Against the Stereotype Threat

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In this article, we discuss the nature of psychological influences which prevent women's equal participation in science and suggest ways to create confidence instead.

INTRODUCTION:

The proportion of women in academic staff is considerably smaller in physics and mathematics than in the arts and social sciences. For example, women comprise 21.6% of physics faculty in French Universities [1] and 22.1% of physics researchers in the French Center for Scientific Research (CNRS) [2]. Only 12.4% physics faculty in Canada are women [3]. This is in contrast to social sciences and arts where women at the faculty level exceed 50% [3]. Considerable research efforts have been devoted to understand this `imbalance', and examine the root causes of why women do not pursue careers in natural sciences. Typically, hypothetical biological differences between the brain of men and women, social barriers, and existing prejudices are examined and assessed for their possible roles in the persisting gender disparity. However, a growing body of research challenges the conventional

assumptions based on genetics or cultural differences and highlights the influence of negative stereotypes.

In the present article, we examine `stereotype threat', a psychological condition in which an individual is at risk of confirming existing negative biases about the individual's group of identity. The concept was introduced in a paper by Steele and Aaronson in 1995 [4]. The "stereotype threat" is rooted in the social, gender and racial identity of an individual, and is believed to be sufficiently influential in affecting the individuals performance in science. It invalidates the justification of women's lack of appreciation of sciences as due to inherent "biological" constraints.

The present article presents selected experiments on scientific performance of women in math tests under the stereotype threat as reported in pioneering papers discussing this condition [5,6].

PERFORMING UNDER THE STEREOTYPE:

In the 1980's Benbow and Stanley attributed the significant differences in performance in math observed at a very young age between boys and girls to intrinsic differences in mathematical ability [7]. The conclusions of the study were later rebutted and attributed to social prejudice rather than inherent biological differences [5,6]. In an important study, the concept of `stereotype threat' and the methodology introduced by Steele and Aaronson to explain the performance of African-Americans [4] were used by Spencer, Steele and Quinn (SSQ) [5] to study gender differences in math tests in 1999. Their results are discussed briefly.

The SSQ investigation comprised three sets of studies with samples ranging from 28-36 men and a similar number of women from University of Michigan and State University of New York, USA. All participants had good qualification in math, including calculus. In study 1 the participants were given two sets of questions, an `easy test' and an `advanced or difficult test'. Women scored significantly less

than men in the advanced test. This test was done to confirm existing notions of women underperforming in difficult math tests. In study 2 the notion of gender difference was introduced. The participants were given two sets of questions. They were told that the performance outcome had previously shown a gender difference for the first set and no gender difference for the second set. For half of the participants the first and second sets of questions were reversed. The test results revealed that, when women were told that the test was unbiased, they performed significantly better, and equally as men, independently of the actual questions. Figure 1 (adapted from SSQ [5]) shows the results of the studies.

