which are: priming positive images prior to an assessment (Aronson & McGlone, 2006), making students aware of stereotype threat (Johns, Marten, & Schmader, 2005), and creating an identity safe classroom (Cohn-Vargas & Steele, 2014).

Priming positive images prior to an assessment, or giving students positive ideas about the assessment and themselves, can look like a teacher saying to their students, "You are all capable of doing well on this test, I believe in you and your success." This strategy has been proven to lessen the effects of stereotype threat, because students are less likely to think about negative stereotypes about a group they are a part of, and instead perform to their potential (Aronson & McGlone, 2006). Teachers have a responsibility to their students to convey belief in them, and create a space where students can live up to their potential.

Another method of mitigating the effects of stereotype threat on female students' mathematics performance is making students aware of stereotype threat. If female students are aware of what stereotype threat is, they are less likely to be affected by stereotype threat because

this allows female students to separate any anxiety they may have as a result of this stereotype from their own abilities. (Johns et al, 2005).

A third strategy for combating the effects of stereotype threat examined in this study was creating an identity safe classroom. An identity safe classroom is one where all students feel like they can be themselves, regardless of outside expectations of them from their sexual orientation, gender, race, religion, or disabilities. To create an identity safe classroom, teachers should be mindful of differences between students, but still allow students to speak about what makes them unique relative to their peers. This strategy mitigates the effects of stereotype threat as it makes the students' identities part of their learning experience, rather than something that may limit potential to perform in class in some way. (Cohn-Vargas & Steele, 2014).

The hypotheses examined in this study were: students are aware of the stereotype, but not necessarily of stereotype threat and the impact it can have on female mathematics students; female students are more likely to be aware of the stereotype than male students; teachers are aware of stereotype threat, although they may not know strategies to mitigate its effects; even if a teacher is not necessarily addressing stereotype threat as a priority in their mathematics classroom, they will still be implementing at least one of the three strategies in the classroom because of the positive impact they can have on all students.

METHODS

The research conducted in this study was in the form of an action research study performed with students in a single class. The classroom was a grade-level geometry class at a large suburban high school in the northeastern United States. The classroom in question was chosen because of previous connections held by the researchers to the class, as well as the even split in gender.

The participants were 20 students ranging from 10th-11th grade. Nineteen of the students were Caucasian, and one was African American, and 10 of the students were female, and 10 of the students were male. Most of the students were from middle or upper-middle class backgrounds. None of the students were categorized as having a disability with an Individualized Education Plan or a Section 504 Plan. The teacher in the class was a white male teacher with over 20 years' experience teaching at the school where the study was conducted.

The study was conducted in the form of three surveys: a longer, initial survey (Appendix A.) issued to the students, an initial survey issued to the teacher (Appendix B.), and lastly a shorter, follow-up survey administered only to the students (Appendix C.). A few days after administering the first surveys to the teacher and the students, the researcher had a small discussion on stereotype threat with the teacher, then held a discussion on stereotype threat and the three ways to limit its

effects being studied with the students the following day, directly after which the researcher administered the final survey. The first survey was administered during the start of the mathematics class. The students were instructed to fill out the survey as honestly as possible, and assured that no one except the researchers would see their surveys, including their teachers, and that it would not affect their grades in any way. Simultaneously, a survey was administered to the teacher in the classroom that was similar, but not identical to the survey the students received. A few days after the survey was administered, the researcher discussed with the teacher what stereotype threat is, and the three ways to mitigate the effects being studied. Following this, the researcher presented students with the definition of stereotype threat, as well as made students aware that there is a false stereotype that female students do not perform as well in mathematics classes as male students, as many students were not aware of the stereotype according to the results of the original survey. The researcher then taught students the three ways of lessening the effects of stereotype threat, offering students an opportunity to ask questions about stereotype threat if they had any. Lastly, the researcher administered a short follow up survey to the students, which asked students only three questions.

RESULTS

The results of the study indicated that students in this school are mostly unaware of the stereotype about male students performing better at mathematics than female students, and so are logically less affected by stereotype threat. Figure 1 shows the results of the question: “Have you ever heard of the stereotype that male students are better at mathematics than female students?”

Percentage of Student Aware of Stereotype, by answers to the question: Have you ever heard of the stereotype that male students are better at mathematics than female students?

