Whether Informing Participants with High Self-Relevance of Gender Stereotype Alleviates Stereotype Activation Threat

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Abstract: Females, as a minority group, experience social inequalities relative to males in most societies. Part of the inequalities originates from gender-stereotypical thoughts, which impose threats and anxiety on females, worsening their performances. The study aimed to investigate the relationship between the self-relevance level of the stereotypical traits and the performance improvement under the informing women about stereotype threat. Female participants finished a gender role orientation inventory and were exposed to gender stereotype threats before the two-dimensional mental orientation task. The performance of the task was measured by reaction time and the number of correct answers. The participants in the teaching-intervention condition were additionally informed that gender stereotype threat could interfere with their spatial performance. Results showed that women with female gender role orientation performed worse than those without. However, no relation between gender role orientation and teaching-intervention was found. The results suggest a potential problem under the two-dimensional mental rotation tasks and provide future studies with further suggestions.

Keywords: Gender Stereotypes, Priming, Gender Role Orientation, Mental Rotation, Stereotype Threat, Gender Differences.

1. Introduction

The priming effect refers to the nonconscious influence of past experiences on organisms' current thoughts or behaviours, representing an example of implicit or nondeclarative memories[1]. Sex-priming would be elicited by various cues, such as being exposed to sexual stimuli, in the minority gender or completing gender-typed tasks, and stating explicitly that gender differences exist in a tested domain[2,3]. The authors pointed out that the activation of sex-priming would attune the individuals' behaviour to gender stereotypes unconsciously and evoke greater compliance in gender-based behaviours. Thus, sex-priming influences self-perception or self-categorization, and increases self-stereotyping.

The priming of gender stereotypes increases cognitive accessibility of stereotypical gender traits, affecting the expectations and thoughts of the individuals', and hence contributes to stereotyping consistent behaviours[4,5]. Merely exposing participants to gender-related materials could activate gender stereotypes and affect their perception of others[5]. The stereotypical beliefs about the advantages of males in mathematical and visual-spatial reasoning abilities and the inferiority of the group in the emotional sensitivity influence both men's and women's behaviour[3]. The stereotypical

beliefs that men are superior in specific domains undermine the test performance of women. For example, exposing women to gender stereotypes before mathematical and visual-spatial tests would deteriorate their performance, resulting in a lower correctness rate or solving fewer test problems, relative to the women in the same test without a corresponding stereotype activation[4,6].

The inferior performance of the spatial tasks may relate to spatial anxiety, which is the anxiety about performing spatial tasks (e.g., navigation, mentally manipulating or rotating objects)[7]. Previous studies found that females experienced higher spatial anxiety than males and thus underperformed on spatial tasks[7,8]. The spatial anxiety can be evoked by the clarification of the tasks' type and negative messages conveyed[9]. The explicit negative messages for females (e.g., "Females are worse") leads to bad group performance. The gender gap in spatial tasks, especially in mental rotation, is a result of previous experiences[8]. The reported males' advantages in mental rotation ability can be attributed to the preference for sports activities and toys with spatial components[7]. The early exposure to spatial-related activities may arise from social norms and generate later advantages in the mental rotation tasks. Other potential explanations for the differences in performance were beliefs in gender-roles or gender-stereotypes, confidence about performance, and general anxiety experienced while taking the test[7].

When comparing 3D vs. 2D mental rotation tasks, the superiority of males' performance appeared only in the 2D version[10]. In an experiment, training participants (both females and males) with mental rotation tasks improved female participants' performance, suggesting the sex differences in the tasks were acquired through nurture instead of nature[10]. The current study applied 2D mental rotation tasks to measure the performance of the female participants as the 2D tasks are initially harder for the group, aiming to achieve higher spatial anxiety levels and more significant impact sizes, compared with 3D ones.

