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The amount of practice affects the tennis forehand performance but not the perceived competence

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HIGHLIGHTS

• There is no correlation between motor competence and perceived competence.
• Practice affects motor skill performance but not the perceived competence.
• Becoming competent in performing motor skills does not imply an increase in perceived competence.

ABBREVIATIONS

G180	180 trials
G180H	180 trials into high perceived competence
G180L	180 trials into low perceived competence
G360	360 trials
G360H	360 trials into high perceived competence
G360L	360 trials into low perceived competence
PSPPb	Physical Self Perception Profile questionnaire

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BACKGROUND: If practice makes it possible for individuals to become competent in performing motor skills, it seems logical to expect that they will come to perceive themselves as such. Although this is a widely accepted hypothesis, the limited evidence on this subject has not supported it.
AIM: To investigate whether perceived competence would change due to the amount of practice.
METHODS: Twenty-four individuals between 18 and 35 years of age, right-handed, of both sexes and inexperienced in sport of tennis participated in this study. They were randomly divided into two groups according to the amount of practice: (1) G180 (180 trials) and (2) G360 (360 trials). They were also subdivided into high (G180A and G360A) and low (G180B and G360B) perceived competence. The task was the open stance forehand. Perceived competence was assessed before and after practice using the Physical Self Perception profile questionnaire, a Brazilian version adapted to field tennis. Performance was assessed through scores related to the hitting zones.
RESULTS: Both groups improved their performances over practice and, in the last block, the G360 group performed better than the G180 group. The global perceived competence did not change with practice. Gains in the perceived competence were found only in relation to the physical strength (all groups) and physical fitness (except for the G180B group) subscales.
INTERPRETATION: The greater amount of practice provided greater gains in forehand performance, i.e., motor competence; however, it did not influence the level of perceived competence.

KEYWORDS: Practice | Perceived competence | Motor skill | Field tennis | Forehand stroke

INTRODUCTION

Over the past few decades, researchers have increasingly recognized perceived competence as a key aspect of the engagement of individuals in school, health, and sports programs, as well as of the motivational climate in these contexts. Perceived competence is a multidimensional motivational construct that relates to how competent individuals feel [1-4].

The basic assumption here is that individuals who perceive themselves as competent in relation to something tend to feel pleasure in relation to it, which motivates them to persist in the search for more mastery. This leads to a positive cycle of engagement for improved performance and brings associated benefits, such as strengthening autonomy, self-confidence and self-esteem, in addition to increased intrinsic motivation. Conversely, those with low perceived competence lose interest and give up the practice [5-13].

A considerable body of research has been developed to understand perceived competence regarding several variables, including practice [14-24]. Notwithstanding the advances in the existing knowledge provided by these studies, it can be observed that they are not without their limitations. For instance, some of them did not access the level of perceived competence prior to practice [14,17,20,25]. To the best of our knowledge, only a few studies have addressed this issue [25,26]. For example, considering motor learning as a process of gaining competence in the execution of motor skills, Carvalhais et al. [26] hypothesized that perceived competence would increase as the ability to perform a tennis forehand increased. Participants were divided into three groups according to their initial level of perceived competence (high, moderate, and low). The acquisition was carried out on three consecutive days and the transfer test was applied 10 minutes after its completion. The participants' perceived competence was assessed every day before practice and on the last day before and after practice. The results showed that everyone, regardless of the experimental condition, improved performance with practice, and the group with high perceived competence had the best performance. Therefore, it was inferred that the level of perceived competence influenced the level of motor learning. However, contrary to what was expected, motor learning did not influence the level of perceived competence, that is, the individuals remained at their levels, even with the increase in competence in performing the task.

There is no doubt that the existing findings contribute to understanding the relationship between perceived competence and practice. However, the results of Carvalhais et al. [26] suggest that the perceived competence does not change with practice. We hypothesized that it had occurred because the acquisition phase was short, with a small number of trials. In addition, the fact that participants are beginners performing a sub facet at the hierarchical level of the sport of tennis, that is, for there to be a change in the perceived competence, it may have been necessary for the individuals to reach a higher level of proficiency in the forehand skill. Furthermore, the number of trials may not have been enough for participants to develop the necessary competence to evaluate their performance. Based on the above, we ask: should there be a greater amount of practice for the perceived competence to change with the increase in competence in the execution of the motor skill? Therefore, this study sought to investigate whether the perceived competence would change due to the amount of practice.

