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Goal difficulty level and perceived competence on volleyball serve learning

Cicero Luciano Alves-Costa[1*], Leandro Nogueira Dutra[2], Glauber Carvalho Nobre[1] and Herbert Ugrinowitsch[2]

1 Instituto Federal de Educação, Ciência e Tecnologia do Ceará. Brazil.

2 Universidade Federal de Minas Gerais. Brazil.

*Correspondence: (CLAC) cicero.luciano-costa@ifce.edu.br)000-0002-5310-7376

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Abstract: The purpose of this study was to evaluate the effect of the goal difficulty level on the volleyball serve learning and if the perceived sports competence mediates this process. Adolescent volunteers (N = 22, age = 14.0 ± 0.9 years) participated in this study performing the volleyball serve. Two experimental groups were formed: high difficult goal group (HDG; n = 11) and low difficult goal group (LDG; n = 11). Both groups performed 15 trials in the pretest, 160 trials in the acquisition throughout four days, and 15 trials in the retention test after 72 hours. Performance was measured by means of the target bull's-eye accuracy of the volleyball serve. Comparing the two groups' performance accuracy and consistency on pretest and retention tests was run through two-way ANOVA and ANCOVA (2 Groups x 2 Blocks). The results showed high goal led to greater performance accuracy in the retention than the lower goal, with a very large effect size. The HDG had higher accuracy in the retention test than the pretest ($p < .001$), while the LDG had no improvement. ANCOVA detected significant between the covariate perceived sport competence and tests. The effect size magnitude of the high goal difficulty in the serve accuracy was higher when adjusted by perceived sports competence. This finding indicates that perceived sports competence could maximize goal difficulty effectiveness. In conclusion, the goal with high difficulty is more effective for volleyball serve learning than low difficulty, and the perceived sports competence seems to moderate the learning process.

Keywords: Sport motor skills; Goal setting; Motor learning; Motivation.

1. Introduction

In the process of learning sports motor skills, individuals exhibit different behaviors to reach the task goal. The difference in these behaviors is influenced by motivational aspects that energize and regulate how

achieves the goal (Tenembaum & Eklund, 2007). Highly motivated people become more involved in the practice, with greater attention and time devoted for learning (Schmidt & Lee, 2005). In this process, setting specific and challenging goals is an effective strategy to increase performance (Locke & Latham, 1985).

Goal-setting strategies have been investigated in the sports context manipulating different attributes (Boyce et al., 2001; Dutra et al., 2017; Mellalieu et al., 2006; Wack et al., 2014), such as the goal difficulty (Burton, 1994). Difficult goals are associated with greater task commitment, guiding effort, and persistence to achieve them, resulting in better performance (Locke, 1991; Locke & Latham, 2006). This behavior was observed in endurance performance (Bar-Eli, Tenenbaum, Pie, Btesh, & Almog, 1997; Tenenbaum, Pinchas, Elbaz, Bar-eli, & Weinberg, 1991). However, the effects of goal difficulty on learning sports skills are still inconclusive (Lane & Streeter, 2003; Marinho et al., 2009; Mooney & Mutrie, 2000). In a review, Kyllo and Landers (1995) observed a higher effect of the moderate goal difficulty than the easy and difficult goals. The capacity to achieve a difficult goal can be influenced by the performer's confidence (Latham & Locke, 2007), so differences in confidence can explain the different results.

Following this way of thinking, while learning sports motor skills, the performer's commitment to the established goal may be associated with perceived sports competence, which is related to the capacity and confidence to play sports and learn new sports skills (Fox & Corbin, 1989; Wagnsson et al., 2014).

Perceived sports competence means something that leads the individual to the search for competence and the satisfaction gained with the feeling of efficacy when the goal is reached (White, 1959). In addition to this concept, studies on the perception of competence have been the assumption of feelings of competence as an important motivational aspect that affects learning (Carvalhais et al., 2021). In fact, perceived competence can influence more the motivation for learning than actual competence (Barnett et al., 2008). Consequently, studies have investigated the perceived competence related to physical activity and fitness (Kolunsarka et., 2022; Feitoza et al., 2022; Jaakkola et al. 2019). However, motor learning is a phenomenon still little investigated with regard to perceived competence (Carvalhais et al., 2021; Iwatsuki & Regis, 2020).

