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RESEARCH

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Does enhanced expectancy mitigate the negative impact of gender stereotype threat on women's motor learning, perceived competence and self-efficacy?

Mahdiah Behbahanabadi¹, Esmael Saemi^{1*}, Mohammadreza Doustan¹, Thomas Simpson² and Maxime Deshayes³

Abstract

Background A substantial body of literature has demonstrated that women may be negatively influenced by gender stereotypes, especially when induced in an evaluative situation, during a task where a negative stereotype toward women exists (e.g., soccer). Although numerous studies have been conducted with the aim of reducing these negative effects of stereotype threat, exploring newer methods such as using enhanced expectancy, achieved through the simplification of task criteria for success, could be significant. Therefore, the purpose of the present study was to explore how enhanced expectancy could mitigate the negative impact of gender stereotype threat on women's motor learning, perceived competence, and self-efficacy.

Methods The participants were 99 novice women (Mage = 21.55 ± 2.65 years) who were randomly divided into three groups (1- Gender stereotype threat + easy criteria for success, 2- Gender stereotype threat and 3- Nullified-stereotype group). On the first day and after completing 12 trials of soccer kicking task as a pretest, the participants completed the perceived competence as well as self-efficacy scale and then practiced in 5 blocks of 12 trials during practice phase. At the end of the first day, the participants completed the perceived competence and the self-efficacy scale again, and the stereotype threat and task difficulty checklists. On the second day (24 h after the practice phase), participants completed self-efficacy scale again and then took a 12-trial retention test.

Results The results showed that participants in both the stereotype threat + relatively easy criteria and the nullified-stereotype groups performed better than the stereotype threat group ($p < 0.001$) while there was no difference between the stereotype threat + relatively easy criteria and nullified-stereotype groups ($P > 0.05$). Interestingly, these results highlighted that enhanced expectancy, achieved through the simplification of task criteria, could mitigate the negative impact of stereotype threat. Furthermore, although the results of this study failed to show a significant difference in perceived competence ($p > 0.05$), the findings showed that the self-efficacy levels of learners in the stereotype threat group were significantly lower than the nullified-stereotype and stereotype threat/ enhanced expectancy groups ($p < 0.05$) while there was no difference between two stereotype threat + relatively easy criteria and nullified-stereotype groups ($P > 0.05$).

*Correspondence:
Esmael Saemi
e.saemi@scu.ac.ir

Full list of author information is available at the end of the article



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Conclusion Ultimately, this is emphasized to coaches and practitioners working with adult women that they should aim to reduce the potential negative impact of gender stereotype threats on motor learning by using enhanced expectancy, achieved through the simplification of task criteria for success.

Keywords Stereotype threats, Easy criteria for success, Motor learning, Perceived competence, Self-efficacy

Introduction

A substantial body of literature has demonstrated that people may negatively be influenced by some stereotypes and, in particular, may experience a phenomenon known as “stereotype threat (ST)” [1]. ST is a situational phenomenon that refers to the concerns and anxiety that individuals experience because of inducing a negative stereotype toward their group and lead to a decrease in performance [2]. The negative impact of ST has been shown to impact cognitive, academic performance as well as motor learning and performance in sports (for a review, see [3, 4, 5, 6, 7]). In sport settings, ST has been shown to have a negative impact on a large variety of tasks such as: soccer dribbling [8, 9, 10, 11], soccer kicking [12, 13, 14], golf putting [15], balance [16, 17, 18], muscular strength [19] and standing long jump [20, 21]. For example, Cardozo et al. [16], demonstrated that women exposed to overweight ST experience a significant decline in motor learning and performance during a balance task.

In female populations the effect of gender ST has been consistently shown to negatively influence motor learning and performance [3, 8, 10]. For example, Cardozo et al. [8] found that when women were exposed to the instruction ‘men are superior to women in soccer skills,’ their motor learning and performance significantly declined. Additionally, Heidrich and Chiviawowsky [10] examined the effect of a gender stereotype on a soccer dribbling task in women and found a reduced motor learning for those who were induced by ST. Chalabaev et al. [22], also showed that when women were induced by gender ST, may experience a decrease in the velocity of force production within the first milliseconds of their contraction during performing a simple strength task. In general, all these studies have emphasized the negative impact of ST on sports performance and motor learning.

Various reasons and mechanisms have been proposed to explain the decrease in motor learning and performance during ST induction [15, 21; for a review see 4,6]. For example, some studies have shown that under conditions of ST induction, increased anxiety can act as a negative factor leading to a decline in individual performance [21, 23], while others attribute this decline to a disruption in attentional processes as well as a reduction in individuals’ working memory capacity [15, 24]. According to the explicit monitoring hypothesis [24, 25], ST induces heightened psychological stress by prompting individuals to focus excessively on error-avoidance strategies in an effort to disprove negative stereotypes. This

impairs automatic motor processes by placing increased demands on working memory, ultimately impairing motor learning and performance [15, 24, 25].