METHODS

Participants

Twenty-four right-handed volunteers, aged between 18 and 35, men (n = 11) and women (n = 13), took part in this experiment. The exclusion criteria involved participants having any experience with the practice of field tennis. Participation required the volunteers' written consent, and the experimental protocol was given ethical approval by the local Institutional Review Board.

Task and materials

The task consisted of performing the forehand stroke, open stance, with an eastern grip of field tennis, whose aim was to hit a ball thrown from a machine in a circular target (5.5m in diameter) positioned at the bottom of the opponent's court (Figure 1A).

The following materials were used: (a) Tennis Tutor Plus Player, a tennis ball launcher machine, which allowed the control of the variables direction, frequency, speed, height and spin of the throws; (b) two video cameras (GoPro Hero 3 and GoPro Hero3+), both positioned on the side of the court, next to the apprentice, at a distance of approximately 7 meters away and 1.50 meters high to record the movement during practice (Figure 1A); (c) an iPhone SE mobile phone, used to play the video demonstrating the movement and to film the target (errors and successes); (d) three tripods to support the cameras and the mobile phone; (e) a circular target measuring 5.5 meters in diameter; (f) a Wilson Hyper Hammer 5.3 racket; (g) forty-five (45) Wilson brand tennis balls; (h) a tennis ball collector made from pipes; (i) a chair and a parasol for the apprentice rest during breaks; (j) the Brazilian version of the Physical Self Perception profile questionnaire (PSPPb) [27] , which was adapted to be used in the field tennis context [28].

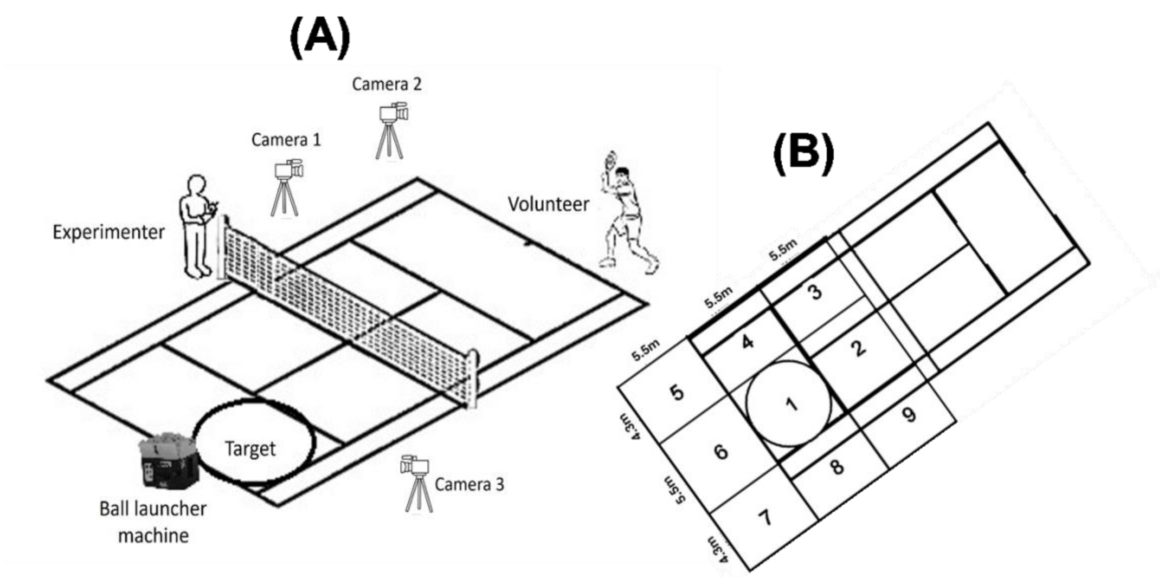

Figure 1. (A) Data collection environment; (B) Scoring zones.