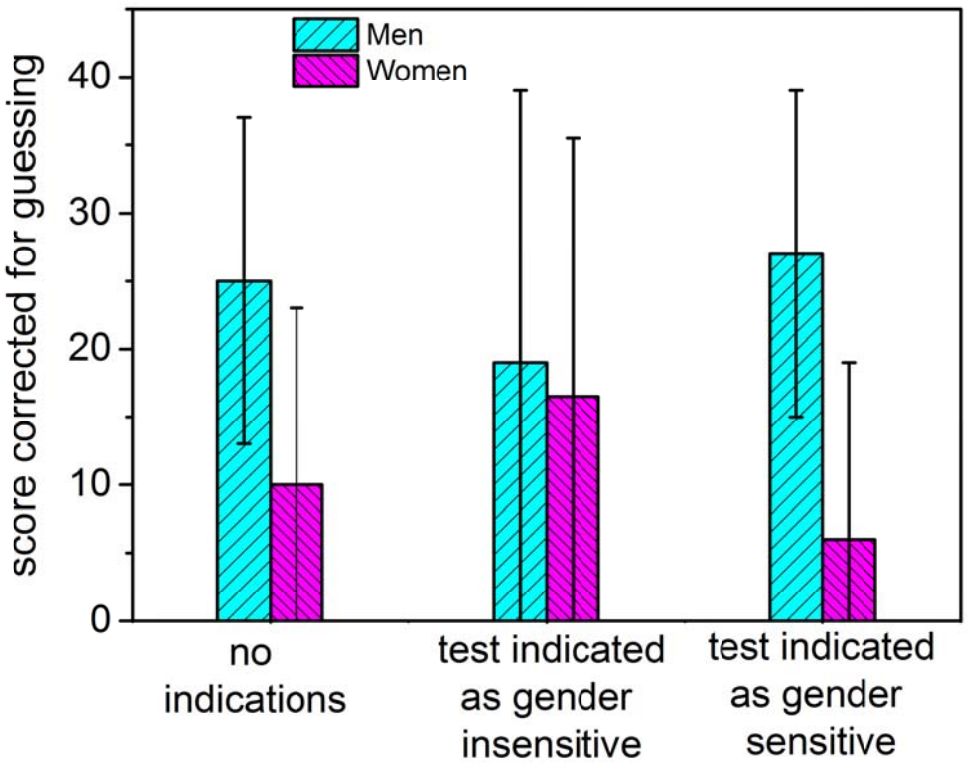

Figure 1. Men and Women results for difficult math tests depending on the context. Error bars represent the score distribution width. (Adapted from [5])

The SSQ Study 3 was equivalent to Study 2 with easier questions. It further analysed the psychological stress level, the evaluation apprehension, self-efficacy and anxiety of each individual in the study. Based on the three studies, SSQ concluded that women were performing poorly because of the `stereotype threat' (which might have been promoted by anxiety). When the `threat' was removed, women's performance equalled that of the other gender independently of the difficulty of the test. For the detailed account of the experiments and findings, the reader is referred to the original paper [5].

Huguet and Régner [6] conducted a series of studies to examine the effect of the `stereotype threat' on young school pupils of a French public middle school, in an age group of 11-13 year olds. The test consisted in reconstructing by memory a complex drawing with different lines and figures. One half of participants were told that the test was a geometry test, whereas the other half, were told that the test was a drawing memory game.

In a first study, 20 girls and 20 boys with good math skills were tested. They had 50 seconds to memorise the figure and 5 minutes to reproduce it. The result was astounding (Figure 2 left); in the test labelled as memory game, the girls significantly outperformed the boys whereas the result was reverse when the test was presented as a geometry test.

A second study involved 454 children (223 girls and 231 boys) with average math skills. They were divided into groups of 20 persons either of the same sex or with mixed sex members and given the same test as for study 1. The test was again specified as a `geometry test' for half of the groups and as a `drawing test' for the others. They had 90 seconds to encode the figure and 5 minutes to reproduce it. The results of Study 2 are presented in the right panel of Figure 2. Again, in mixed groups, the girls significantly outperformed the boys when the test was labelled as a `drawing test', replicating for a larger sample the observations of study 1. In the groups comprised of same-sex members, the scores were very good for both genders. These studies show that the stereotype threat influences the results of

both girls (stereotype favouring boys in geometry ability) and boys (stereotype favouring girls in artistic ability) in the mixed groups. Whereas in the same-sex groups the stereotypes are inhibited; the influence of role models (high ability persons of the same sex) can be useful in improving performance. Further details can be found in the original paper [6].