Recently, researchers have shown interest in investigating the relationship between the level of goal difficulty and perceived competence. For example, Iwatsuki and Regis (2020) investigated the effects of performance criteria difficulty (i.e., level of goal difficulty) on learning and perceived competence. The authors formed two groups, one with relatively easy criteria and the other with difficult criteria adopted during the practice phase, indicating two levels of goal difficulty. The relatively easy criteria yielded better performance than difficult criteria on learning tests, which improved the perceived competence. Although these results show that reaching the relatively easy performance criteria improves the perceived competence, it does not indicate whether the previously perceived competence mediates the

commitment to difficult goals during learning sports motor skills. Higher confidence and skillful performance can result in higher commitment and engagement in highly challenging tasks (i.e., more difficult goals) and improve the learning of sports motor skills.

This study aimed to evaluate the effect of the goal difficulty level on volleyball serve learning and whether perceived sports competence is a covariate in this process. We first hypothesized that higher difficulty goals (HDG) would be more effective for learning a sports motor skill; and secondly, the perceived sports competence acts as a moderator of the learning.

2. Materials and Methods

Participants - Twenty-two right-handed adolescents of both genders (female = 11, 50%), 13 to 15 years old (M = 14.0, SD = 0.9), from a public school in Belo Horizonte, Brazil, were invited to participate in the experiment. They were allocated into two experimental groups: higher difficulty goal (HDG) (n= 11; 6 girls and 5 boys) and lower difficulty goal (LDG) (n= 11; 5 girls and 6 boys), after applying the pretest phase. The pretest was used to rank the performance of the participants and then allocate them to the groups (the participants were counterbalanced into two experimental group). This procedure was conducted to ensure that both groups started the experiment with similar performance. Participants were considered eligible for this study if they: 1) did not show physical and psychological difficulties (e.g., motor and neurological disorders) that would be unviable for participation in the experiment; 2) did not have previous experience with regular training or playing volleyball as a leisure activity. All volunteers expressed interest in participating in the study, and the legal guardians of the adolescents provided written consent. The Institutional Review Board of the University of Minas Gerais approved this study (n. 1.077.888) and followed the ethical standards established in the 1964 Declaration of Helsinki, amended in 1989.

Instruments - To measure the volleyball serve performance, we adapted the protocol of Matos et al. (2021). The experiment was run in a gym with an official volleyball court with a net fixed two meters high. Five official volleyballs were used for data collection. The serve position was marked with adhesive tape on side "A" of the court four meters away from the net, facing the target located on side "B" with its center positioned seven meters away from the net (Figure 1). Two marking lines five centimeters wide were placed on the ground from the serve position, passing on the edge of the target and finishing outside the side "B" of the court, forming a cone to distinguish errors of force from errors of direction. The target was four meters in diameter and was divided into four concentric circles. The most central (i.e., target bull's eye) was one meter in diameter, and the other three were increased by one meter each. Any ball that reached the target bull's-eye received 28 points (maximum score), and the score decreased when the ball hit another location, moving away from the center of the target. The off-target scores were assigned considering the differences in direction and force applied to the serve. For example, balls landing outside the circular target but inside the cone received a higher score than those outside the cone. The balls

that hit any line between the two zones received the highest score.