Design and procedures

The experiment was developed on an official tennis court located at the Centro de Práticas Esportivas da Universidade de São Paulo (CEPEUSP). The volunteers were randomly divided into two groups (n = 12), which differed in the amount of practice: G180 (5 men and 7 women) and G360 (6 men and 6 women). The acquisition phase consisted of six blocks of thirty trials (G180), in which the ball was launched at a velocity of 65 km/h. The inter trial and inter blocks intervals were 8 seconds and 3 minutes, respectively. The practice of G360 group occurred in a similar condition, however it involved two sessions. That is, to avoid the influence of fatigue on the results, the G360 practice session was split into two days, with a mandatory one-day break in between.

Before starting the practice, participants filled out the PSPPb questionnaire adapted to the field tennis context. It comprised 26 questions related to the following sub-scales: sport competence (six questions), physical conditioning (six questions), body attraction (three questions), physical strength (five questions) and physical self-worth (six questions). Each question is made up of two statements, one positive and one negative. To fill them in, participants should choose which they most identify with and then tick whether the statement was 'really true' or 'almost true' for them. The score varied according to the answers. For those related to the negative statements, one and two points were awarded for 'really true' and 'almost true', respectively. For answers related to the positive statements, three and four points were awarded for 'almost true' for 'really true'. Thus, the score for each question ranged from 1 to 4 points, totaling a maximum of 104 points. This questionnaire was also filled out after the last practice trial.

After participants filled out the PSPPb questionnaire, they received verbal and visual instructions together, that is, the task was verbally described as it was visualized through the performance of an expert model. This occurred in a standardized way at both normal and slow-motion velocities before starting each block of trials. After receiving the instructions, participants were positioned on the court and informed that they could move freely around the space during the shots. Then, they performed four trials for familiarization.

Measures

Two measures were used as dependent variables:

(1) Performance – scores related to the accuracy of hitting the target by considering different zones around it (Figure 1B): twenty points corresponding to hitting zone 1 (including the circular target); ten points corresponding to the hit in the zones 2, 4, 6 or 8. The hits in the zones 4 and 8 involved direction parameterization error, whereas the hits in the zones 2 and 6 involved force parameterization error; five points for the hits in the zones 3, 5, 7 or 9 (force and direction parameterization error); one point when the ball didn't pass the net; and, zero point when the player didn't hit the ball. Performance was analyzed considering the sum of points in blocks of 10 trials. Thus, the higher the score, the better the performance.

(2) Perceived competence – total PSPPb questionnaire scores obtained pre- and post-practice, which ranged from 26 to 104 points. The partial scores were also utilized for analysis by considering the sports competence (from 6 to 24 points), physical conditioning (from 6 to 24 points), body attractiveness (from 3 to 12 points), physical strength (from 5 to 20 points), and physical self-worth (from 6 to 24 points). The higher the score, the greater the perceived competence.

Data analysis

First statistical analyses considered data from two moments [first and last practice blocks (performance), pre- and post-practice (perceived competence)], and two groups, G180 and G360. For this purpose, a 2 x 2 mixed-model ANOVA (groups x moments) with repeated measures in the second factor was conducted.

Second, based on median values of perceived competence scores in the pre-practice moment, groups were subdivided into low (G180L and G360L) and high (G180H and G360H) level of perceived competence. Therefore, it was also considered as an independent variable. In this case, a 4 x 2 mixed-model ANOVA (groups x moments) with repeated measures in the second factor was run.

Third statistical analysis considered each subscale of perceived competence (sports competence, physical conditioning, body attractiveness, physical strength and physical self-worth). Here, we also conducted a 4 x 2 mixed-model ANOVA (groups x moments) with repeated measures in the second factor.

Fourth, perceived competence was analyzed in relation to the statements connotation, that is, by separating them into questions that suggest social comparisons (n = 10; questions 3, 5, 10, 12, 17, 19, 20, 22, 23 and 25) and the other questions (n = 16; questions 1, 2, 4, 6, 7, 8, 9, 11, 13, 14, 15, 16, 18, 21, 24 and 26). To do this, it was calculated a rate between the obtained scores divided by the total number of questions. For this purpose, a 4 x 2 mixed-model ANOVA (groups x moments) with repeated measures in the second factor was conducted for social and non-social questions.

When necessary, the observed significant effects were followed up using $Tukey_{HSD}$ test. All analyses were preceded by Shapiro-Wilk's W and Bartlett's tests of normality and homogeneity of variance. For all analyses, the level of significance was set at $p < .05$, using Statistica® 13.0 software (StatSoft Inc., Tulsa, OK, USA).

