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ORIGINAL

EFFECTS OF VARIABLE PRACTICE ON LONG DISTANCE SHOT AT GOAL IN FOOTBALL

EFECTOS DE LA PRÁCTICA VARIABLE SOBRE EL GOLPEO A PORTERÍA EN FÚTBOL

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ABSTRACT

This paper analyzes the effect of the variability of practice on the accuracy and speed of the ball in the shot on goal in football. Twenty seven male players (age of 20,34±1,5 years; training experience in football of 11,67±2,15 years) were distributed into two groups, variable practice (N = 13) and specific practice (N = 14). The results showed that both groups improved the accuracy in the post-test and retention test. The group of specific practice achieve more accuracy than variable practice in the post-test and retention test ($p \leq .05$). Regarding the speed of the shots, the group of variable practice improved ($p \leq .05$) in the post-test and retention test. The group of specific practice showed a lower speed

(p≤.05) in the post-test and retention test than the pre-test. The speed of the shots was higher in the variable practice in the post-test and retention test.

KEY WORDS: variable practice, accuracy, football, shot at goal

RESUMEN

El trabajo analiza el efecto de la variabilidad de la práctica sobre la precisión y la velocidad del balón en el golpeo a portería en fútbol. Veintisiete futbolistas (20,34±1,5 años de edad, 11,67±2,15 años de experiencia) se dividieron en dos grupos. Todos mejoran su precisión en el pos-test y el test de retención. El grupo de práctica específica es más preciso que el de práctica variable en el pos-test y en el test de retención (*p*≤.05). En la variable velocidad de golpeo, el grupo de práctica variable ha mejorado significativamente (*p*≤.05) en el pos-test y en el test de retención. El grupo de práctica específica ha manifestado una velocidad de golpeo significativamente menor (*p*≤.05) en el pos-test y el test de retención que el pre-test. La velocidad de golpeo ha sido superior en el grupo de práctica variable tanto en el pos-test como en test de retención.

PALABRAS CLAVE: práctica variable, precisión, fútbol, golpeo a portería

1 INTRODUCTION

In the field of motor skill learning, variability is studied as a feature present in biological systems enabling the acquisition of motor competence. At first, it was defined as variations that are present in motor performance and are observed across multiple repetitions of a task (Stergiou, Buzzi, Kurz & Heidel 2004). Some are the authors who reflect on the phenomenon of motor variability and refer to the variable characteristics of living beings emphasizing their presence in human behavior (Newell & Corcos, 1993; Newell & Slifkin, 1998). This variability is therefore transferred to the motor behavior field so to explain the differences found in it between individuals, and even in motor actions performed by a same person. From the knowledge of kinetic, kinematic and neurophysiological parameters characterizing human movement is has been possible to demonstrate the inexistence of two identical movements, finding intra- and inter-individual differences of performance in the same motor task (Newell & Slifkin, 1998).

Variability appears in different dimensions and levels of movement organization (Davids, Bennett, & Newell, 2006). This presence is due to the interactions taking place between the multiple systems and conditioners involved in movement production and control, as a direct result of the degrees of freedom associated therewith (Bernstein, 1967). The interpretation of variability as a detrimental feature to performance must be cautiously evaluated. New approaches suggest that the appearance of variability in motor performance may be beneficial for the organization and execution of movement even

representing a resilience index to such implementation-related constrains (Menayo, Moreno, Fuentes, Reina & García, 2010).

Considering variability an inherent characteristic within movement, it would therefore be only logical to argue that variable practice is an appropriate means to facilitate motor learning. This assertion is supported by studies having confirmed the benefits of variable practice in motor learning and to increase sports performance (Schölhorn, Röber, Jaitner, Hellstern, & Käubler, 2001; Rein, & Simon, 2003; Jaitner, & Pfeifer, 2003; Schönherr, & Schölhorn, 2003; Beckman, & Schölhorn, 2003; Wagner, Müller, Kösters, Von Tscharner, & Brunner, 2003; Jaitner, Kretzschmar, & Hellstern, 2003; Shahrzad, Bahram, & Shafizadeh, 2010; Savelsbergh, Canal-Bruland, & van der Kamp, 2012).This practice seems to increase movement execution variability (Miller, 2002; Sabido, Caballero y Moreno, 2009; Menayo, Moreno, Fuentes, Reina, & Damas, 2012), leading to initial losses of performance tending to increase with practice in the long term as a consequence of exploratory processes in search for the best execution (van Emmerik, Van Wegen, 2000; Scholz, & Schöner, 1999;Newell, & Corcos, 1993; Zanone, & Kelso, 1992; Kelso, & Ding, 1993).