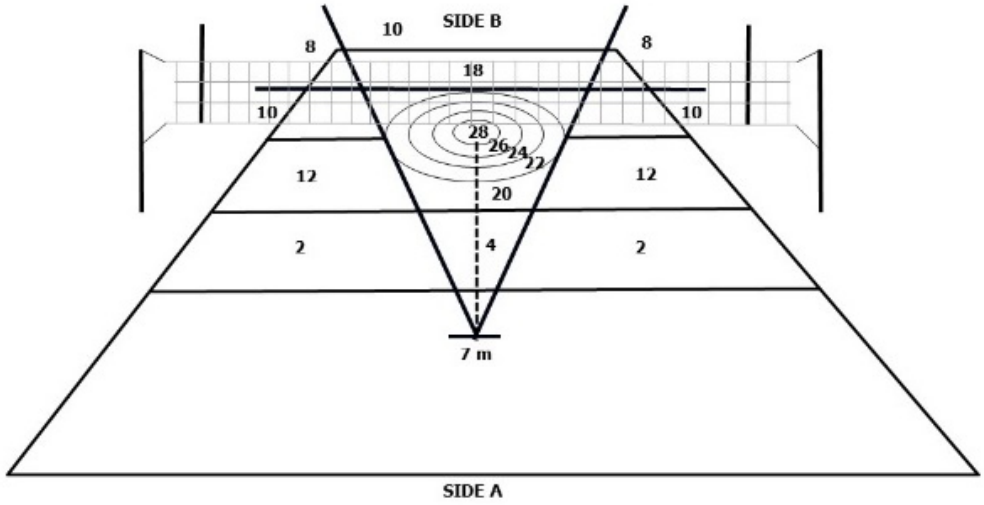

Figure 1. Experimental environment and task.

Perceived sports competence was assessed by the Brazilian version of Harter's Self-Perception Profile for Adolescents (Bandeira et al., 2008). This study used only the sport competence scale, composed of six questions on a Likert scale, ranging from 1 to 4 points. The sport competence subscale showed acceptable reliability and construct validity values in Brazilian adolescents (Bandeira et al., 2008). Cronbach`s Alpha value showed was 0.8.

Procedure and Experimental Design - The participants arrived at the gym, gave their written consent to the experimenters, and filled in the Brazilian version of Self-Perception Profile for Adolescents of Harter (Bandeira et al., 2008). After they completed the profile, the motor task procedures began. The experimental design was organized as showed in Figure 2.

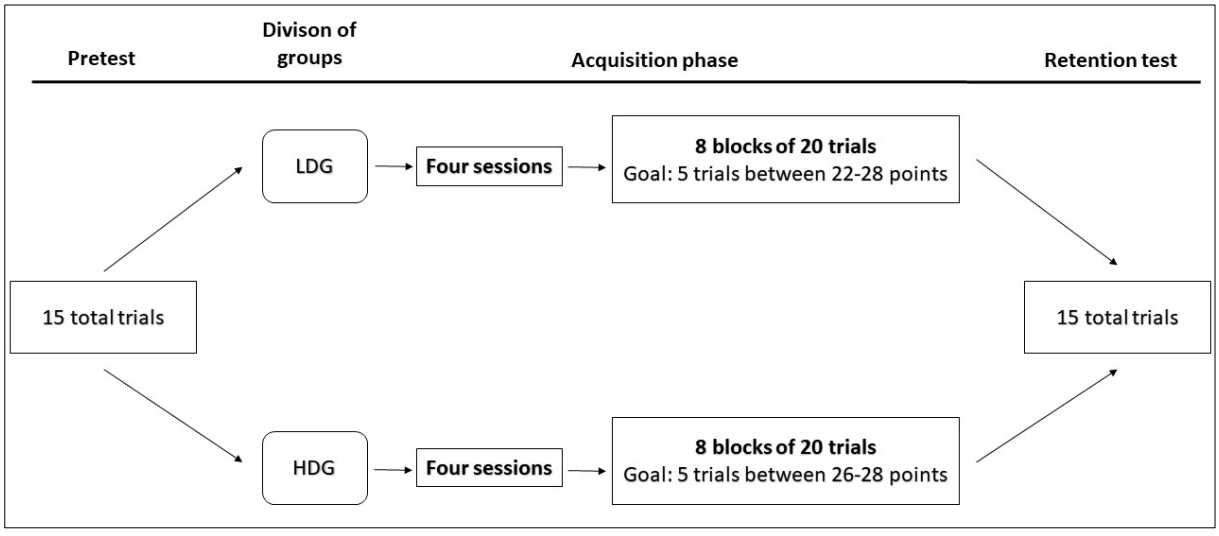

Figure 2. Experimental design.