RESULTS

Figure 2 shows the scores of the G180 a G360 groups related to the performance (A) and perceived competence (B). It also shows the performance scores of the G180 a G360 groups by considering the level of perceived competence (C).

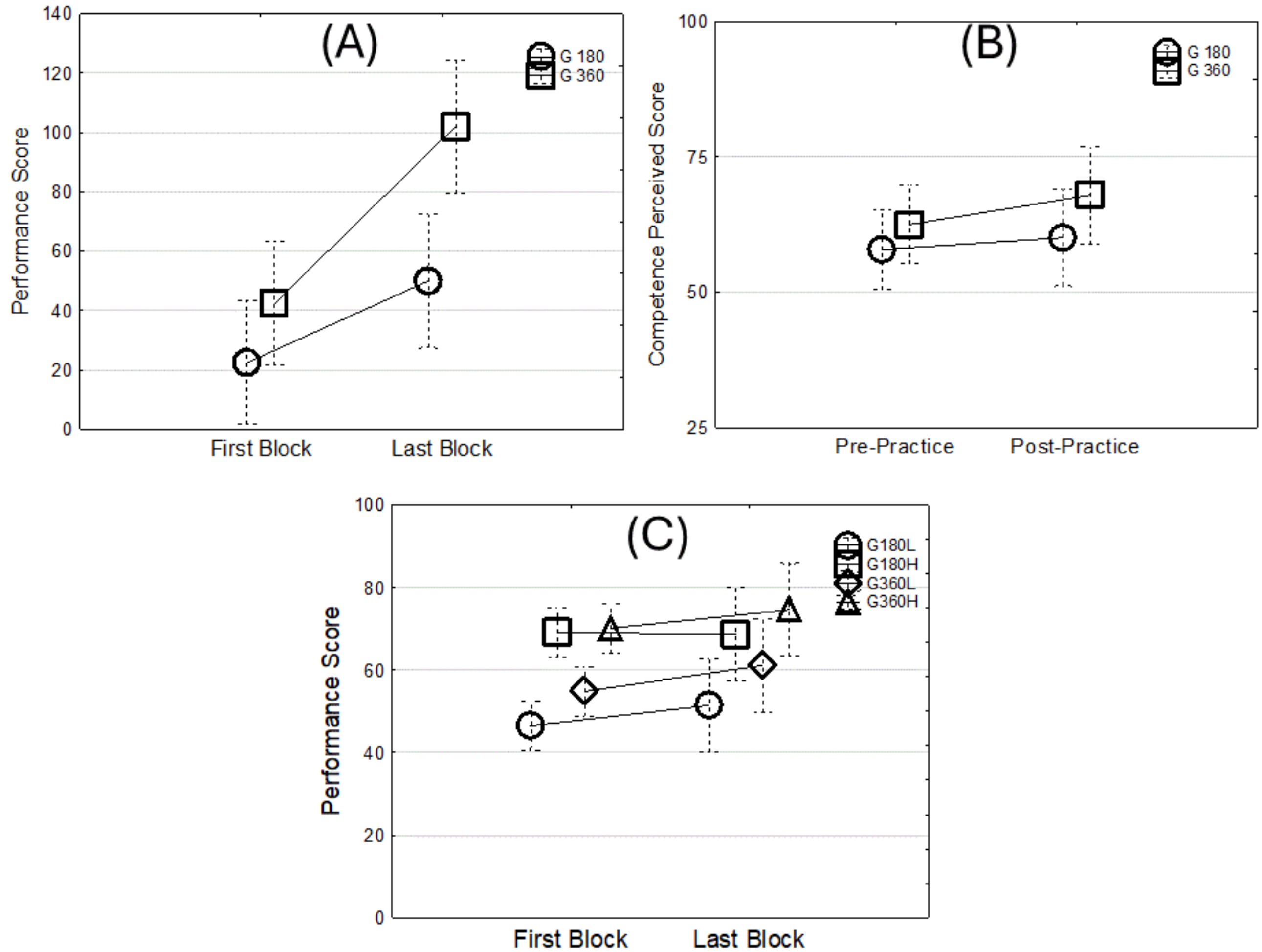

Figure 2. (A) Means of performance scores of the G180 e G360 groups in the first and last practice blocks; (B) means of perceived competence scores of the G180 e G360 groups pre- and post-practice; (C) means of performance scores of the G180 e G360 groups in the first and last practice blocks by considering the level of perceived competence (L = Low; H = High).

