

Growth Mindset Training and the Effect of Math-Gender Stereotype Threat on Girl Students

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Abstract: *To investigate whether growth mindset training can weaken the effect of math-gender stereotype threat on girl students, this study undertook experimental intervention in a group of grade-11 girl students and found that: (i) Mindsets can moderate the effect of math-gender stereotype threat. Girls with a growth mindset are less likely to be affected by math-gender stereotype threat compared with those with a fixed mindset. (ii) Growth mindset training for girls with a fixed mindset can effectively reduce the effect of math-gender stereotype threat on their math performance.*

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Raising Questions

There have been two contrasting attitudes towards the malleability of individual traits such as intelligence and personalities. One is named the “fixed mindset,” which views personal traits as innate and unchangeable; the other is referred to as the “growth mindset,” which believes that some basic personal qualities are in constant development, and that individual ability improves as the result of persistent efforts. Those who hold intellectual ability to be an unchangeable quality are more prone to apprehension about failure, mistake, and criticism, whilst those with the growth mindset tend to see failures as opportunities for learning and personal improvement and are more likely to carry on being positive and resilient in subsequent tasks.

The math-gender stereotype is a belief that women have weaker mathematical ability than men. Prior research discovered that individuals who are the targets of a devaluing group stereotype experience extra pressure which may depress their performance. Such an experience is referred to as the “stereotype threat.” Will women with the growth mindset feel less anxiety when facing the math-gender stereotype, thus less susceptible to its threat, as they hold that individual competencies are consistently developing and malleable? Since women with the fixed mindset believe that individual abilities are innate and hard to change, are they more severely affected by math-gender stereotype threat? Will growth mindset training mitigate the effect of math-gender stereotype threat on girl students? These are the questions to be addressed in this article.

Study 1: How Do Mindsets Influence the Effect of Math-Gender Stereotype Threat on Girl Students?

Research Design

Subjects

This study selected 202 girl students from high achieving classes in three county-level senior secondary schools and investigated their mindsets and math ability.

Research Tools

- Growth Mindset Scale (GMS) developed by Dweck was employed as a measure, which comprised 20 items. The more highly the student scores, the stronger her disposition towards the growth mindset.
- The math test paper was prepared by a grade-11 math teacher. It was relatively difficult, containing 15 objective test items. The total score was 20 points, and students had 25 minutes to complete the test.

Procedure

The investigation on the mindsets of the 202 girls was carried out in their evening self-study session. They were divided into the stereotype threat group and the non-threat group. Each group consisted of 101 students. The stereotype threat group were asked to read a piece of writing first to activate their awareness of the math-gender stereotype before they started to work on the math test, whereas the control group took the test straightaway without the extra reading.

Research Results

The Analysis of the Effect of Math-Gender Stereotype Threat on Math Performance

The math test scores the two groups got showed that the performance of the girls in the stereotype threat condition is lower than that of girls in the control condition ($t = 2.46$, $p < 0.05$), indicating that the math-gender stereotype threat has a detrimental effect on girls' math performance.

The Moderating Effect of Student Mindsets

The study established an interactive regression model, in which the math test score was the dependent variable, and the stereotype condition (the stereotype threat condition was coded as 1; the control condition as 0) and the type of mindset were independent variables. According to the Bootstrap analysis results ($n = 5000$, the confidence coefficient = 95%), the overall effect of the regression model is significant ($R^2_{\text{adj}} = 0.097$, $F_{(3, 190)} = 6.799$, $p = 0.0002$). The stereotype threat group scored lower than the control group; the math-gender stereotype imposed a depressing effect on math test scores of girl students ($t = -2.2584$, $p < 0.05$; confidence intervals do not contain 0). The growth mindset could positively predict math performance ($t = 2.2817$, $p < 0.01$; confidence intervals do not contain 0); girls with stronger disposition towards the growth mindset got higher math test scores. The coefficient of the product of the stereotype threat condition and the mindset is significant ($t = 2.3488$, $p < 0.05$; confidence intervals do not contain 0), indicating that the mindset had a moderating effect on the impact of the stereotype threat condition on the math test scores.

Study 2: The Dampening Effect of Growth Mindset Training on the Math-Gender Stereotype Threat

Research Design

Subjects

This study recruited 671 grade-11 girl students of the science track from two county-level key high schools who would be measured by the Growth Mindset Scale and

ranked by the scores they got. A total of 181 girls who scored below the 27th percentiles were selected to participate in the experiment as students with the fixed mindset.

Research Tools

The Growth Mindset Scale, the math test paper, and growth mindset training module PPT were used in the experiment.

Procedure

The 181 participants were randomly divided into the mindset training group and the non-training group. Each of the two groups was then subdivided into the stereotype threat group and non-threat group, and thereby four subgroups were established: the mindset training* stereotype threat group of 46 students; the mindset training* non-threat group of 45; non-training* stereotype threat group of 45; non-training* non-threat group of 45. After the test, the numbers of questionnaires retrieved from the four groups were 44, 43, 43, and 42, respectively.

In an evening self-study session, growth mindset training was administered to the mindset training group, while the non-training group performed self-study as usual. When the training finished, the stereotype threat group were requested to read a piece of writing to activate their awareness of math-gender stereotype (as in Study 1). After that, all students were given 25 minutes to complete the math test.

Research Results

To examine the differences in math test scores among the four groups, a 2×2 ANOVA was undertaken, using the math test score as dependent variable, and the mindset training condition and the stereotype threat condition as independent variables. The results showed that the overall effect of growth mindset training was significant ($F_{(1,168)} = 41.747$, $p = 0.000$), and that the interaction between the mindset training and the stereotype threat conditions was also significant ($F_{(1,168)} = 4.075$, $p = 0.045$). The results of simple effects test demonstrated that the difference between the math test scores under the stereotype threat condition and those under the non-threat condition was insignificant ($p = 0.725$) among girls having received growth mindset training, but significant ($p = 0.014$) among girls without growth mindset training. The results of the experiment revealed that growth mindset training could effectively weaken the effect of the math-gender stereotype threat on girl students and considerably improve their math performance.

Discussions

The Impact of Mindsets on the Effect of the Math-Gender Stereotype Threat

The math-gender stereotype cannot considerably and adversely affect girl students with a growth mindset, even when they are in the situation where the math-gender stereotype is activated. Nevertheless, it can impose a significant threatening effect on girls with a fixed mindset especially when they are made sensitive to the stereotype; because they believe that individual competences are inborn, thus unallowable.

The Role of Growth Mindset Training in Mitigating the Detrimental Effect of the Math-Gender Stereotype Threat

Deliberate, pertinent training can effectively develop students' growth mindset. The math performance of girls who have received growth mindset training is unexceptionally, significantly better than that of those without such experience, which confirms that growth mindset training is not only effective in reducing the negative effect of the math-gender stereotype threat but can also improve math achievement of every girl. Particularly for girls with a fixed mindset, growth mindset training has a significant dampening effect on the math-gender stereotype threat and is extremely beneficial for their math performance progress.

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