Thus, understanding the learner's motor behavior as a dynamic process, variable practice would modulate the interaction between its morphological characteristics, the playing environment and the learning tasks guiding him/her towards unstable behavioral states that are far from optimal performance. If practice can make these situations stable, becoming system attractors, the learner will achieve equilibrium (Wallace, 1997) and therefore get adapted. Variable practice becomes thus fundamental in order to achieve adaptation (Menayo et al., 2010), through which an optimal relationship is sought between the sport system’s parameters - playing environment - related with performance, that is, between the player's behavior when he is not subjected to loads and the task’s dynamics. This should be understood as a task-influenced behavior that leads to the spontaneous generation of new motor patterns that facilitate the learner to overcome constraints and limitations associated with the resolution of the action.

The motor learning process is thus approached applying variability to the sports technique practice as a tool to generate performance imbalances leading the learner to the spontaneous discovery of movement patterns from the exploration of his perceptual-motor landscape (*constraints-led-aproach*; Davids, Button, & Bennett, 2008). This would allow the environment and the football player adapt to the task’s constraints increasing motor efficiency. This motor learning approach is directly related with its interpretation as an adapted-to-variability process of the practice conditions (Davids, Chow, & Shuttleworth, 2005).

Considering the above premises, the aim of the present study was determining the effects of specific and variable practice on long distance shot at goal in football.

2 MATERIALS AND METHODS

2.1 Participants

A total of 27 male players took part in this research. They were all members of the *Unión Deportiva Salamanca Club* and part of the '*Juvenil A*' team, competing in the Spanish *División de Honor*; and the '*Salmantino*' team, included in the Spanish *Grupo VIII* of the 3rd National Division. The age range was 20.34±1.5 years, having them all experience in football training of 11.67±2.15 years. Previous to the start, participants signed an informed consent to participate in this research.

2.2 Research variables

Following Hancock, Butler, & Fishman (1995) the Mean Radial Error –MRE– was employed to measure shot accuracy. The MRE was considered the absolute distance from the target marked in the soccer goal to the site reached by the ball, that is, the vector module comprised by each shot's spatial coordinates 'X -horizontal-' and 'Y -vertical-'. The dependant variables of this study were the radial error expressed in centimeters, and the maximum speed reached by the ball in km/h. The type of intervention was the independent variable that was reflected in both practice conditions: variability or specificity.

Weight, size and laterality of all football players were controlled. Experience and specific positions were also considered.

2.3 Procedure

Before data collection all participants were informed about the task to be performed and the duration of the measuring process. After this, a standardized warm-up was carried out by all players equally and the ball's maximum speed at shot was measured. Each player was instructed to perform five shots at goal not worrying about accuracy with one-minute rest between attempts. The highest speed shot was taken into consideration.

In the experimental situation the player must hit a ball in order to reach a cross formed by two rubber bands placed at 50cm x 50cm of the goal's corners (right-footed players would hit towards the goal's top left corner and left-footed ones to the right) at a distance of 19.5 m from the goal-line surmounting a 5-component fixed wall located at 9.15 m from the kicking point. All shots were performed with the dominant leg's inner instep (Figure 1).