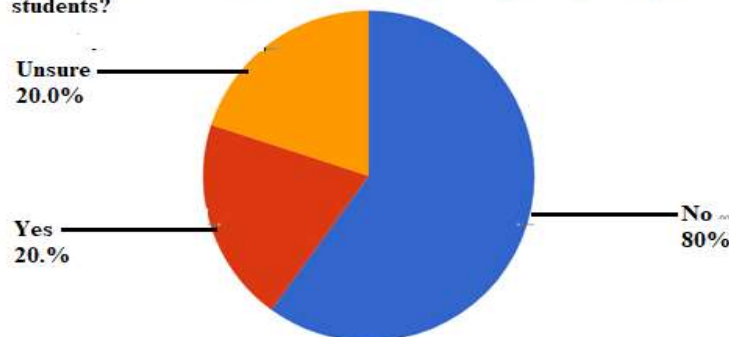


Figure 1. Students aware of stereotype threats.

The majority of the students 60% (12 students) said “No,” 20% (four students) said “Yes,” and 20% (four students) were unsure if they had ever heard the stereotype previously.

When comparing knowledge of the stereotype by gender, the results show that there was no difference between male and female students, and that exactly the same number of students of each gender knew and did not know about the stereotype (Figures 2 and 3).

Female Students Knowledge of Stereotype

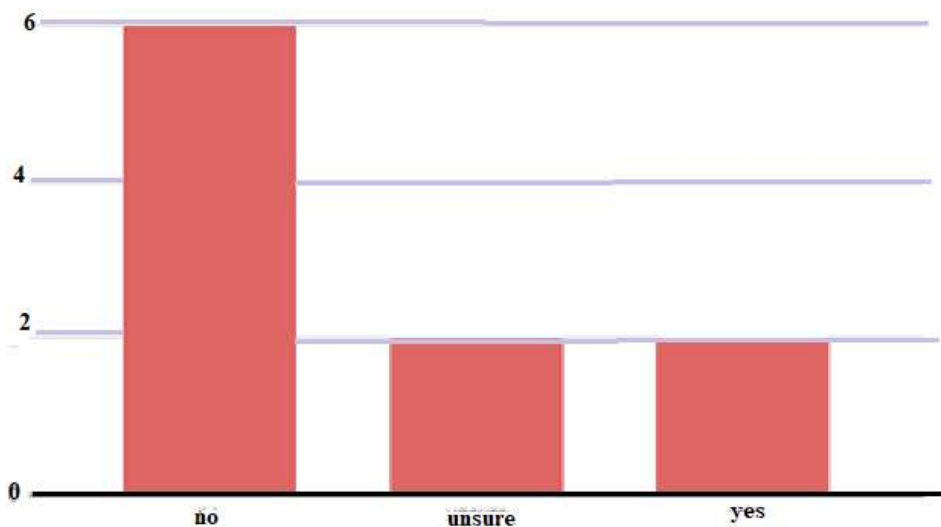


Figure 2. Female students aware of stereotype.

Male Students Knowledge of Stereotype

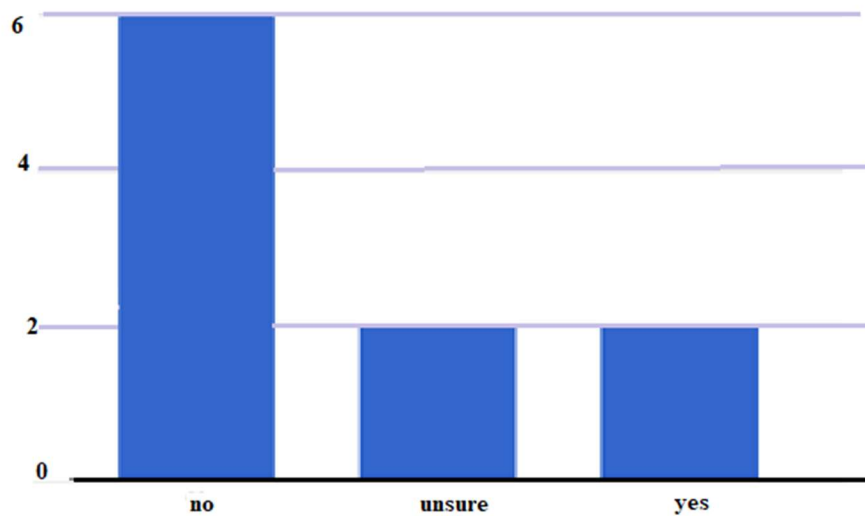


Figure 3. Male students aware of stereotype.

Do you agree with the statement: "I can't be true to myself in the math classroom"?

