

SE367 : Project Report

Effects of stereotyping on performance of women in maths

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Abstract

Stereotype threat, as defined by Steele and Aronson, is being at risk of confirming, as a self-characteristic, a negative stereotype about one's social group. It is also believed to be a potential contributor to racial and gender gaps in academic performance. Steel and Aronson in their study compared the performance of white and black students on standardized tests to find that black students performed poorly when their race was emphasized. On the other hand, they performed better or equivalently when it was not. Similarly, it has been shown for many other stereotypes and corresponding social groups that the performance of an individual is negatively affected in situations where they are expected to perform poorly as per the stereotype. For example, white men in sports, elderly in memory performance and women in maths.

In this project, I have looked at the stereotype that women are weak in maths to observe the extent to which this threat affects their performance. The results provide strong evidence that underperformance of women in math ability tests results is a result of stereotype threat.

1 Introduction

A stereotype is a belief/bias built either through experience or influence about a class of people which may be true for some but not all people belonging to that class. Some of the commonly known stereotypes are - blondes

are unintelligent, asians are good in maths, white men are weak in sports, elderly people are unreliable, etc.

Claude Steele and Joshua Aronson coined the term **Stereotype threat**[1] in 1995 describing it as a self-evaluative threat which is experienced by an individual belonging to a group targeted by a negative stereotype when he/she is at the risk of conforming to it. They described it as the fear of being characterized by the stereotype in front of others/self on undertaking any task related to the stereotype. Further, they discussed the possibility that the stereotypes which describe individuals of a group as performing poor in certain domains disrupt performance of those belonging to the group in situations related to the stereotype. They also show through experiments that African-American students perform poorly on standardized tests as compared to white students when their race was made relevant. Since then, numerous experiments have been done which observe the extent to which Steele and Aronson's hypothesis is true for a variety of stereotypes.

In this project, I have looked at the popular stereotype which claims that women are weak in maths. This is a very commonly known stereotype and the gap in performance between the genders has been shown true in literature for school children[2] as well as college going students[3, 10]. Stereotype threat is a possible explanation for this gap. Other theories explaining this exist too - one being that there are genetically rooted differences in math ability between the genders and the other that it is because in the society, men are encouraged more to do

math as compared to women.

Due to the popularity of this stereotype, when women do math, the chances are high that they will be judged by this stereotype. In the following section, I have discussed work which deals with the effect of stereotype threat on the performance of women in academic domains.

2 Related Work

The earliest work[4] to observe whether stereotype threat undermines the performance of women in mathematics was by Spencer, Steele and Quinn in 1999. In their first experiment, they showed that women underperform on difficult tests and not on easy ones. In the next experiment, they demonstrated that the difference is seen only when the test is described as producing gender differences and no difference is seen when it is described as not producing any gender differences. [9] have done similar work. Inzlicht and Ben-Zeev[5] in another study grouped females with males/females to participate in math tests and it was observed that they underperformed on being grouped with males with their negative performance proportional to the number of males in the group. Contrary to the above two studies, in [6] it was shown that stereotype threat might have an opposite effect on the performance of women. They compared the performance of women in two situations - one in which they were shown a cartoon mocking their math ability and another no-gender-difference situation. Women were found to perform better in the first situation. Quinn and Spencer in 2001[7] suggested that under stereotype threat, women lose their problem-solving abilities which causes the underperformance. Some studies[8, 14] studied the effect of situation factors on women's math performance. Women were found to perform better when the test was administered by a female competent in math in [8]. They performed better[11] when they were reminded of their accomplishments. In another study[15], teaching test-takers about stereotype threat reduced the negative effects it has on women's performance.

3 My Experiment

In my experiment, similar to the ones mentioned above, I hypothesized that it is the apprehension caused by stereotype threat which causes women to underperform in math ability tests. It consisted of two tests taken one after the other. These tests were administered on a class of 22 boys and 15 girls studying in 12th standard at Central School, IIT Kanpur. Both the tests contained 15 questions each from the quantitative section of standardized test GRE(Graduate Record Examination). Before the first test, the class was told that, "We are making some new math ability tests and first want to evaluate them on XII standard students. We need you to take the test for this purpose." where as before the second test, they were told, "This is another math ability test and it has shown difference in performance of girls and boys in the past. We want to see if this is really true." By doing this, the stereotype was made relevant in the second test.