In addition, others studies attribute the reason for the decrease in performance in conditions of ST to a decrease in self-efficacy and perceived competence of learners [8, 10, 17]. For example, Heidrich and Chiviawowsky [10], found that when women were exposed to the ST instruction (e.g., ‘soccer is a sport that relies more on male capacities such as speed/power’), their motor learning as well as their self-efficacy were negatively affected. In addition, Cardozo et al. [17] also found that when men were exposed to the ST instruction (e.g., ‘men normally perform worse than women’), their perceived competence significantly decreased. Moreover, Gray et al., [19] found that the level of self-efficacy in induction of ST can moderate the negative impact of ST on motor performance in people living with HIV during performing of a handgrip task. Indeed, it has been demonstrated that individuals in a social comparison situation experience a decline in motor learning due to a reduction in their perceived competence [26], which is one of the basic psychological needs [27]. Therefore, it appears that inducing ST can negatively affect an individual’s self-efficacy, perceived competence, and ultimately motor learning by creating a social comparison situation [10, 17].

Given the detrimental impacts of ST, research has examined various methods to mitigate its negative effects on learning and performance (e.g., stereotype lift instructions [23]; drawing on individuals’ positive social identities [28]; providing positive social comparative feedback [29]; using challenge-based rather than threat-based strategies [11]; emphasizing that task performance is not influenced by individual differences [16]; developing growth mindsets [30]; highlighting in-group norms while downplaying those of out-groups [31]; questioning the validity of ST [20]; and employing dual-task strategies [15]). For example, Beilock et al. [15] showed that using a secondary cognitive task in conditions of ST activation (by preventing the induction of attention and explicit monitoring of the step-by-step execution of the skill) can improve golf putt performance in skilled male golfers and reduce the negative effects of gender ST. While some approaches to reducing ST have been effective [15, 20, 23, 28], others have not [14]. Furthermore, given that ST is a complex phenomenon and can have different effects depending on the context and nature of the task [7, 14, 32]; and also, that most of these studies have

been conducted on girls [14, 20]; and men [15]; and fewer studies have been conducted on adult women [28]; there is still a need to find other new ways to mitigate the negative effects of ST.

On the other hand, recent research has shown that reducing perceptions of task difficulty, to increase perceptions of success, has been shown to improve motor learning and performance [36, 37, 38]. For example, in a study by Iwatsuki and Regis [36], it was shown that reducing perceptions of difficulty by liberally defining success criteria for success improved overhand throwing accuracy when throwing towards a bullseye target. Specifically, the authors informed participants that scores higher than 6 points were considered good attempts (easy success group) whereas in participants in the difficult success group (i.e., throws those score more than 9 points were considered good attempts). These findings were previously reported by other researchers [37, 38]. Other studies, such as Palmer et al. [37], also investigated the effect of manipulating task criteria for success on motor learning in a golf putting task. They assigned 34 novice participants into two groups (easy and difficult criteria for success). Their findings supported the notion that easy task criteria for success can enhance motor learning.

According to the OPTIMAL theory of motor learning, reducing perceptions of task difficulty as well as simplification of task criteria enhances a learner's expectations for future successful performances thereby readying the motor system through enhanced goal-action coupling [39]. Specifically, enhanced expectancies have been shown to contribute to improved motor learning and performance indirectly through motivational mediators such as perceived competence and self-efficacy [40, 41], and directly by increasing dopaminergic activity in the striatum (a brain region implicated in the reward system) aiding the consolidation of goal-directed movements [42, 43].

However, as enhanced expectancy has been shown to increase motor learning and performance through motivational factors (e.g., perceived competence and self-efficacy; Iwatsuki and Regis [36]), , and that these motivational factors are impacted and involved in performance decrement in ST activation [17], enhanced expectancy may emerge as a new solution to mitigate the negative effects of ST activation. Furthermore, given that the negative effects of ST are moderated by task difficulty, only occurring in more difficult tasks [33, 34, 35]; it seems plausible that reducing the perceived difficulty of a task under ST could help diminish or even mitigate the negative effects of ST. However, despite this theoretical promise, there is limited empirical research to date with no studies assessing the underlying mechanisms of these approaches.

Supporting this notion, a recent study found that the expectancy-based training can neutralize the negative effects of ST [44]. However, this study was conducted with young girls, and the underlying psychological mechanisms were not assessed. Therefore, the purpose of the present study was to explore how enhanced expectancy, achieved through the simplification of task criteria for success, could mitigate the negative impact of gender ST on adult women's motor learning and performance, perceived competence, and self-efficacy. We hypothesized that creating enhanced expectancy in the form of easy success criteria during the induction of gender ST could mitigate the negative impact of ST adult women's motor learning and performance, perceived competence, and self-efficacy.

Method

The participants of the present study included 99 women who were selected by convenience sampling. The sample size was calculated by GPower (v3.1) and reported to be appropriate according to a within-between group design, significance level of 0.05, statistic power of 0.80, effect size of 0.33 [10]. The participants were randomly divided into 3 groups including: 1- Gender ST-REC, 2- Gender ST and 3- nST group. The inclusion criteria for the study included: 1- Being a beginner in the soccer kicking task (self-report) 2- the soccer task should be important to all participants and they should identify with the domain (a mean more than 4 by self-report checklist) 3- Age range of 20 to 30 years 4- Not having any motor or cognitive impairment 5- All being right-footed. The study was conducted in accordance with the ethical principles of the Declaration of Helsinki and was approved by the Institutional Review Board. Written informed consent was obtained from all participants prior to their involvement in the study.