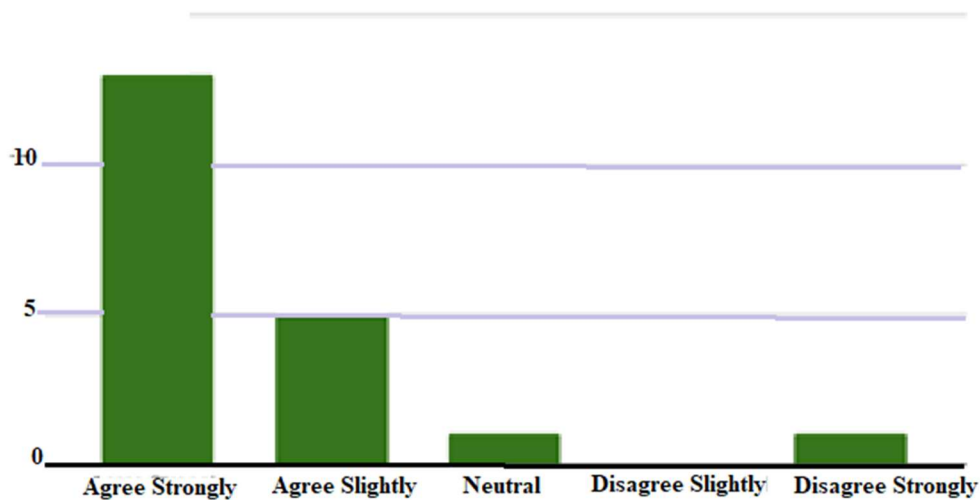


Figure 4. "I can be true to myself in the math classroom."

On the teacher survey, the teacher answered “unsure” to the question, “Have you ever heard of the phrase ‘Stereotype threat?’”. When discussing with the researcher, the teacher said that while he had heard the phrase before, he answered unsure because he was not clear on what it meant in the context of education, nor did he have faith in the vague definition he knew. However, even though stereotype threat was not at the forefront of this teacher's mind, he was using some of the strategies to lessen the effects of stereotype threat. For instance, when asked if he agreed with the statements, “I feel like my students can be true to themselves in my math classroom,” and “I believe in my students regardless of factors of gender, race, religion, or sexual orientation.” The teacher answered “Agree Strongly.” The teacher also answered “Agree slightly” when asked about the statement, “My students know I believe in them.” Conversely, when the students were asked about being true to themselves in the classroom, the students almost all answered that they “Agree Strongly” (Figure 4). This data shows that the teacher has worked to create an identity-safe classroom for his students, one of the three ways of mitigating stereotype threat effects.

The results showed that the majority of students did not know about stereotype threat. The question on the survey that measured this simply asked the students, “Have you ever heard the phrase, ‘Stereotype Threat?’” to which 12 students answered “No,” six students answered “Unsure,” and only two students answered “Yes.” This indicates that most students have not been presented this concept, in a classroom setting or elsewhere.

Lastly, after the discussion with the students, they were asked whether or not they felt like their teacher was effective in combating stereotype threat. The majority of students, 13, answered, “Yes,” four students answered, “Unsure,” and three students answered, “No.”

DISCUSSION

The results of this study did not support one of the hypotheses, strongly supported another hypothesis, and left the other two still with more research needed. For the first hypothesis, that students are aware of the stereotype but are not necessarily aware of stereotype threat was shown to be only partially true: yes, students do not have an awareness of stereotype threat as a phenomenon, but the stereotype about the perceived relationship between gender and mathematics was also missing: many students even wrote on their follow-up survey statements including “I don't believe that stereotype is true, I've never come [sic] across this stereotype. You control your own grades no one else,” and “No, I believe this stereotype is lessening in the modern world and I do not believe in this stereotype.” These students (both male and female) were firmly set in their beliefs that this stereotype was false, and did not have any understanding of how anyone could perceive this stereotype as true. One student even wrote about how he felt that “in fact girls are sometimes better at math than guys.”

The second hypothesis, that female students are more likely to be aware of the negative stereotype was found to be false: when compared by gender, male and female students had the exact same percentage who had been previously aware of that stereotype. This shows that even though the stereotype is about female students, it is not more likely, at least in this group of students for female students to be aware of this stereotype about them.

The third hypothesis, that teachers are aware of stereotype threat was not supported by the results of this survey. The teacher studied was unsure of the meaning of stereotype threat, and as mentioned answered “unsure” when asked if he had knowledge of stereotype threat. Since the teacher did not have enough previous knowledge of stereotype threat, he would have no ability to actively try to prevent the effects of stereotype threat from coming into play in his classroom. However, with only researching one teacher it is still nearly impossible to make a conclusion about a hypothesis based on one subject.