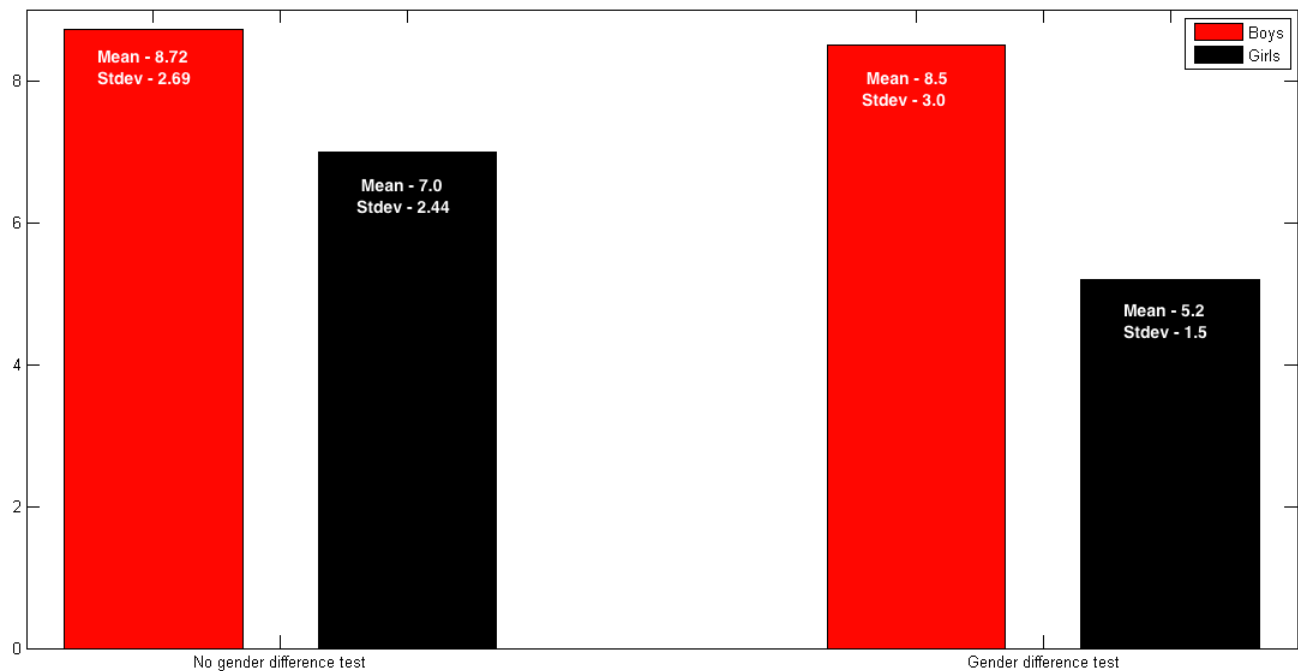
4 Results

The results show that the difference in average marks of males and females in low(less than the standard deviation) for the first test. On the other hand, the performance of women dropped down drastically in the second test. These results are consistent with the hypothesis made. They show that by presenting the test as one on which gender differences occur, the stereotype was made relevant which created an extra pressure on women causing them to underperform.

5 Discussion

Numerous theories exist to explain how stereotype threat works. Some of the possible explanations are -

- Anxiety - Stereotype threat is believed to make the target anxious with the fear of conforming to the stereotype.
- Negative cognitions and dejection- It was suggested in [12] that stereotype threat generates feelings of frustration, disappointment and sadness in women which causes them to underperform.



- Arousal - In [13], it was shown that arousal decreases performance on easy tests and improves on the easy ones.
- Low expectations - Members of the targeted group lose confidence in the task in question.
- Reduced effort, self-control - Targeted individuals don't put too much effort in the task related to the stereotype.
- Reduced working memory capacity - It is also suggested that [15] stereotype threat has a harmful effect on working memory.

6 Conclusion

The results of my experiment provide evidence to support the previous experiments which suggest that stereotype threat is one of the reasons which cause women to underperform in math tests. I have shown that when, on a math ability test, women are made aware of their gender or the stereotype, fear of conforming to the stereotype as a result of stereotype threat causes them to underperform.

7 Acknowledgement

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References

- [1] C. M. Steele and J. Aronson. Stereotype threat and the intellectual test performance of African-Americans. *Journal of Personality and Social Psychology* (1995), 69, 797-811
- [2] C. P. Benbow, D. Lubinski, D. L. Shea and H. E. Aronson. Sex Differences in Mathematical Reasoning Ability at Age 13: Their Status 20 Years Later. *Psychological Science*, 69, 1 November 2000: 474-480.
- [3] R. P. Brown, R. A. Josephs. A burden of proof: Stereotype relevance and gender differences in math

- performance. *Journal of Personality and Social Psychology*(1999), 76, 246257.
- [4] S. J. Spencer, C. M. Steele and D. M. Quinn. Stereotype threat and women's math performance. *Journal of Experimental Social Psychology*(1999), 35, 4-28.
- [5] M. Inzlicht and T. Ben-Zeev. A threatening intellectual environment: Why females are susceptible to experiencing problem-solving deficits in the presence of males. *Psychological Science*(2000), 11, 365-371.
- [6] D. Oswald and R. Harvey. Hostile environments, stereotype threat, and math performance among undergraduate women. *Current Psychology*(2000), 0737-8262
- [7] S. J. Spencer, C. M. Steele and D. M. Quinn. The Interference of stereotype threat with women's generation of mathematical problem-solving strategies. *Journal of Social Issues*(2001), 57, 55-71.
- [8] D. M. Marx and J. S Roman. Female role models: Protecting women's math test performance. *Personality and Social Psychology Bulletin*(2002), 28, 1183-1193.
- [9] T. Schmader. Gender Identification Moderates Stereotype Threat Effects on Women's Math Performance *Journal of Experimental Social Psychology*(2002), 38, 194-201.
- [10] J. Steele , J. B. James and R. Barnett. Learning in a man's world: Examining the perceptions of undergraduate women in male-dominated academic areas. *Psychology of Women Quarterly*(2002), 26, 46-50.
- [11] R. B. McIntyre, R. Paulson and C. Lord. Alleviating women's mathematics stereotype threat through salience of group achievements. *Journal of Experimental Social Psychology*(2003), 39, 83-90.
- [12] J. Keller and D. Dauenheimer. Stereotype threat in the classroom: Dejection mediates the disrupting threat effect on womens math performance. *Personality and Social Psychology Bulletin*(2003), 29, 371381.
- [13] L. T. OBrien and C. S. Crandall. Stereotype threat and arousal: Effects on womens math performance. *Personality and Social Psychology Bulletin*(2003), 29, 782789.
- [14] M. C. Murphy, C. M. Steele and J. J Gross. Signaling threat: How situational cues affect women in math, science, and engineering settings. *Psychological Science*(2007), 18, 879-885.
- [15] M. Johns, T. Schmader and A. Martens. Knowing is half the battle: Teaching stereotype threat as a means of improving women's math performance. *Psychological Science*(2005), 16, 175-179.