Task

The task used in this study to measure motor learning and performance (similar to previous related studies; Saemi et al., [14]), was a soccer kicking task towards targets designed on the wall. The tools used included a standard leather ball (size: 4, circumference: 66 cm and weight: 370 g) and rectangular targets designed on the wall in front of the participants. The target consisted of three areas; Area 1 included an area measuring 50×150 cm, Area 2 included two areas measuring 50×100 cm and Area 3 included two areas measuring 50×50 cm. The scores for areas 1, 2 and 3 were 1, 2 and 3 points respectively, and if the ball hit the outside of the targets, a score of zero was considered. The ball was placed 8 m away from the targets and the participants had to shoot the ball towards the targets using an inside-foot shot (Fig. 1).

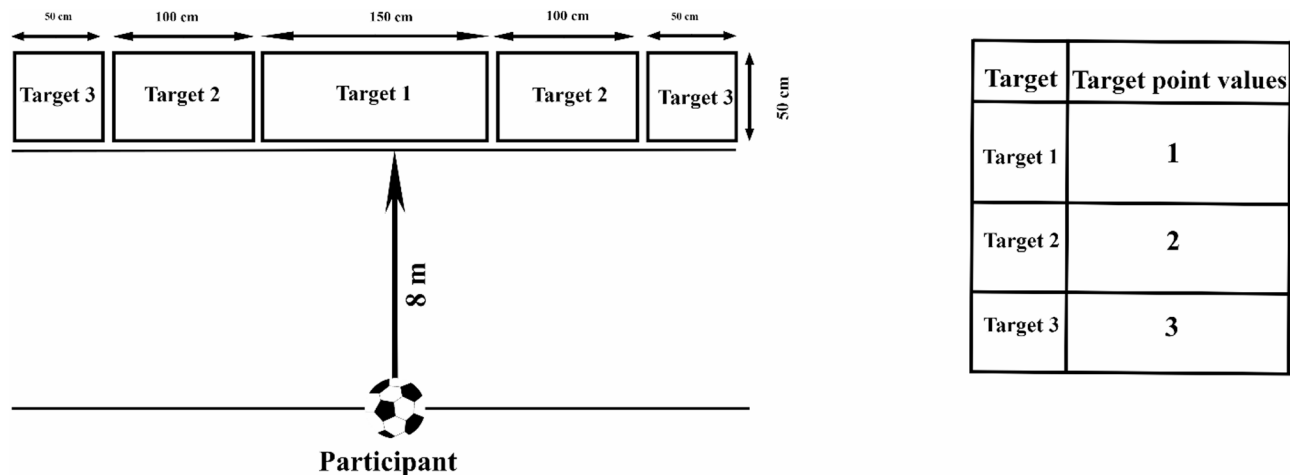


Fig. 1 A schematic illustration of the soccer kicking task

Measures

Self-efficacy scale

The self-efficacy Scale, introduced by Bandura [45], assesses individuals' confidence in performing tasks. Participants rated their confidence from 0 (not confident) to 100 (very confident) for performing each task. They answer questions like: (1) 'How confident are you in scoring at least 1 (zone 1) in the next trail?' (2) 'How confident are you in scoring at least 2 (zone 2) in the next trail?' (3) 'How confident are you in scoring at least 3 (zone 3) in the next trail?' The scores from these questions are added up (minimum score = 0, maximum score = 300) to gauge self-efficacy in the study.

Perceived competence

In this study, we used only the perceived competence as a subscale of Intrinsic Motivation Inventory (e.g., "I think I am pretty good at this activity"; Ryan [46]), which consists of 3 questions and the scoring scale for each question is a 7-point Likert scale from 1 (strongly disagree) to 7 (strongly agree). The final score of each individual is considered as the average of the 3 scores as an indicator of perceived competence and higher scores indicate higher levels of perceived competence in individuals. The internal consistency of this subscale has been reported to be good for all subscales, especially the perceived competence subscale (0.75; McAuley et al. [47]).

Domain identification checklist in soccer

In ST studies, it is common to first examine the level of the participants domain identification [1, 48]. Indeed, for participants to enter ST studies, the relevant task must be important to them and they need to identify with the domain. Therefore, at the beginning of the first day, before the pre-test, all participants were asked to answer the questions related to the domain identification checklist. This checklist includes two questions with

a 7-point scale from 1 (completely disagree) to 7 (completely agree). These questions are: 1- My performance in soccer kicking is very important to me. 2- Soccer is very important to me. Based on previous studies, obtaining an average of 4 or higher was considered as an inclusion criterion [12]. Therefore, in this study, individuals with an average of 4 or higher were selected.

Stereotype threat compliance checklist

At the end of the practice session, all participants were asked to answer the ST compliance checklist using a 7-point Likert scale. This checklist consists of two questions 1- To what extent is there a gender difference in the execution of the soccer kicking task that you performed? (1 (no gender difference) to 7 (different in terms of gender)) 2- Who do you think performs better in this task [14]? , 1 (men perform better) to 7 (women perform better).