Regarding the performance, a 2 x 2 mixed-model ANOVA (groups x moments) revealed main effects for interaction [$F(1, 22) = 5.34$, $p < 0.05$, $\eta p^2 = 0.19$, observed power = 0.59]. The $\text{Tukey}_{\text{HSD}}$ test showed that in the last block the scores of both groups were greater than those of the first block ($p < 0.05$), and the score of G360 was superior to that of the G180 ($p < 0.01$) in the last block. Regarding the perceived competence, no significant differences were revealed by the 2 x 2 mixed-model ANOVA (groups x moments). And, for the performance scores by considering levels of perceived competence, a 4 x 2 mixed-model ANOVA (groups x moments) revealed main effects only for groups [$F(3, 20) = 7.74$, $p < 0.01$, $\eta p^2 = 0.53$, observed power = 0.96]. The $\text{Tukey}_{\text{HSD}}$ test showed that G360H and G180H had greater scores of perceived competence than G360L and G180L ($p < 0.01$).

Concerning the subscales of perceived competence (Figure 3), a 4 x 2 mixed-model ANOVA (groups x moments) did not reveal significant differences for sports competence. For the remaining subscales the following results were revealed:

- Physical conditioning - interaction between moments and groups [$F(3, 20) = 3.66$, $p < 0.05$, $\eta p^2 = 0.35$, observed power = 0.71]. The $\text{Tukey}_{\text{HSD}}$ test showed that G360L has higher scores in post-practice than in pre-practice; G180L was inferior to G180H and G360H in pre-practice moment ($p < 0.01$);
- Body Attractiveness - groups [$F(3, 20) = 5.09$, $p < 0.01$, $\eta p^2 = 0.43$, observed power = 0.85]. The $\text{Tukey}_{\text{HSD}}$ test showed that G180L was inferior to G180H and G360H ($p < 0.01$);
- Physical strength - groups [$F(3, 20) = 14.69$, $p < 0.01$, $\eta p^2 = 0.68$, observed power = 0.99], and moments [$F(1, 20) = 5.75$, $p < 0.05$, $\eta p^2 = 0.22$, observed power = 0.62]. The $\text{Tukey}_{\text{HSD}}$ test showed that all groups improved their perceived competence related to the physical strength from pre- to post-practice ($p < 0.01$). Additionally, G180H and G360H had higher scores than G180L and G360L ($p < 0.01$);

- Physical self-worth - groups [$F(3, 20) = 10.75$, $p < 0.01$, $\eta p^2 = .61$, observed power = .99]. The Tukey$_{HSD}$ test showed that G180H and G360H had higher scores than G180L ($p < 0.01$).