Pretest - Initially, the participants watched a video two times with a skillful person performing the overhead volleyball serve and were informed about the aim of the task (i.e., execute the demonstrated skill trying to reach the center of the target). The participants watched the model in a laptop Dell® Inspiron 3583. Then, each participant was directed to the serve zone to perform 15 trials (individually). Before each trial, an experimenter positioned on the left side of the participants provided a ball and gave the command "ready" and "go", controlling the inter-trial interval between 5 to 8 sec. The other researcher was positioned on the right side of side B of the court and close to the net and was responsible for data collecting. Finally, the pretest performance score was used to counterbalance the participants into two experimental groups named higher difficulty goal (HDG) and lower difficulty goal (LDG).

Acquisition phase – After 72 hours from the pre-test initiated the Acquisition phase. This phase was used to manipulate the independent variable goal difficulty during the learning process. Participants of both groups practiced (individually) four sessions on four consecutive days, with two blocks of 20 trials each, totaling 160 trials. During this phase, the HDG group had the goal of hitting five trials in a row on the two central areas of the circular target in every block of 20 trials, which means scoring 26-28 points on five serves. The LDG group had the goal of hitting five trials in a row on any area of the circular target, which means scoring 22-28 points in five serves. These goals had been established in a pilot study, in which a smaller group of volunteers (n = 6) were tested with the following goals: 1 - hitting five trials in a row on the two central areas of the circular target; 2 - hitting 3 trials in a row on the two central areas of the circular target; and 3 - hitting five trials in a row on any area of the circular target. The first and third goals showed to be the most difficult and easy, respectively, and were chosen as the high-difficulty and low-difficulty goals.

The experimenter that collected performance data provided feedback informing if the goal was reached or not after every block of trials. Before starting the new block of trials, the researcher also remembered the participant his/her goal.

Retention test - The retention test was conducted 72 hours after the last session of practice to assess the persistent effects of our goal difficulty, as well as perceived competence, on learning. The conditions of the retention phase were identical to the pretest, except for watching the video before the test.

In this study, two performance measures were adopted to evaluate the learning of the volleyball serve: 1) mean score of the performance, which provides information about the performance accuracy; and 2) coefficient of variation of the score, which provides information about the consistency performance.

Statistical analysis - All data were organized in mean and coefficient of variation to describe the result. The Student's t-test was applied to identify differences between groups in the perceived sports competence and serve performance before the acquisition phase. The effects of goal difficulty on the learning of both groups were tested by the Repeated Measures Two-Way

ANOVA (2 Difficulty Goal X 2 Tests) (unadjusted model). Also, to verify this effect adjusted by perceived sport competence, Repeated Measures Two-Way ANCOVA was utilized (adjusted model). Before this procedure, regression parameters of homogeneity were confirmed (p = .936), and the independent variable, goal difficulty level, did not influence the perceived competence covariate (p > .05), supporting the use of ANCOVA in this study (Hair et al., 2010). We loaded the box's M and Levene's tests in all analyses. Post hoc Bonferroni analyses were conducted for pair comparison when necessary. The effect size was assessed by Cohen's d test (Cohen, 1988; Rosenthal, 1996) for paired and independent sample conditions, considering the following cutoff values: below .19 as insignificant, between .20 to .49 as small; between .50 to .79 as medium; between .80 to 1.29 as large and above 1.30 as very large effect size. The significance level was set at 5%.

3. Results

In all analyses, the box's M tests showed equality of covariance matrixes (p values from .809 to .490) and Levene's test results indicated the equality of variance errors between groups (p values from .856 to .155. Student's t-test showed nonsignificant differences in perceived sport competence between groups LDG (M = 14.1+2.9) and HDG (M = 13.3+2,7) in pretest (t20= .604, p = .553). Moreover, no differences were observed in serve accuracy between the LDG (M = 14.8+5.4) and HDG (M = 16.9+4,1) groups (t20= 1.012, p = .324) in the pretest.