Task difficulty perception checklist

To assess perceptions of task difficulty perception at the end of the practice phase, participants were asked to answer a question "How difficult was it for you to perform the soccer kicking task?" on a 7-point scale from 1 (very easy) to 7 (very difficult).

Procedure

This study was conducted as a quasi-experimental study and consisted of three phases: a pre-test (first day), a practice phase (first day) and a 24-hour delayed retention test (second day). On the first day prior to the pre-test, participants provided written informed consent and completed the domain identification checklist in soccer. All participants were then taught how to perform an inside-foot kick at targets on the wall. The participants were instructed to kick at target on the wall and score as many points as possible. In the pre-test phase,

participants were asked to kick a soccer ball (12 trials) and to score the highest possible score according to the scoring method of the task that had been explained to them in advance. There were no other restrictions for them in this phase and the participants were completely free to choose the targets and only had to try to score the highest score (According to the Fig. 1). This approach was designed to assess the participants' initial soccer kicking performance.

After completing the pre-test, participants completed the perceived competence and self-efficacy scales, and then they were randomly divided into three groups; 1- Gender ST + easy criteria for success, 2- Gender ST and 3- Nullified-stereotype group. The gender ST + easy criteria for success group received the two specific instructions before each block; "based on previous studies, women perform poorly compared to men in soccer kicking task" [14] and "receiving a score higher than 2 points was considered a successful trail" [36]. In the gender ST group, individuals received just the ST instruction ("based on previous studies, women perform poorly compared to men in soccer kicking task"; [14]). In the nullified-stereotype group, individuals received the instruction; "based on previous studies, women and men perform similarly in soccer kicking task" [14]. Participants then completed the practice phase consisting of 5 blocks of 12 trials. Before each of the 5 blocks (12 trials), participants were given the instructions. In other words, the instructions were presented 5 times. This was designed to maintain consistency of the instructions and to reinforce focus on the main message.

After completing the practice phase, participants completed the perceived competence subscale, the self-efficacy scale, the ST compliance checklist and task difficulty

Table 1 Mean and standard deviation (mean \pm SD) of the individual variables as well as pre-test motor and psychological outcomes

Individual characteristics	Groups (mean \pm SD)			P-value
	ST-REC	ST	nST	
N	33	33	33	-
Age (year)	21.88 \pm 2.61	20.70 \pm 2.00	22.06 \pm 3.10	0.07
Height (cm)	162.33 \pm 5.10	164.39 \pm 6.29	162.39 \pm 5.00	0.22
Weight (kg)	57.48 \pm 10.19	60.79 \pm 6.29	60.64 \pm 10.19	0.58
Soccer kicking accuracy (pretest)	1.37 \pm 0.32	1.52 \pm 0.20	1.48 \pm 0.29	0.06
Self-efficacy (pretest)	197.58 \pm 41.91	188.48 \pm 54.49	189.39 \pm 56.17	0.91
Perceived competence (pretest)	2.87 \pm 0.85	2.65 \pm 0.77	2.71 \pm 1.22	0.63
Domain identification	5.45 \pm 0.90	5.28 \pm 0.93	5.37 \pm 1.07	0.78

Notes: ST-REC = stereotype threat + relatively easy criteria group, ST = stereotype threat group, nST = nullified-stereotype threat group

perception question. On the second day (e.g., 24 h after practice phase), participants again completed the self-efficacy scale and then similar with the pretest performed a 12-trial for the retention test.

Data analysis

Statistical data analysis was performed using SPSS (V₂₅) at a significance level of 0.05. The Kolmogorov–Smirnov test was used to examine the normal distribution of data. The mixed ANCOVA with repeated measures (to compares the three groups on practice phase and on soccer kicking accuracy), one-way ANCOVA (to compares the three groups on self-efficacy, perceived competence, perceived task difficulty and retention data on soccer kicking accuracy) and one-way ANOVA (to compares the three groups on demographic, ST compliance and pre-test data for all dependent variables) were used to analyze the data. The Bonferroni post hoc test was also used for pairwise comparisons of groups.

Results

Initial analyses indicated that the data were normal (all $p > 0.05$). The results also showed that there were no differences between the three experimental groups in individual variables such as age, height, and weight, as well as pre-test soccer kicking accuracy, self-efficacy, and perceived competence (Table 1). However, as pretest of soccer kicking accuracy is marginal, we decided to use ANCOVA to control for this non-significant but marginal effect.

Soccer kicking accuracy

Practice phase

To compare the ST + relatively easy criteria, ST and nullified-stereotype groups in the practice phase; a 3 (experimental groups) X 5 (practice blocks) mixed ANCOVA with repeated measures on the last factor and controlling for pre-test scores (soccer kicking accuracy) as covariate was used. The results showed that the main effect of block ($F(4, 380) = 0.90, p = 0.46, \text{partial } \eta^2 = 0.009$) and the interaction effect ($F(8, 380) = 1.57, p = 0.13, \text{partial } \eta^2 = 0.03$) were not significant. However, a main effect of group was reported to be significant ($F(2, 95) = 94.97, p = 0.0001, \text{partial } \eta^2 = 0.66$). The results of the Bonferroni follow-up test showed that participants in both the ST-REC ($1.78 \pm 0.27; p = 0.0001$) and the nST groups ($1.71 \pm 0.28; p = 0.0001$) performed better than the ST group (1.23 ± 0.31). However, there was no difference between the ST-REC and nST groups ($P > 0.05$; Fig. 2).