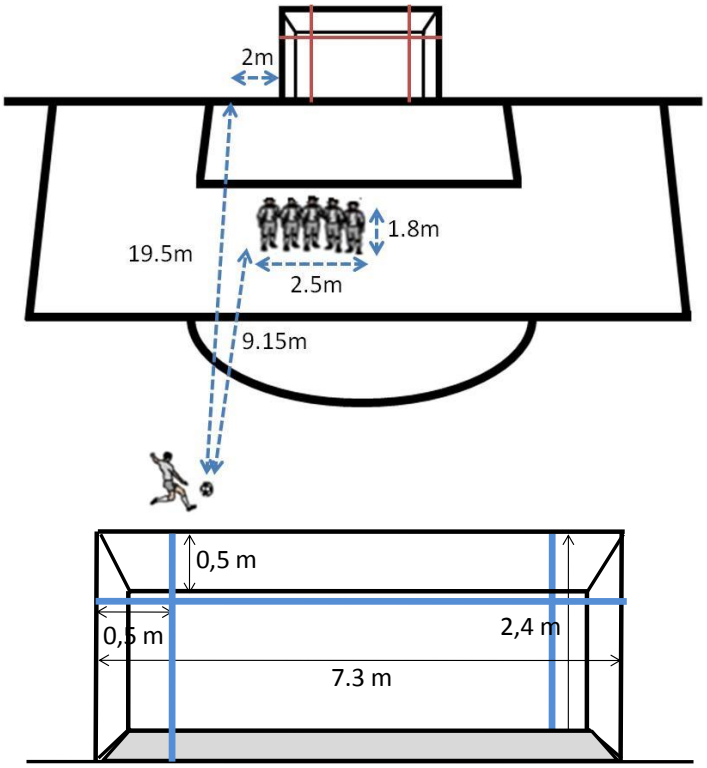

Figure 1. Experimental situation. Ball shot to target placed at soccer goal-11.

Participants were randomly divided into two groups (N=13, in the variable practice group and N=14, in the specific practice one) although a balancing of the sample was carried out in order to equilibrate the players' specific position in the groups (defense, midfielders or forwards) considering an even distribution according to laterality. Each group was assigned a different practice condition: in variability or specificity.

The variable practice group carried out a pre-test consisting of five series of ten variable shots each, a post-test and a re-test taken after 48h. The specific practice group carried performed a pre-test, plus five series of 10 specific practice shots (exactly like the pre-test), a post-test and a re-test after 48h. Considering the work of Van den Tillaar, & Ettema (2003) and García, Sabido, Barbado & Moreno (2011), all the participants of the shot series were given the same instructions: *'Shoot to achieve the highest possible accuracy'*.
All tests and specific practice group's series were performed with a standard soccer ball (Nike, T90 model, Strike LFP 2010-2011) with a 70cm circumference and 440gr weight. The 10 variable practice shots were divided into five types: two standard ball shots, two 7 a-side-football ball shots, two standard ball shots but positioned for the run in front of the goal and two shots with a standard ball in-motion. There a random order of the shots during the series.

The data collection was distributed along 14 days, performing 4 shooting sessions per week. The time elapsed between post- and re-test was 48h.

2.4 Instruments

A Panasonic digital camera (model SDR-H80, 30 hz) was used to record the shots. It was located in front of the goal, two meters behind the line where the shots had to be performed (9m from the goal line and at 2.5 m height). All shots were digitized with a software application implemented in Visual Basic 5.0 © for this research, from the one developed by Moreno, Reina, Damas & Sabido (2003), already employed in other studies (i.e Menayo, 2010) which allowed to detect deviations from the target. We calculated the coordinates' actual position by the digitization of the points were the ball entered the goal and taking as a reference its dimensions (for both deviations, the X axis –horizontal- and the Y-vertical-).

A Sports Radar Ltd. (model SR 3600) was employed to measure the speed of the ball. This tool registers moving objects' speed with a +/- 1 km/h accuracy. This radar was located on a tripod at the back of the player and lining up with him, directed towards the ball and the goal's target (cross) in order to avoid cosine effect errors.

2.5 Data analysis

The software package SPSS v.19.0 for Windows (SPSS, Chicago, IL, EEUU) was used for the data statistical analysis. A significance level of $p \leq .05$ was established.

The Saphiro-Wilk test detected a lack of normality in the data distribution of the study variables. Attending to the results obtained, it was decided to perform a non-parametric Mann-Whitney U test to confirm the effects of training between the variable and specific group. The Friedman's ANOVA test was likewise applied to find the effects of the training method on each group.

3 Results

Results are presented according to the dependent variables established:

- Accuracy:

The inferential analysis determines the existence of significant differences in accuracy between the specificity and variability practice groups in the final and retention tests in favour of the specific practice one. A significant increase of accuracy was likewise observed between the initial and the pos-test and the retention test in the group of variability practice. The said increase also appears between the initial and retention tests in the specificity practice group (Figures 2).