Fig. 3 shows the means of serve accuracy between the groups in the acquisition phase. Two-way ANOVA showed main effect in the groups factor (F(1,20) = 7.111, p = .015, η2 = .262, φ = .718) with HDG group achieving better accuracy. There was also a main effect in the blocks factor (F(7,140) = 3.307, p = .003, η2 = .142, φ = .952), and the post hoc test detected higher score accuracy in block 8 than block 1 (p = .006). No significant interaction between groups and blocks was observed (F(7,140) = .566, p = .782, η2 = .028, φ = .238).

Figure 4 shows the comparisons of the means of the accuracy score between LDG and HDG groups in the pretest and retention. The two-way ANOVA showed significant interaction between groups and tests (F(1,20) = 6.546, p = .019, η2 = .247, φ = .682). The post hoc detected that the HDG had higher score accuracy than the LDG in retention (p = .004), with a very large effect size (d = 1.49). In addition, the HDG had higher accuracy in the retention compared to the pretest (p < .001), while the LDG had no improvement (p = .302) (Fig. 4a).

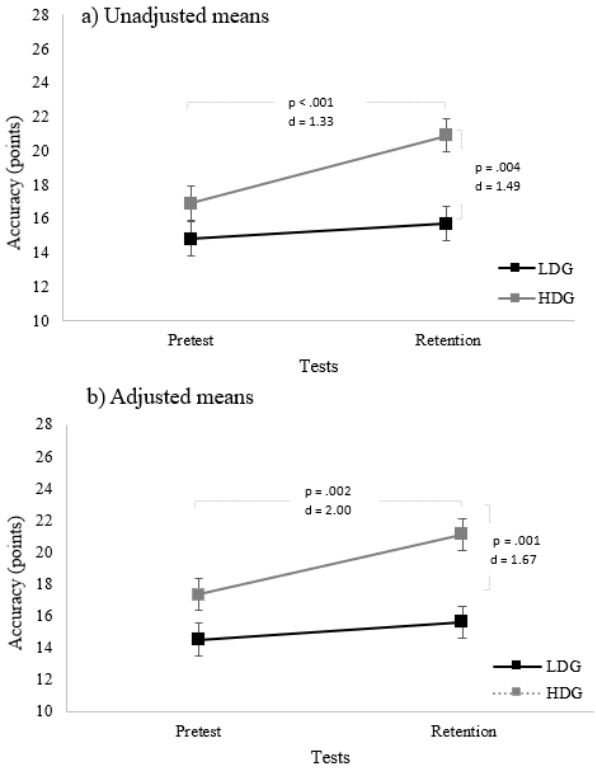

Figure 4. Comparison of unadjusted (a) and adjusted (b) means of accuracy scores between LDG and HDG groups. Error bars indicate standard errors.

The adjusted analyses of the accuracy score (two-way ANCOVA) revealed

significant interaction between the covariate perceived sport competence and tests (pretest and retention) ($F(1,19) = 10.541$, $p = .004$, $\eta 2 = .357$, $\varphi = .868$). There was also significant interaction between groups and tests ($F(1,19) = 7.006$, $p = .016$, $\eta 2 = .269$, $\varphi = .709$). The post hoc detected that the HDG had higher serve accuracy in the retention compared to the pretest ($p < .002$) with a very large effect size ($d = 2.00$). Moreover, the post hoc also detected that the HDG had higher score accuracy than the LDG in the retention test ($p = .001$) with a very large effect size ($d = 1.67$). The unadjusted and adjusted analyses comparison increased the effect size when perceived sports competence was considered covariate (Fig. 4b).