Retention

The results of one-way ANCOVA with controlling for pre-test scores (soccer kicking accuracy) as covariate on the retention test scores, showed that there was a

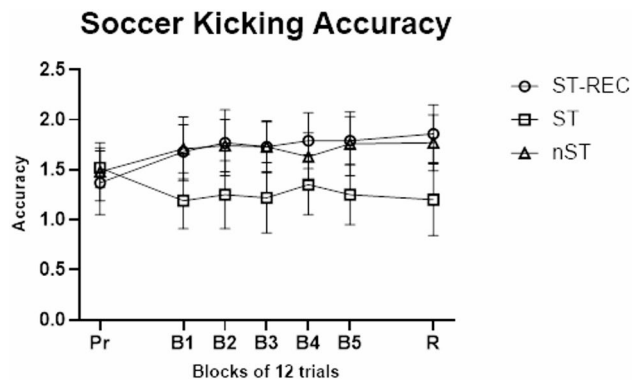


Fig. 2 The soccer kicking accuracy for all experimental groups during pretest, practice and retention test. Error bars represent standard deviation. Notes: ST-REC=Stereotype threat+easy criteria for success; ST=Stereotype threat; nST=Nullified-stereotype threat group

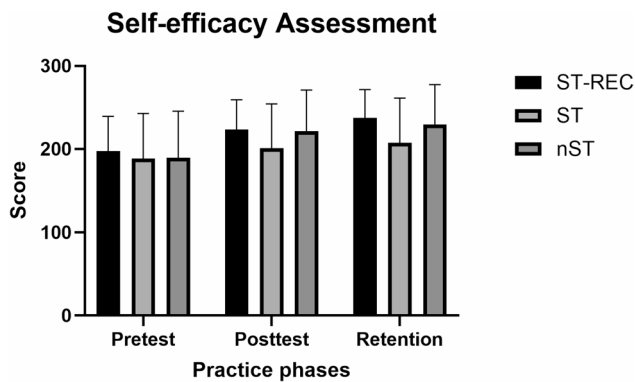


Fig. 3 The Self-efficacy scores for all experimental groups during pretest, posttest and retention test. Error bars represent standard deviation. Notes: ST-REC=Stereotype threat+easy criteria for success; ST=Stereotype threat; nST=Nullified-stereotype threat group

significant difference between the three experimental groups ($F(2, 95) = 51.51, p = 0.0001, \text{partial } \eta^2 = 0.52$). The results of the Bonferroni follow-up test showed that participants in both the ST-REC ($1.89 \pm 0.29; p = 0.0001$) and the nST groups ($1.77 \pm 0.28; p = 0.0001$) performed better than the ST group (1.18 ± 0.36). However, there was no difference between the ST-REC and nST groups ($P > 0.05$; Fig. 2).

Self-efficacy

The results of the one-way ANCOVA with controlling for pre-test scores of self-efficacy as covariate, showed that there was a significant difference between the three experimental groups at posttest ($F(2, 95) = 5.54, p = 0.005, \text{partial } \eta^2 = 0.10$). The results of the Bonferroni follow-up test showed that participants in both the ST-REC ($223.56 \pm 35.79; p = 0.01$) and the nST group ($221.44 \pm 49.77; p = 0.02$) were better than the ST group (201.11 ± 53.31). While there was no difference between the ST-REC and the nST groups ($P > 0.05$). The results of the one-way ANCOVA with controlling for pre-test

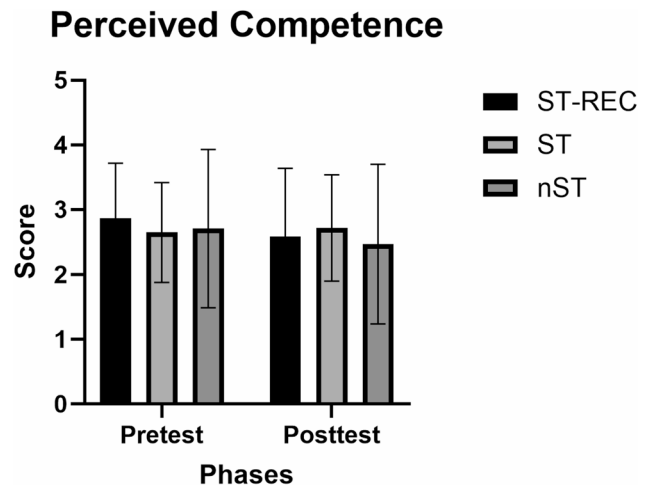


Fig. 4 The perceived competence scores for all experimental groups during pretest and posttest. Error bars represent standard deviation. Notes: ST-REC=Stereotype threat+easy criteria for success; ST=Stereotype threat; nST=Nullified-stereotype threat group

scores of self-efficacy as covariate, showed that there was a significant difference between the three experimental groups at retention ($F(2, 95) = 5.62, p = 0.005, \text{partial } \eta^2 = 0.10$). The results of the Bonferroni follow-up test showed that participants in both the ST-REC ($237.27 \pm 34.30; p = 0.009$) and the nST groups ($229.57 \pm 48.03; p = 0.02$) performed better than the ST group (207.27 ± 53.98). While there was no difference between the ST-REC and nST groups ($P > 0.05$; Fig. 3).