The last hypothesis was shown to be true: even if a teacher is not actively trying to prevent stereotype threat in the classroom, there will still be some of the preventative measures in place that mitigate the effects of stereotype threat because they are simultaneously practices that make the classroom a better environment. This study showed that despite the teacher’s lack of knowledge, the teacher did work on creating an identity safe classroom. The majority of his students did feel like they could be true to themselves in his classroom, and the teacher also reported that he worked hard to make sure all his students felt included and safe in his classroom, regardless of factors including gender, sexual orientation, race, and religion. These actions would combat stereotype threat if students were feeling it regardless of whether or not it was the teacher’s motivation when creating that environment.

The results of this study indicate that not only is stereotype threat less of an issue in this school environment than was initially believed, and that the best practices of teachers can combat stereotype threat without intention. A teacher who is acting in the best interests of his/her students will be effective in combating stereotype threat even without that being his/her original intent.

LIMITATIONS

This study was limited to a single classroom, and this classroom is in a moderately affluent community. The majority of the students were white, and middle to upper-middle class, and may not give an accurate picture of the attitudes and beliefs of diverse learners across the country. These students’ privileges have a direct correlation with the beliefs they have grown up hearing. This study included only 20 students, which resulted in each data point having a strong impact on overall trends.

FUTURE RESEARCH

Future research would go back and look at different classrooms to see if what was seen in this classroom is common for awareness of the stereotype about female students and mathematics, if it is truly becoming less of a prevalence in our school systems, or if this classroom was an anomaly. Extending the study across social class lines, and to more classrooms for a diverse picture of attitudes and thoughts by students on this stereotype, would strengthen the results.

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Appendix A: Survey on Student Opinions: Math, Gender and Stereotype Threat.

Note: This survey is *completely anonymous*. The outcomes of this survey will not affect any grades or classwork for any of the participants. ***Please Answer Honestly.***

1. What gender are you?

- (a) Female
- (b) Male
- (c) Non-binary/Other

2. What gender is your math teacher?

- (a) Female
- (b) Male
- (c) Non-binary/Other
- (d) I don't know

3. Have you ever heard someone say something similar to "boys are better at math than girls?"

- (a) yes
- (b) no
- (c) unsure

4. Do you believe that boys are better at math than girls?

- (a) Definitely yes
- (b) Maybe yes
- (c) maybe no
- (d) Definitely no
- (e) Unsure

For the questions 5-15, please rate how much you agree or disagree with the statement given.

5. "In my math class, boys answer more questions than girls."

- (a) Agree Strongly
- (b) Agree Slightly
- (c) Neutral

- (d) Disagree Slightly
- (e) Disagree Strongly

6. "In my math class, my teacher is more likely to call on male students than female students."

- (a) Agree Strongly
- (b) Agree Slightly
- (c) Neutral
- (d) Disagree Slightly
- (e) Disagree Strongly

7. "My gender affects how well I do in math class."

- (a) Agree Strongly
- (b) Agree Slightly
- (c) Neutral
- (d) Disagree Slightly
- (e) Disagree Strongly

8. "I put more pressure on myself in math class because of expectations about my gender"

- (a) Agree Strongly
- (b) Agree Slightly
- (c) Neutral
- (d) Disagree Slightly
- (e) Disagree Strongly

9. "My peers expect me to do worse in math class because of my gender"

- (a) Agree Strongly
- (b) Agree Slightly
- (c) Neutral
- (d) Disagree Slightly
- (e) Disagree Strongly

10. "My teacher expects me to do worse in math class because of my gender"

- (a) Agree Strongly
- (b) Agree Slightly
- (c) Neutral
- (d) Disagree Slightly
- (e) Disagree Strongly

11. “My family expects me to do worse in math class because of my gender”

- (a) Agree Strongly
- (b) Agree Slightly
- (c) Neutral
- (d) Disagree Slightly
- (e) Disagree Strongly

12. “I feel like I can be true to myself in my math classroom.”

- (a) Agree Strongly
- (b) Agree Slightly
- (c) Neutral
- (d) Disagree Slightly
- (e) Disagree Strongly

13. “My teacher believes in me.”

- (a) Agree Strongly
- (b) Agree Slightly
- (c) Neutral
- (d) Disagree Slightly
- (e) Disagree Strongly

14. “I feel confident in my math abilities.”