On the other hand, accuracy is not affected by the players' specific position since no significant differences have been found derived from it.

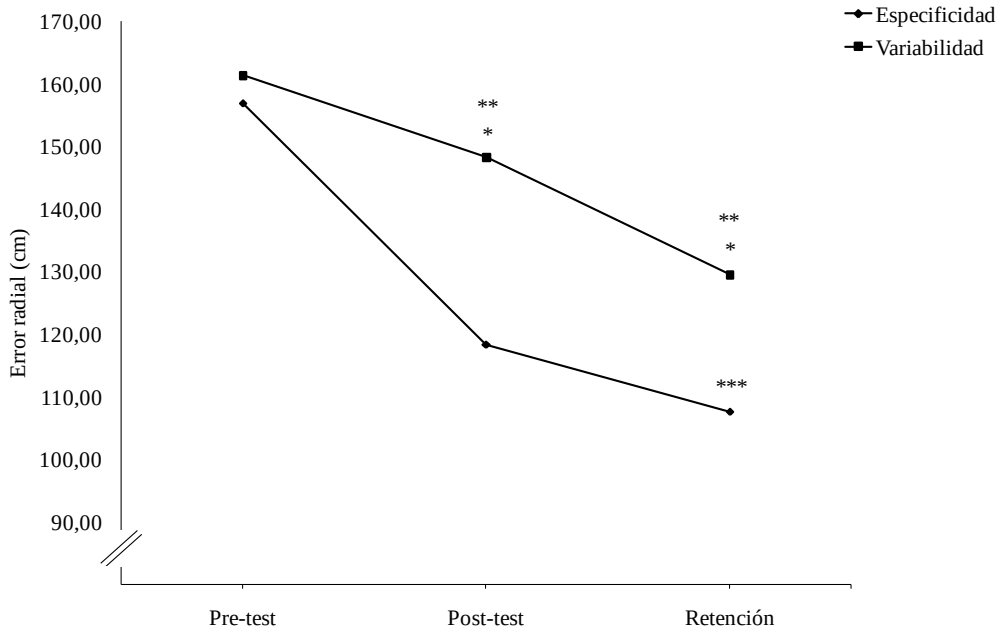

Figure 2. Accuracy (radial error) reached by each group of practice – specificity and variability– when each measurement was taken.
* Significant differences between tests and groups of practice ($p \leq .05$).
** Significant differences between the initial and post tests and between the post test and retention test in the variability practice group ($p \leq .05$).
*** Significant differences between initial and retention tests in the specificity practice group ($p \leq .05$).

- Speed:

The same statistical tests determine significantly higher shooting ball speeds of the specific practice group in the initial test, while the variable practice one showed these same results in the retention test. Also, there is a significant decrease of the ball's speed between the pre and post-tests and between the post-test and retention-test in the specific practice group. The variable practice group however, showed a significant increase of the ball's speed at shooting between the initial and post-tests and a significant decrease of speed between the post and retention tests (Figure 3).

It can be concluded that the specific position of each player doesn't affect the ball's exit speed. No significant differences were found derived from this.