Perceived competence

The results of the one-way ANCOVA test at the end of the training session on the perceived competence scores, along with controlling for the perceived competence pre-test scores as a covariate, showed that there was no significant difference between the three experimental groups ($F(2, 95) = 0.67, p = 0.51, \text{partial } \eta^2 = 0.01$; Fig. 4).

Perceived task difficulty

The results of one-way ANOVA on perceived difficulty scores showed that there was a significant difference between the three experimental groups ($F(2, 96) = 23.69, p < 0.001, \text{partial } \eta^2 = 0.33$). The results of the Bonferroni follow-up test showed that participants in both the ST-REC ($1.52 \pm 0.87; p < 0.001$) and the nST groups (1.70 ± 1.01) perceived the task to have lower difficulty than the ST group ($3.45 \pm 1.73; p < 0.001$) while there was no difference between the ST-REC and nST groups ($P > 0.05$; Fig. 5).

Stereotype threat compliance

The results of the one-way ANOVA on the scores of the first question related to ST compliance (To what extent is there a gender difference in the execution of the soccer

Perceived Task Difficulty

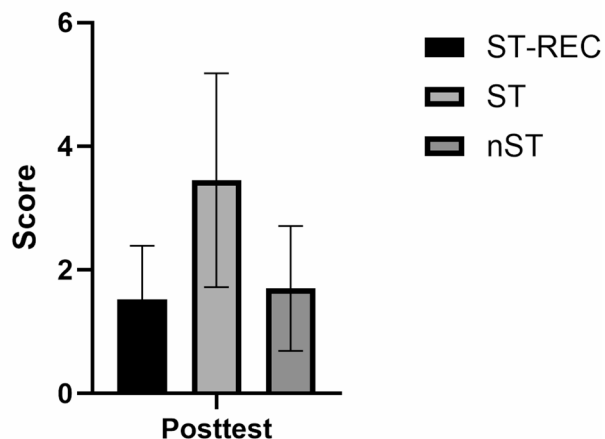


Fig. 5 The perceived task difficulty scores for all experimental groups during pretest and posttest. Error bars represent standard deviation. Notes: ST-REC = Stereotype threat + easy criteria for success; ST = Stereotype threat; nST = Nullified-stereotype threat group

Stereotype Threat Compliance

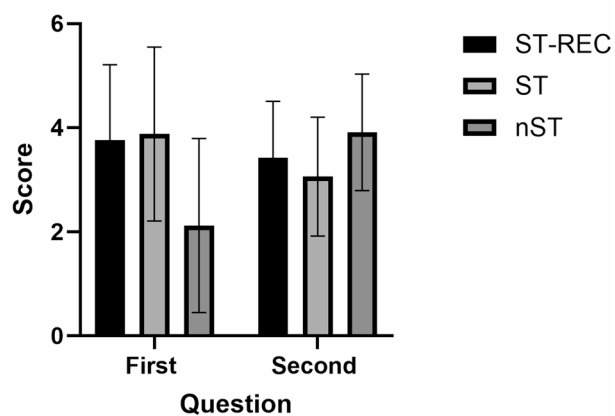


Fig. 6 The stereotype threat compliance scores for all experimental groups for first and second questions. Error bars represent standard deviation. Notes: ST-REC = Stereotype threat + easy criteria for success; ST = Stereotype threat; nST = Nullified-stereotype threat group

kicking task that you performed?) showed that there was a significant difference between the three experimental groups ($F(2, 96) = 11.51, p = 0.0001, \text{partial } \eta^2 = 0.19$). The results of the Bonferroni follow-up test showed that the participants of both the ST-REC ($3.76 \pm 1.45; p = 0.0001$) and the ST group (3.88 ± 1.83) were different from the nST group ($2.12 \pm 1.67; p = 0.0001$) while there was no difference between the ST-REC and ST groups ($P > 0.05$; Fig. 5). The results of the one-way ANOVA on the scores of the second question related to ST compliance (Who do you think performs better in this task?); showed that there was a significant difference between the three experimental groups ($F(2, 96) = 4.75, p = 0.011, \text{partial } \eta^2 = 0.09$). The results of the Bonferroni post hoc test

showed that the nST participants (3.91 ± 1.12) were different from the ST group ($3.06 \pm 1.14; p = 0.008$), but there was no difference between the ST-REC (3.42 ± 1.09) with the nST group as well as the ST group ($P > 0.05$ for both; Fig. 6).

Discussion

The purpose of the study was to explore how enhanced expectancy, achieved through the simplification of task criteria for success, could mitigate the negative impact of gender ST on novice adults' women's motor learning, perceived competence, and self-efficacy. The results showed that gender ST had a negative effect on the motor learning in soccer kicking task compared to the nST group as well as the ST-REC group. Interestingly, and as expected, the results showed that enhanced expectancy mitigated the negative effects of ST on motor learning and performance. Furthermore, although the results of this study did not reveal a significant difference in perceived competence between experimental groups, there were some differences in self-efficacy between groups; and specifically: the nST and the ST-REC groups reported a greater self-efficacy than the ST group.