After being informed of the detriment of gender stereotypes (e.g., "the gender stereotypes would raise your anxiety level and deteriorate your test performance."), female participants' performance improved[11]. The information provided participants with explanation of their anxiety and thus they might be better to realize and handle the emotion. The difficulty level of tests also impacts participants' achievement. Members from a stigmatized group were more likely to be threatened when the tasks were challenging, compared with other tasks[12]. The difficult tasks might burden individuals' cognitive capacity, requiring them to engage in alleviating their anxiety and thus distracting their attention to the tasks[12]. The authors also claimed that challenging tasks might posit the stereotype is true and affect subsequent motivation. Hence, the present study adopted easy mental rotation tasks to avoid the negative impact of demotivation.

Gender role orientation is the self-relevance of stereotypic gender traits[3], assessed by self-selected descriptions of masculine and feminine traits. Most of the studies used Bem Sex Role Inventory (BSRI) to evaluate gender role orientation. Researchers found that females who possess feminine gender role orientation experienced inferior performance on gender-stereotyped tasks because of stereotype activation[10]. The underperformance appeared both in mathematical and mental orientation tests. The authors discovered that participants with feminine gender role orientation did not encounter performance deterioration when stereotype was not activated. Preventing the threatening role played by gender stereotype activation could liberate women from that inferiority. The current study adopted the 50-item sex role inventory for Chinese college students (CSRI-50), a Chinese version of BSRI, to measure the gender role orientation. CSRI-50 matched the items in BSRI to Chinese cultural contexts and modified elements to match Chinese social desirability[13]. CSRI-50 reduced individualistic traits (highly valued in Western culture) and added items describing rationality, which are highly valued under Chinese cultural background. The theoretical framework of the inventory is the same as BSRI.

The present study aimed to discover the interaction and correlation between gender role orientation and the impact of being informed of the hazards of gender stereotypes. The study assumed that participants with a higher initial perception of self-relevance of the stereotypical traits (i.e., female gender role orientation) would improve performance more than lower initial perception groups, because of spatial anxiety reduction.

2. Method

2.1. Participants

Participants were Chinese females, recruited via advertisement on a social media website and received CNY 3 (~ US $0.5) for their participation. Fifty female participants (M_{age} = 22.8, SD = 2.9, after outlier exclusion) were randomly assigned to two conditions: teaching-intervention (n = 28) and control (n = 22). To avoid unserious attempts, the exclusion criteria were (1) the overall task completion time was less than 1 min 30 s, (2) the average reaction time to complete the mental rotation task was less than 1260 msec (based on the researcher's own data divided by two), (3) failure to complete tasks.

2.2. Measures

The experiments ran on Gorilla and can conduct on various devices (mobile phones, tablets, PC).

2.2.1. Gender Role Assessment

The Gender role orientation was assessed by CSRI-50, comprising three scales: masculinity, femineity, and social desirability. The first two scales consist of 16 items each. The items are single adjectives of a specific trait. The participants rated themselves on a 7-point scale (1 = the trait never applies to me, 7 = the trait always applies to me). Example items in English are yielding (feminine), leadership ability (masculine), and genuine (social desirability). The score of different categories was calculated from the average score on that scale. Same as the previous experiment, the current study used the F-M difference to measure gender role orientation[3]. The social desirability scores were not accounted for in the data analysis phase.

2.2.2. Mental Rotation

The mental rotations paradigm used in the study is mental transformation tasks on Gorilla[14]. Mental rotation is a special case in the mental transformation[15]. The current task acquired participants to decide which one of the 4 shapes tested can be created by the target shapes joined together (see Figure 1). The task involved 3 practice trials with feedback and 16 experimental trials without feedback. The experimental trials differed systematically by rotation (45 °or 0 °) or by translation (presented on the same or split planes). The positions of correct answers were counterbalanced across trials. Participants' performances were measured by reaction time and the number of correct answers.

2.3. Procedure

First, participants answered the CSRI-50. Before the stereotype activation, they need to restate their gender (i.e., female) to ensure the perception of the social identity. They then read a statement about the males' advantages in the spatial tasks to evoke their perception of gender stereotypes. The teaching-intervention group was given extra instruction that "it is worth noting that the anxiety you experienced in the test might come from the gender stereotypes rooted in the society, and it has

nothing to do with your personal ability." They then took the mental rotation tasks. They self-reported their confidence level of getting 100% correctness of the spatial tasks at the end.