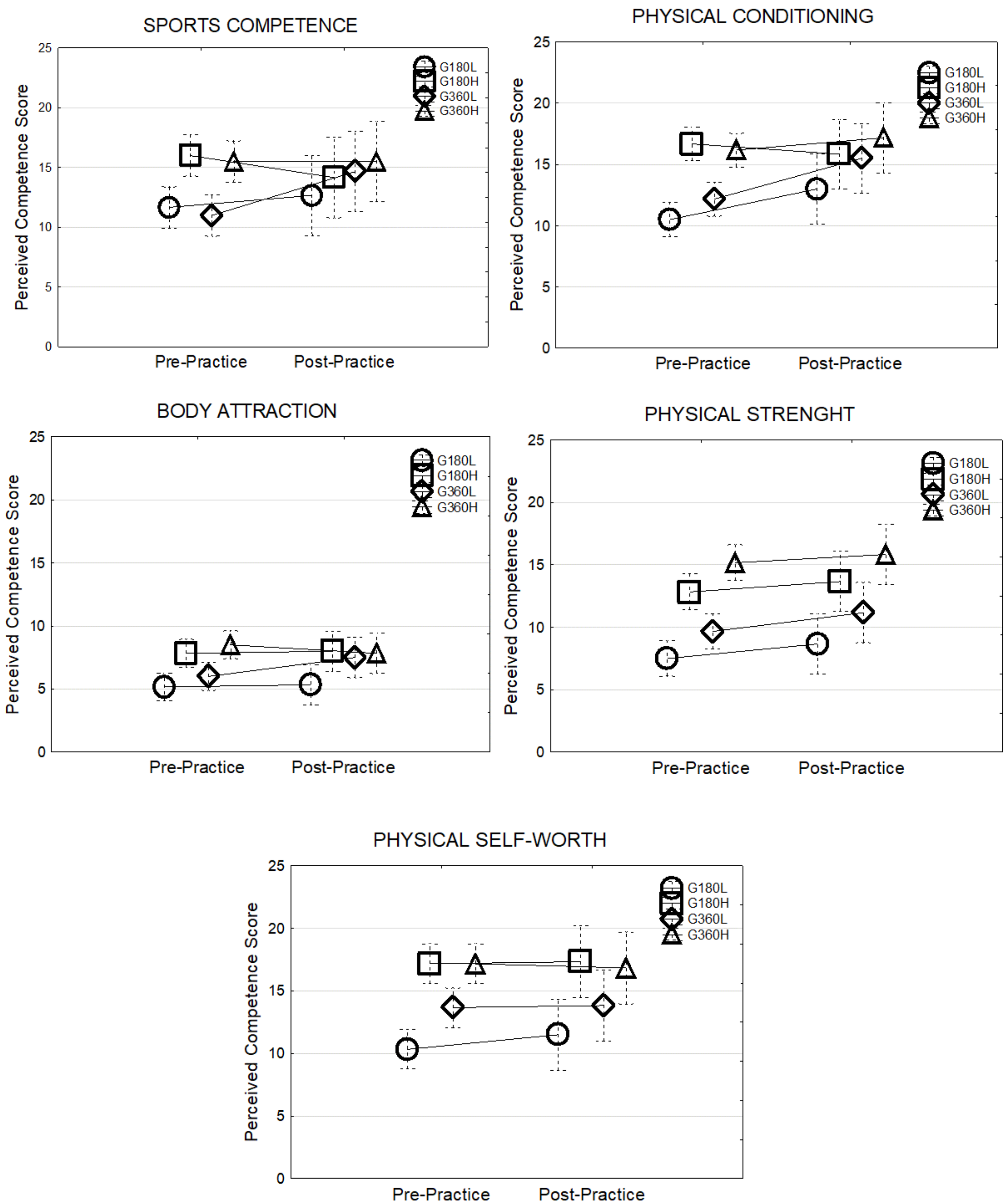

Figure 3. Means of perceived competence values related to subscales of sports competence, physical conditioning, body attraction, physical strength, and physical self-worth, of the G180L, G180H, G360L e G360H groups, in the pre- and post-practice moments.

Finally, regarding the social vs. non-social connotation of perceived competence questions (Figure 4), a 4 x 2 mixed-model ANOVA (groups x moments) did not reveal any significant difference.