Consistent with the main purpose of this study, the results showed that creating conditions to enhance expectancies by simplifying the task criterion for success can mitigate the negative effects of gender ST (via self-efficacy pathways) in learning and performance of the soccer kicking task in novice adults' women. This part of the findings is noteworthy in that although many attempts have been made to find different ways to mitigate the negative effects of ST on learning and performance [11, 14, 15, 16, 20, 23, 28, 29, 31], not all of these attempts necessarily reported the positive effects of these approaches [14]. For example, Saemi et al. [14] failed to report the benefits of simultaneously using a dual-task paradigm to neutralize the negative effects of ST in girls while learning a soccer kicking task. Also, few studies have been conducted on neutralizing the negative effects of ST using enhanced expectancy, achieved through the simplification of task criteria for success in adults' women. Additionally, few studies have failed to assess the underlying mechanisms associated with ST (i.e., perceived competence and self-efficacy). Therefore, the present findings highlight that enhancing expectancies by increasing opportunities for task success (i.e., through task simplification) may be a useful method to mitigate the negative effects of gender ST.

According to the OPTIMAL theory of motor learning [39], enhanced expectancy can affect motor learning both directly (increasing dopamine levels) and indirectly (motivational) [41, 49]. Enhanced expectancy creates conditions for the individual in which the individual expectations to achieve success in future attempts [39].

This expectation can ensure improved motor learning in subsequent attempts by increasing the individual's self-efficacy levels, obtaining positive results [50]. Providing an easy criterion for success as one of the ways to creating enhanced expectancy, also increases learning by changing the physical constraints of the task [36, 38, 41]. In addition, given that previous studies have shown the induction of ST on motor learning and performance is accentuated in more difficult tasks [33, 34, 35]; it seems that simplifying the task success criterion by enhancing expectancies can mitigate the stereotype effect. That is even, when the functional task difficulty remained the same, reducing perceptions of difficulty was an effective method to improve motor learning where ST is present via enhanced expectancies pathways (i.e., improved self-efficacy). This interpretation is consistent with some of the perceived difficulty results. Our findings showed that perceived difficulty was significantly higher in the ST group compared to the ST-REC and nST groups. Therefore, we can interpret the enhanced expectancy manipulation was effective at reducing perceived difficulty to mitigate the ST. Indeed, given that ST appears only occur in more (perceived) difficult tasks suggests that approaches to reduce task difficulty may be an effective method to enhance motor learning and performance where there is a risk of ST. Future studies should continue to explore the interactions between enhanced expectancies and ST induction.

The findings of the present study also emphasizing the negative impact of gender ST on women's motor learning, are consistent with the majority of previous research findings in this field [8, 10, 11, 28]; for a review see [4, 7]. For example, Nahidi et al. [11] reported that women can be negatively affected and experience a decrease in motor learning while learning soccer dribbling skills in conditions of gender ST. Cardozo et al. [8] also reported that women experience a decrease in kicking soccer task in conditions of ST. In addition, Hedrich and Chiviakovsky [10] also showed in their study, which focused on soccer dribbling skills, that participants in the ST group showed poorer motor learning and performance than the nST group.

According to research, one of the main factors that can explain the relationship between performance and ST is individuals' perceived competence and self-efficacy [10, 17]. The results of this part of the study, which stated that perceived competence did not change in ST induction conditions, are inconsistent with some studies such as Cardozo et al. [17]. They showed that men in gender ST induction conditions versus the nST group, although they faced a decrease in perceived competence, did not report a decrease in balance performance. In our study, the results were the opposite, that is, although a decrease in perceived competence was not observed due to ST

induction, a decline in motor learning was observed. These findings challenge hypothesis that suggest perceived competence is a mediator of performance and learning under ST.

On the other hand, although no difference in perceived competence was observed between the experimental groups in this study, it was found that the self-efficacy levels of learners in the ST group were significantly lower than the nST and ST-REC groups in performing the soccer kicking task. Given the positive relationship between self-efficacy and motor learning [50, 51], the reduction in motor learning and performance in the soccer kicking skill due to the induction of gender ST in women can be attributed to lower self-efficacy levels compared to the other groups. According to social cognitive theory [52], self-efficacy beliefs help determine an individual's motivations to face challenges that lead to goal achievement [53]. Furthermore, in the present study, it seems that inducing ST reduced expectancies for success as highlighted by lower self-efficacy scores of the ST group rather than two other groups; ultimately leading to the poorer goal action coupling, followed by a reduction in motor learning [39]. These findings are also consistent with the results of some related studies [10]. For example, Heidrich & Chiviakovsky [10] reported that women, while learning the soccer dribbling skill in conditions of ST induction, faced a decrease in motor learning and self-efficacy. Therefore, it seems that the use of interventions to simplifying the task criterion in situations of ST activation can help reduce the negative effects of ST on motor learning and performance.