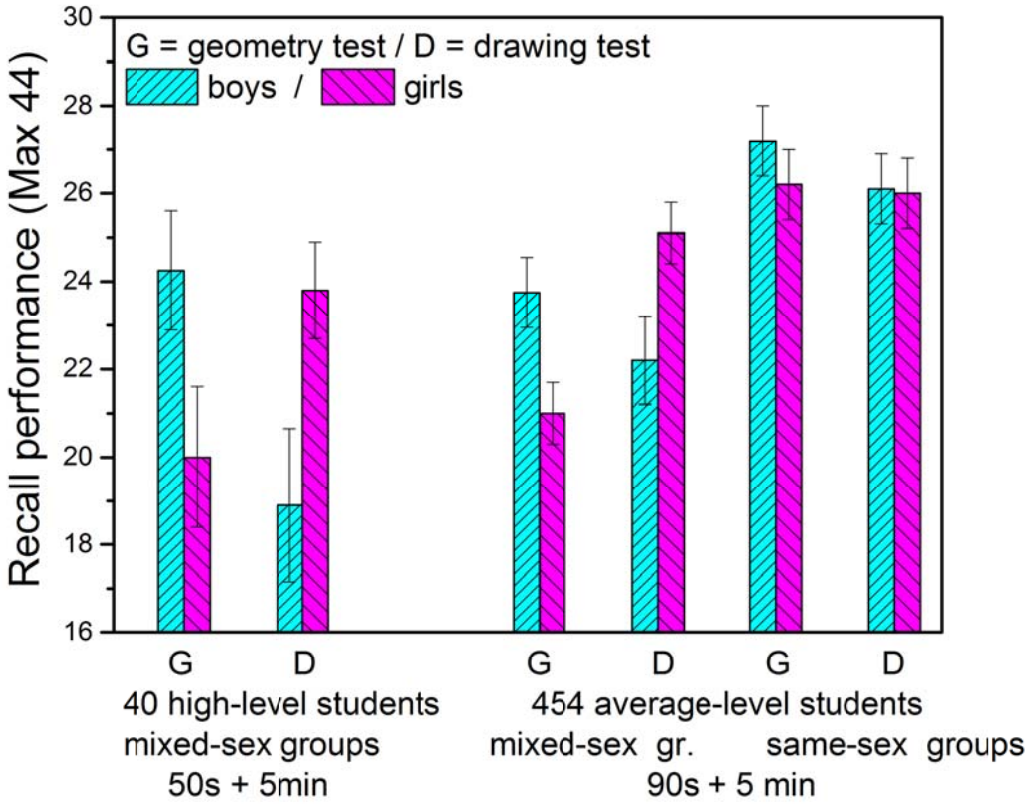

Figure 2. Scores of boys and girls in geometry tests depending on the context (test presented as a geometry test (G) or a drawing test (D) — groups of same or mixed sex). Error bars represent standard errors. (Adapted from [6])

A recent study [8] used a similar test for 312 high school students in physics in USA. Three different stereotype threat conditions were assigned to different groups: They were (i) Implicit stereotypes (the students were not told about any gender notions), (ii) Explicit stereotypes (students were told that in the test boys outperformed girls), and (iii) Nullified stereotypes (The students were told that girls performed

equally as boys). The results of this recent study [8] confirmed the outcomes of the previous studies [5,6]. The groups with implicit and explicit stereotype threat conditions showed disparity in the performance: boys performed better than girls. On the contrary, in the groups with nullified stereotype condition, girls and boys performed equally.

CONCLUSION

In conclusion, the notion that women would be weaker than men in their math skills, particularly in difficult math skills, persisted during the test of individuals and influenced their performance. The use of psychological manipulation to counter-influence the individuals against this bias clearly increased their performance level. The use of positive role models, e.g. the presence of girls with excellent math skills in the group, also increased the performance level of the group [6]. Thus the existence of `stereotype threat' is real, and like all threats must be removed from the classrooms and educational centers of human knowledge as a beginning. However, the good performance of girls at exams is only a first step, towards achieving gender balance in scientific careers. The next step is changing the negative stereotypes that have a strong influence on their career choices. Women with high scientific skills statistically prefer medical and social jobs to maths, physics and engineering jobs.

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