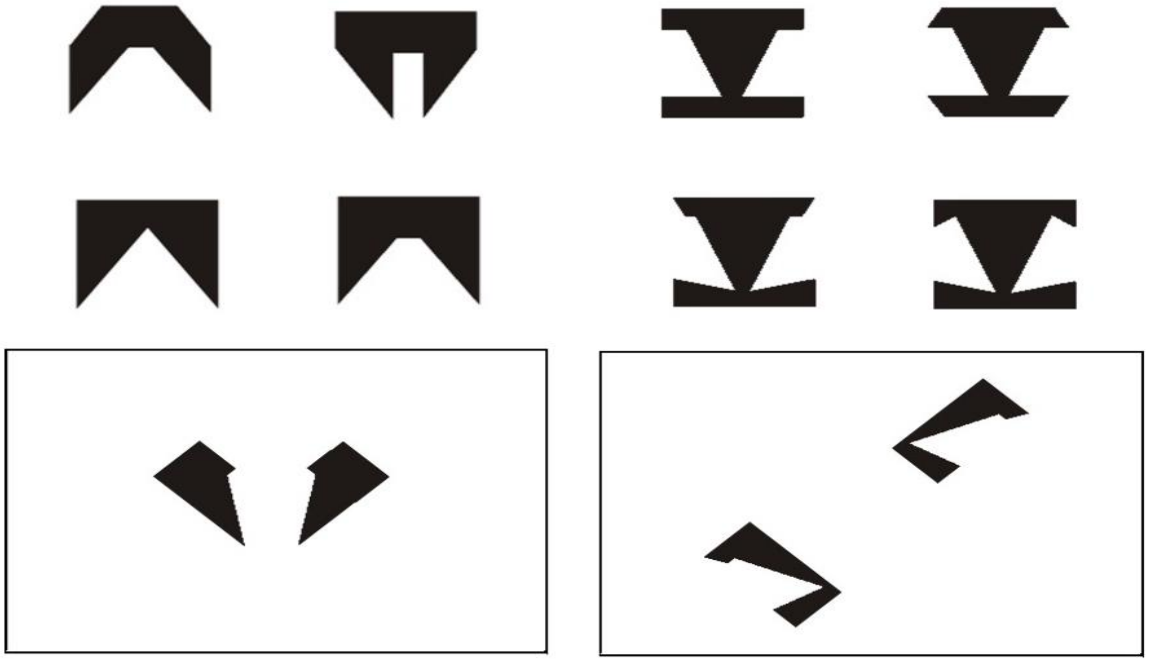

Figure 1: A demonstration of the task used in the experiment[14].

3. Results

Performance in the test was analyzed using a one-tail t-test. Based on the previous literature, the experimenter conducted a power analysis to calculate the number of participants needed to get the same power[3]. The required number of participants was 55 per group, which was more than the current study. Therefore, the present study applied the one-tail test to the replication parts of the previous study.

The reaction time of the Teaching-intervention group ($M = 5545.99$, $SD = 2230.39$) was significantly higher than No-teaching group ($M = 4557.03$, $SD = 1625.09$), $t(48) = -1.746$, $p = .087$. Other results of different variables were insignificant across the conditions (Teaching-intervention/No-teaching) (Table 1).

The study failed to find significant differences in the test performance (number of correct answers and reaction time) between the female gender role orientation and other gender role orientation across conditions. The feminine tendency (F-M > 0) performed less correct answers ($M = 12.429$, $SD = 2.76$) than other traits tendency ($M = 13.07$, $SD = 4.42$) in the No-Teaching group, compared with Teaching-intervention group (Table 2), however, the test was insignificant (Table 3). No significant performance differences between female role orientation and other traits orientation across conditions were found (Table 2 & 3).

The study conducted a one-tail correlation test to measure the linear correlation between female gender role orientation and test performance in the Teaching condition. The result showed that the higher the feminine traits labelled by participants themselves, the lower correct answers they demonstrated, compared with participants who marked themselves with other gender role orientations, $r = -0.358$, $p = .062$.