The results of this study also showed that there were no differences between the two the ST-REC and nST groups in all the dependent variables studied, such as motor learning, perceived competence, and self-efficacy. This suggests that verbal instructions which nullify ST and conditions that enhance expectancies are equally effective beneficial to motor performance and learning where ST may be present. Given the improvement in the self-efficacy level of individuals and subsequent motor learning in these two groups compared to the ST only group; it is suggested that future studies consider a combination of nST group plus simplifying the task criterion together to assess if these conditions have additive effects. The combination of the two approaches would likely enhance expectations beyond each approach in isolation thereby having additional benefits for motor learning.

Despite several strengths (e.g., an appropriate sample size), this study also had some limitations. For example, only the effect of gender ST on women and the mitigating effect of task simplification were examined. It may be better for future studies to examine this issue in men as well, as men can also be negatively affected by gender stereotypes in certain situations [15]. Therefore, it would

be important to examine strategies for mitigating ST in men.

In addition, considering the one-day intervention and its effect on the following day (retention), it is recommended that future research be conducted with a longer intervention duration and longer follow-up tests in order to more accurately examine the long-term effects of simplifying the task success criterion in mitigating ST.

Moreover, although participants were randomly assigned to experimental groups, the level of perceived difficulty was assessed only during the post-test and not at the pre-test stage. Although the protocol of this study was designed in accordance with some previous related studies [36], in order to have a more comprehensive understanding of this variable, it is suggested that future studies, taking this into account, measure perceived difficulty in both pre-test and post-test stages. Another limitation of the present study could be related to the lack of a real control group (a group that does not receive any instructions or interventions), which limits the ability to separate the effects of ST independently of other contextual factors. Albeit, as in many studies, we compared the nullified group to the experimental group, it would have been judicious to include a fourth group in which no instructions were given to participants. Therefore, it is suggested that other related studies also have a group called the real control group, in order to help better understand the subject under study.

Additionally, during the practice phase, the selection of targets by participants in different experimental groups was not systematically recorded. Since individuals with higher self-efficacy may choose more difficult targets than individuals with lower self-efficacy, even if their probability of success is lower. Therefore, examining this issue and recording individuals' individual choices and examining the relationship between individuals' self-efficacy and the type of target selection (difficult or easy), can provide us with a lot of information in this regard. Therefore, it is suggested that future related studies consider this issue.

Furthermore, in this study, the ST compliance checklist was completed immediately in first day and after the practice phase. Although this timing is appropriate for studies that focus just on motor performance, in studies that emphasize motor learning, it is better to participants complete the checklist after the retention test to more accurately assess the experience of ST during the learning process [38]. Another limitation is the lack of a significant effect of the practice blocks of the soccer kicking task in the experimental groups. Although some related studies have interpreted their results based on differences observed in the retention test, despite the absence of significant differences during the practice blocks [14, 54], it

is advisable to interpret the findings in this section with more caution.

Finally, the study did not include an initial assessment of ST before the intervention in the different experimental groups. Given that the induction of ST was endogenous and carried out by the researchers, it is not clear to what extent participants were influenced by such stereotypes before the intervention. Therefore, it is suggested that future studies include a general assessment of the level of initial ST in participants at the pre-test stage.

Conclusion

Although the findings did not examine the real and natural existence of ST in sports environments, it can be concluded that inducing gender ST in laboratory settings—specifically during the learning of a soccer kicking task—can have a negative impact on motor learning and self-efficacy in women compared to other experimental groups (nST and ST-REC groups). One method that may be able to mitigate this negative impact and prevent the reduction of motor learning and self-efficacy in women in situations where gender ST is activated is to add enhanced expectancy (achieved through the simplification of task criteria) to practice sessions. This method can be useful for promoting motor learning in adult women.

Abbreviations

ST	Stereotype threat
ST-REC	Stereotype threat + easy criteria for success
nST	Nullified-stereotype threat

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Author contributions

Conceptualization, E.S.; methodology, M.B, E.S, M.D. software, E.S.; validation, E.S.; formal analysis, E.S.; investigation, M.B.; resources, E.S.; data curation, M.B.; writing—original draft preparation, M.B, E.S, M.D; writing—review and editing, E.S, T.S, M.D. visualization, E.S, M.D; supervision, E.S; project administration. All authors have read and agreed to the published version of the manuscript.

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Data availability

The datasets used and/or analysed during the current study available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

The study was conducted in accordance with the ethical principles of the Declaration of Helsinki and was approved by the Institutional Review Board of Kharazmi University (IR-KHU.KRC.1000.281). Written informed consent was obtained from all participants prior to their involvement in the study. Participants were provided with comprehensive information regarding the study's purpose, procedures, potential risks, and benefits, and were informed of their right to withdraw at any time without penalty. Confidentiality and anonymity of all participants were strictly maintained throughout the research process.

Competing interests

The authors declare no competing interests.

Author details

¹Department of Motor Behavior and Sport Psychology, Faculty of Sport Sciences, Shahid Chamran University of Ahvaz, Ahvaz, Iran

²Department of Sport and Physical Activity, Edge Hill University, Ormskirk, UK

³NIMES UNIV, APSY-V, F-30021, Nimes Cedex 1, France

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