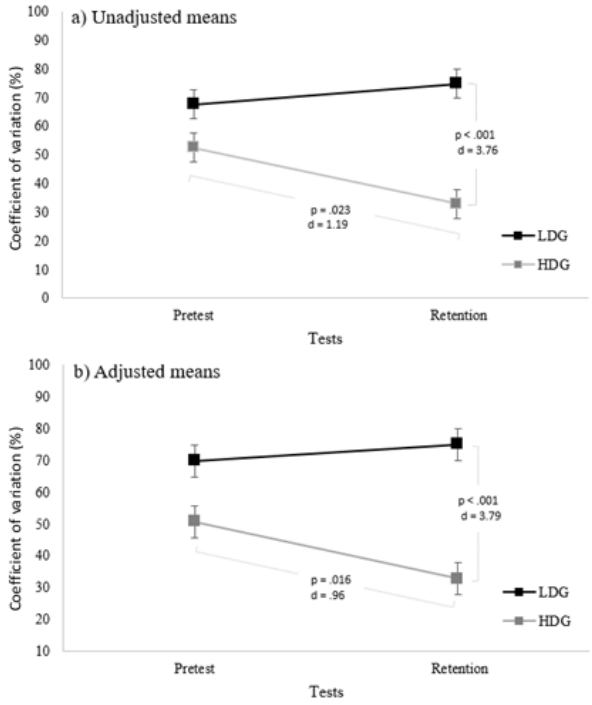

Figure 5. Comparison of unadjusted (a) and adjusted (b**)** means of the coefficients of variation between LDG and HDG groups. Error bars indicate standard errors.

Fig. 5 shows the comparisons of the means of the coefficients of variation (i.e., consistency) between LDG and HDG groups in the pretest and retention. The two-way ANOVA also showed significant interaction between groups and tests ($F(1,20) = 5.640$, $p = .028$, $\eta 2 = .220$, $\varphi = .618$). The post hoc detected that the HDG had higher consistency in the retention test than the LDG ($p < .001$), with a very large effect size ($d = 3.76$). In addition, the HDG had higher consistency in the retention test compared to the pretest ($p = .023$, $d = 1.19$) (Fig. 4a).

The adjusted analyses of the consistency (two-way ANCOVA) revealed significant interaction between the covariate perceived sport competence and tests (pretest and retention) ($F(1,19) = 9.642$, $p = .006$, $\eta 2 = .337$, $\varphi = .838$). There was significant interaction between groups and tests ($F(1,19) = 5.764$, $p = .027$, $\eta 2 = .233$, $\varphi = .625$). Likewise, the post hoc detected that the HDG Group was more consistent in the retention test compared to pretest with large effect size ($p = .016$, $d = .96$). Moreover, the post hoc also detected that the HDG group presented more consistent performance that the LDG group in the retention test ($p < .001$) with very large effect size ($d = 3.79$). Comparing the unadjusted and adjusted analyses, no change in effect sizes is observed when perceived sports competence is considered covariate.

4. Discussion

This study investigated the effects of the goal difficulty level on volleyball serve learning and whether the perceived sports competence acts in this process. Although goal-setting difficulty in sports and exercise has been investigated since the 1990s (Killo & Landers, 1995; Tenenbaum, Bar-Eli & Yaaron, 1999), the results are not consistent among motor skills studies (Corrêa & Souza Jr, 2009; Dutra et al., 2017; Marinho et al., 2009). Moreover, perceived competence and goal-setting difficulty have been investigated in recent years. Studies have suggested that less difficult goals improve success perception but do not differentiate learning (Iwatsuki & Regis, 2020) and that higher perceived competency is better for learning (Carvalhais, Silva, Tani & Corrêa, 2021). In addition, the studies did not investigate whether the perception of competence is a mediator of learning. To fill this gap, the

present study used an instrument to assess perceived sports competence and thus infer whether it acts in any way when interacting with the goal difficulty level. The results demonstrated the positive effect of goal difficulty level and that the perceived sport competence could mediate the effect of the goal difficulty level on learning sports motor skills.

During the acquisition phase, the serve accuracy improved, and the goal of high difficulty influenced this result. The high difficulty goal also influences learning since only the HDG group improved serve accuracy and consistency from pretest to retention. Maybe the practice with higher difficulty goals during the acquisition phase motivated to self-set more difficult goals in the retention test than the practice with lower difficulty goals, resulting in better performance in the retention test. These results differ from some studies that manipulated the goal difficulty in learning complex motor tasks (Corrêa et al., 2006; Corrêa & Souza Jr, 2009; Marinho et al., 2009). One explanation could be the lack of control over the perceived sports competence in these studies. In the present study, the groups showed similar means of self-perception of sports competence.