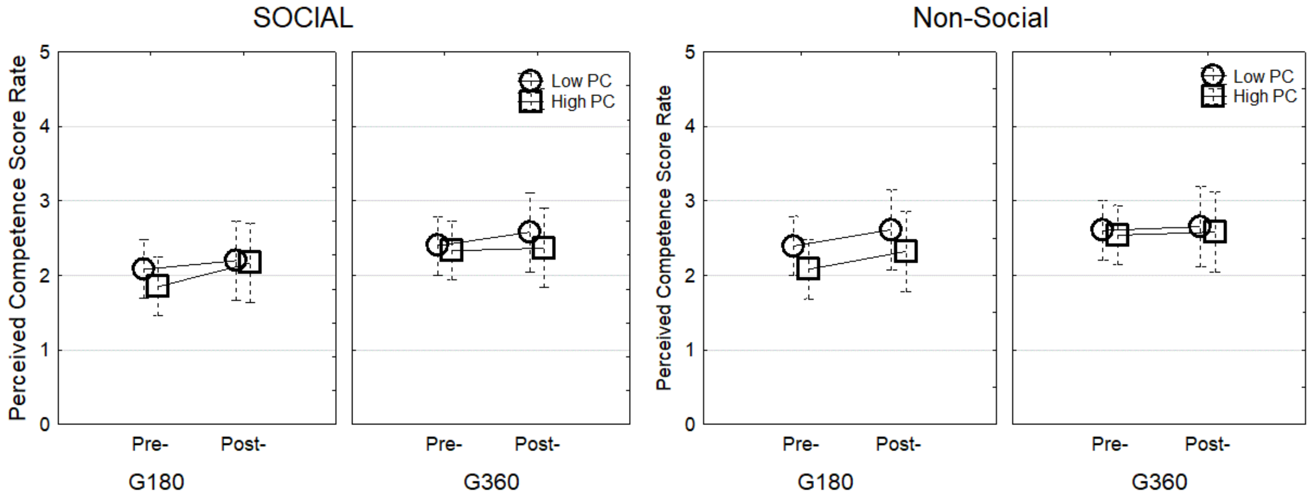

Figure 4. Means of score rate of the G180 and G360 with low and high perceived competence, in the pre- and post-practice moments.

DISCUSSION

The relationship between practice and performance is well established in the literature. The notion that performance changes as practice continues is highly reliable in learning theories [29-31]. Our results corroborated this, as all groups showed better last block performance compared to the first block, with G360 outperforming G180. These results indicate that practice was able to improve the forehand performance, especially for those who practiced more.

However, gains in performance were not accompanied by gains in perceived competence. It was expected that double the amount of practice used by Carvalhais et al. [26] would be enough to alter the perceived competence. Nonetheless, there were no changes in global perceived competence. Therefore, contrary to expectations, our findings corroborate those of Carvalhais et al. [26] and allow us to state that, regardless of the amount, practice is unable to promote changes in perceived competence.

A recent study by Costa et al. [32] pointed out the perceived competence as a possible mediator of goal difficulty effects on the learning of sports motor skills. However, it is important to note that not only global perceived competence but also perceived sports competence have not changed through practice. This supports the Carvalhais et al. [26] hypothesis that perceived competence could function like a trait or a component whose genetic influence is predominant. As posed by them, this may be why studies on perceived competence have addressed more fundamental motor skills rather than sports motor skills. Although the development of both classes of motor skills is influenced by practice, they have been recognized to occur with greater or lesser genetic predominance, respectively, which is why they are also called phylogenetic motor skills and ontogenetic motor skills [33]. Obviously, this explanatory hypothesis needs to be investigated in future studies.

Alternatively, as we wrote previously, the amount of practice may not have affected perceived competence because the forehand represents a sub-facet, or a small part of a domain within the hierarchical model [34]. Thus, gaining competence in this motor skill performance would have little influence on perceived competence. Or, it may be that the level of proficiency reached is not enough to cause change in perceived competence. Maybe it would need a very high level of proficiency, like skillful or expertise behavior. However, it is important to bear in mind that the acquisition of such behavior takes about 10,000 hours of practice [35].

Other results for the sub-scales of perceived competence revealed that more practice led to gains in perceived competence in physical fitness for those who had low perceptions. In addition, it was found that the groups improved their perceived competence in physical strength with practice, regardless of the amount of practice, which could be related to the energetic requirements of the task. It is possible these perceptions have emerged from the physical and cognitive demands of repeatedly performing a gross and ballistic motor skill with high visual attention, anticipation, and accuracy requirements.

Recent studies have suggested that social comparison influences the perceived competence in the context of motor learning [36,37]. This question prompted the analysis of the dimension of perceived competence, separating the questions that suggested social comparisons from the others. According to the results, and contrary to expectations, the groups were similar, i.e., social comparisons do not seem to influence the perceived competence of young adults, regardless of the amount of practice or the initial level of perceived competence.

CONCLUSION

In sum, data from this study indicated that the greater amount of practice provided greater gains in forehand performance, however, this did not influence the level of perceived competence, including in relation to sport (perceived sporting competence). Our findings are closely related to the method we used. Our main limitation is that we did not consider learning tests (retention and transfer), which could contribute to the robustness of our findings by separating the transient effects of practice on performance. This requires future studies. Additional research is also needed to examine whether the nature of motor skill, including in relation to the type of sport, influences learners' perceived competence. Finally, further studies should also investigate whether perceived competence would change if, instead of novices, we consider participants at more advanced stages, for example, with the ability to associate sensory information with that from the action's outcome (e.g., associative stage).

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