- (a) Agree Strongly
- (b) Agree Slightly
- (c) Neutral
- (d) Disagree Slightly
- (e) Disagree Strongly

15. Have you ever heard of the phrase *stereotype threat*?

- (a) yes
- (b) no
- (c) unsure

16. If you have heard of stereotype threat, please write anything you know about it (If you have not heard of stereotype threat, just write “Not Applicable”):

17. If you have heard of stereotype threat, where have you heard it? (Choose all that apply)

- (a) Teachers
- (b) Parents
- (c) Friends/Peers
- (d) Online
- (e) Book/Printed Publication
- (f) Other (please say where): _____
- (g) I have not heard of stereotype threat

Thank you very much for completing this survey!

Appendix B: Survey on Teacher Opinions: Math, Gender and Stereotype Threat.

Note: This survey is *completely anonymous*. The outcomes of this survey will not be given to any students, parents, or administrators. ***Please Answer Honestly.***

1. What gender are you?

- (a) Female
- (b) Male
- (c) Non-binary/Other

3. Have you ever heard someone say something similar to “boys are better at math than girls?”

- (a) yes
- (b) no
- (c) unsure

4. Do you believe that boys are better at math than girls?

- (a) Definitely yes
- (b) Maybe yes
- (c) maybe no
- (d) Definitely no
- (e) Unsure

For the questions 5-15, please rate how much you agree or disagree with the statement given.

5. “In my math classes, boys answer more questions than girls.”

- (a) Agree Strongly
- (b) Agree Slightly
- (c) Neutral
- (d) Disagree Slightly
- (e) Disagree Strongly

6. “In my math class, I am more likely to call on male students than female students.”

- (a) Agree Strongly
- (b) Agree Slightly
- (c) Neutral
- (d) Disagree Slightly

(e) Disagree Strongly

7. “My students’ genders affect how well they perform in math class.”

- (a) Agree Strongly
- (b) Agree Slightly
- (c) Neutral
- (d) Disagree Slightly
- (e) Disagree Strongly

8. “In the past (when I was a student), my gender has affected my experience in a math classroom.”

- (a) Agree Strongly
- (b) Agree Slightly
- (c) Neutral
- (d) Disagree Slightly
- (e) Disagree Strongly

9. “I work hard to make sure that my students’ identities are accepted in my classroom.”

- (a) Agree Strongly
- (b) Agree Slightly
- (c) Neutral
- (d) Disagree Slightly
- (e) Disagree Strongly

10. “I have higher expectations of my male students than my female students.”

- (a) Agree Strongly
- (b) Agree Slightly
- (c) Neutral
- (d) Disagree Slightly
- (e) Disagree Strongly

11. “My family expects me to do worse in math class because of my gender”

- (a) Agree Strongly
- (b) Agree Slightly
- (c) Neutral
- (d) Disagree Slightly
- (e) Disagree Strongly

12. "I feel like my students can be true to themselves in my math classroom."

- (a) Agree Strongly
- (b) Agree Slightly
- (c) Neutral
- (d) Disagree Slightly
- (e) Disagree Strongly

13. "I believe in my students, regardless of factors of gender, race, or sexual orientation."

- (a) Agree Strongly
- (b) Agree Slightly
- (c) Neutral
- (d) Disagree Slightly
- (e) Disagree Strongly

14. "My students know I believe in them."

- (a) Agree Strongly
- (b) Agree Slightly
- (c) Neutral
- (d) Disagree Slightly
- (e) Disagree Strongly

15. "I would talk to my students about stereotype threat."

- (a) Agree Strongly
- (b) Agree Slightly
- (c) Neutral
- (d) Disagree Slightly
- (e) Disagree Strongly

16. "I work hard to make sure my students are not affected by stereotype threat."

- (a) Agree Strongly
- (b) Agree Slightly
- (c) Neutral
- (d) Disagree Slightly
- (e) Disagree Strongly

17. Have you ever heard of the phrase *stereotype threat*?

- (a) yes
- (b) no
- (c) unsure

18. If you have heard of stereotype threat, please write anything you know about it (If you have not heard of stereotype threat, just write “Not Applicable”):

19. If you have heard of stereotype threat, where have you heard it? (Choose all that apply)

- (a) Other teachers
- (b) Parents
- (c) Administrators
- (d) College Education Classes
- (e) Professional Development
- (f) Friends/Social Settings
- (g) Online
- (h) Book/Printed Publication
- (i) Other (please say where): _____
- (j) I have not heard of stereotype threat

Thank you very much for completing this survey!

Appendix C: Follow-Up Student Survey

What gender do you identify as?

- (d) Female
- (e) Male
- (f) Non-binary/Other

Do you feel that your teacher is effective in lessening the effects of stereotype threat?

- (a) Yes
- (b) No
- (c) Unsure

Now knowing what stereotype threat is, how have your feelings about the stereotype female students performance in math changed?