Our results indicated that, when adjusted by perceived sports competence, the magnitude of the effect related to high goal difficulty showed a slight increase in serve accuracy. The perceived sports competence mediation is a relevant finding since individuals with high perceived competence may have greater acceptance of more difficult goals, which may decrease the risk of self-establishing a new goal with lower difficulty.

Latham and Locke (2007, 2019) pinpoint aspects of personality that can mediate the effects of goal setting, such as the confidence in attaining a specific goal. The authors argue that feeling confident about the task contributes to the commitment to difficult goals and self-set even more difficult goals. Based on these arguments and in the present study's findings, the perceived sports competence or another measure of self-efficacy related to the task should be considered to establish goals in the learning process, principally for novices.

Considering the strong relationship between the perceived competence with goal achievement and autonomy (Harter, 1999, 2012), our results show some indication of the relevance in associating perceived sports competence with the difficulty of the goal imposed on the performer. Individuals with high perceived competence appreciate challenges, persist in facing failure, believe in their capabilities, have higher expectations of success (Harter, 1999, 2012), and tend to adopt an orientation toward goal mastery and work toward the intended outcome (Ames, 1992). Otherwise, individuals with low perceived competence avoid challenges, quickly give up on demanding tasks, prefer easier tasks, and have lower task commitment and engagement in setting goals.

On the other hand, concerning experienced subjects, such as athletes, this variable may be less important to be controlled since they have a greater chance of perceiving themselves as competent to perform sports motor skills. Although the present study does not demonstrate this premise, a recent review (Jeong, Healy & McEwan, 2021) argues that motivation levels differ between athletes the novice individuals. The review that only included studies with athletes does not support substantive differences between goal difficulty levels.

Finally, previous studies showed improved success perception when learning involved lower difficulty goals (Ong, Hawke & Hodges, 2019) and even better learning than difficult goals (Iwatsuki & Regis, 2020). However, Carvalhais et al. (2021) showed that learning is better when perceived competence is high. Our results show that perceived sports competence mediates learning sports motor skills with higher

difficulty goals. Our results also show that high difficult goals lead to improved performance accuracy, whereas most of the previous studies only showed the effect on improving endurance tasks (with physiological feedback) (Bar-Eli, Tenenbaum, Pie, Btesh, & Almog, 1997; Tenenbaum, Pinchas, Elbaz, Bar-eli, & Weinberg, 1991), while the effects of goal difficulty on learning accuracy skills are still inconsistent (Lane & Streeter, 2003; Marinho et al., 2009; Mooney & Mutrie, 2000). It is possible that this is due to a consequence of the mediation of perceived sport competence. These results take one step forward for understanding the goal difficulty and perceived competence in learning. However, it is necessary to carry out studies that more robustly verify the effect of the relationship between these variables. For instance, a research design enrolling high and low perceived sport competence groups could help better understand the influence of perceived competence on goal difficulty level in the volleyball serve learning. We assume the limitations in the present study.

As implications, although our design has not separated the participants by the level of perceived sports competence, the great magnitude of effect size observed in the ANCOVA analyses allows us to infer that facing high goal difficulty, those individuals that self-assess as more competent can persist and commit more to the learning process. Conversely, however, those that self-assess as less competent do not appear to be as motivated by the learning process because they may persist less with goals that seem difficult to them.

5. Practical Applications.

It is important that teachers or coaches seek to know the individual characteristics of their students/athletes to establish learning goals that effectively contribute to improving competence. However, more studies are necessary to investigate how goal difficulty is related to perceived sports competence in learning sports motor skills.

6. Conclusions

The goal difficulty effect on the volleyball serve performance was observed, and it is possible to say that perceived sport competence influences this effect. So, when controlling for perceived sports competence, the effect of high goal difficulty on score accuracy was even larger. These are the first pieces of evidence about the relationship between perceived sports competence and goal difficulty in sports motor skills learning.

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Conflicts of Interest: The authors declare no conflict of interest.

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