Table 1: One-tail t-test of the differences on the different variables across conditions.

	Mean		SD			
	Teaching	No-Teaching	Teaching	No-Teaching	t(48)	p-value
Number of Correct Answers	12.86	12.86	2.621	2.933	0	0.993
Confidence	4.96	4.64	1.453	1.217	0.722	0.4
Trait Differences	0.59	0.45	0.9	0.92	0.287	0.594

Table 2: Statistical summary of mean test performance of different gender orientations across two conditions.

		Female gender role orientation		Other gender role orientation	
		Mean	SD	Other Traits	SD
No-Teaching	Correct Answer	12.43	2.76	13.07	4.42
	Avg Reaction Time	4388.82	1282.38	4635.53	1798.84
Teaching	Correct Answer	12.80	3.26	12.89	3.20
	Avg Reaction Time	5228.37	2222.68	5722.45	2067.53

Table 3: Independent samples t-test of test performance between different traits tendency across two conditions.

	Mean Difference	Std. Error Difference	t	df	p
Number of Correct Answers	-0.552	0.786	-0.702	48	0.486
Reaction Time	247.372	566.491	0.437	48	0.664

4. Conclusion

The main purpose of the current study was to investigate whether reminding the hazardous role of the gender stereotype activation to individuals with high initial perceptions of self-relevance of the stereotypical traits would improve their performance. The study successfully replicated previous studies by finding that participants who knew the anxiety evocation role performed by gender stereotypes slowed down their reaction time. The explanation might be that those participants would calm down and employ more time to consider the correct answers, instead of anxiously skipping over questions, relative to others. Further study needs to measure whether the instruction before the test is sufficient to alleviate the anxiety levels by using anxiety questionnaires after the test. Another finding was consistent with the previous study as well, where the higher feminine traits the participants attributed to themselves, the smaller number of correct answers they achieved even when instructed about the hazardous role of the gender stereotypes in the testing phase. The result could be explained

by the high endogenous stereotypes they possessed. Although the reminder was received, they still need to spend more effort to persuade themselves to believe the statement, compared with those who had low levels of self-relevant stereotypes. The necessity to solve conflicts and suppress endogenous anxiety would burden their cognitive capacity. Hence their performance worsened[16].

The results failed to prove the hypothesis that individuals with female gender role tendency would improve more than other groups. A possible explanation is the ceiling effect of the 2D mental rotation tasks used in the current study. The participants almost achieved all answers correct in both conditions. The stereotype-threatened minorities demonstrated worse performance than non-threatened minorities on highly cognitive demand tasks[12]. Although the researcher measured the performance based on both the number of correct answers and average reaction time and a significant reaction time difference was found, future studies still need to design difficult 2D mental rotation tasks to avoid the ceiling effect.

One of the limitations of the present study was the relatively small sample size. The power analysis of the previous study showed that the study needed at least 55 participants per group to achieve the same power. The current study was slightly underpowered. Future study needs to recruit more participants to make a powerful inference.

The other limitation was that the study implemented an explicit gender stereotypes threat (i.e., 'males outperformed females") to activate the implicit anxiety rather than a subtle threat (i.e., the subgroup differences are conveyed indirectly through the context of tests, test takers' subgroup membership or the manipulation of the test-taking experience). A meta-analysis exhibited that subtle gender stereotypes threats deteriorated females' performance more effectively than explicit or blatant threats[12]. Future studies could apply subtle threats to activate the negative stereotypes subconsciously to achieve a greater amount of impact than the current moderately explicit threats. The larger the amount of impact, the easier for researchers to detect a teaching-intervention effect.

To sum up, the present results concur with previous findings, where the test performances improved under intervention and the level of self-relevance of stereotypical traits influenced individuals' behaviors. Although the current study failed to find an interaction effect between gender role orientation and different conditions, the research proposed the direction of future studies. Further studies need to measure participants' anxiety levels to explore the psychological mechanisms under the instruction intervention. Difficulty differentiated two-dimensional mental rotation tasks need to be designed to test females' performance.

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