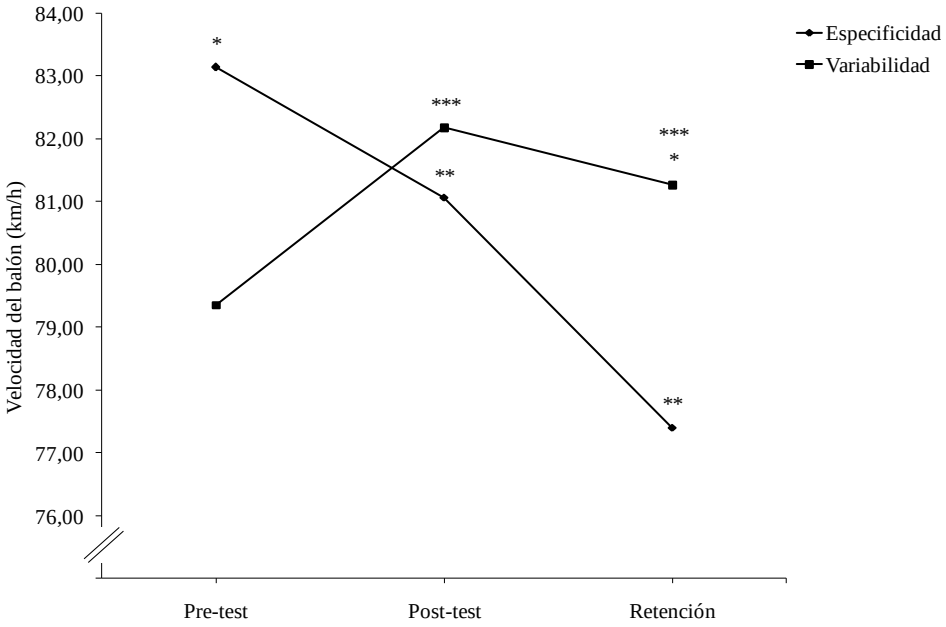

Figure 3. Speed reached by the ball in each group of practice –specificity and variability– at the three moments of measure.
* Significant differences between tests and groups of practice ($p \leq .05$).
**Significant differences between the initial and post tests and between the post and retention tests in the specificity practice group ($p \leq .05$).
*** Significant differences between the initial and post tests and the post and retention tests in the variability practice group ($p \leq .05$).

4 DISCUSSION

The objective of this research was determining what type of practice, specific or variable, was most suitable to improve performance in long distance shot on goal with wall in football. As opposed to other motor skills and sports, studies regarding variable load application on football shooting skills are scarce.

It is important to point out that both groups improved accuracy after the training period. This improvement was significant for the variable practice group in the final and retention tests and only in the retention test for the specific practice group. This confirmed that both groups of practice improved this skill's performance in the search for accuracy, being also true that this improvement is earlier appreciated in variable practice. This last result is far from the general conclusions regarding variable practice effects reflecting long term improvements when compared to specific practice, more appropriate to obtain performance increases at the beginning of the learning process.

The analysis of the accuracy reached by the specific practice group in the shots also reflects improvements in this parameter after the training period against the variable practice one. This group also keeps accuracy improvement levels higher than the variable practice group in the retention test performed. This result is in contrast with some other works that applied mixed or variables conditions to the shot on goal training through differential training (Trockel, &

Schölhorn; 2003), to increase performance of the run technique in athletism (Rein ,& Simon, 2003), drop jump and ball throw simultaneously (Jaitner, & Pfeiffer, 2003), in female hurdles (Jaitneret al., 2003), or skills like throwing in handball (Wagner et al., 2003; Beckmann, & Schöllhorn, 2003; Wagner, & Müler, 2008; García, Moreno and Cabero, 2011; Caballero, Luís and Sabido, 2012). Those studies show accuracy increases of the sportsmen who practiced under this condition against the lower one reached by the specific practice players. This lack of concordance with previous studies regarding the decreased accuracy of the variable practice group compared to the specific one could be understood considering the ideas proposed by Davids et al., (2003) and Schöllhorn et al., (2009) regarding the application of variability loads during the practice. According to these authors, the application of important variability levels –referred to as noise- can jeopardise movement performance, so they recommend adjusted or medium noise levels so the perturbation generated by the task variation doesn't prevent the sportsman from achieving the most efficient performance in order to get the desired results. This might be the explanation to the results obtained in this study. In the discussion about this outcome, the option that the differences found in favor of specific practice are due to the fact that players are experienced and task-adapted can also be envisaged, it is also possible that reduced essays loads and the proposal during the training period wasn't enough stimulating to generate the unbalance needed for their later adaptation to the task demands.

Regarding speed, it was observed in the pre-test taken before intervention, that the specific practice group obtained better results than the variable practice one. However, speed lowers significantly in the variable group of practice at the end of the learning process (pos-test) and in the long term (retention). On the contrary, the specific practice group improves its speed scores at the end of the learning period and keeps them, although a bit lower; over the ones obtained by the variable practice group in the re-test. In this case, variable practice helps footballers gain shot speed and even keep it at a good level after non-practice periods. The results obtained in the variable Speed coincide with the ones showed by other authors who studied the said practice conditions in other sports. Schölhorn et al., (2001), applied variability through differential training to optimize the skills corresponding to several sports modalities. After six months of training, the second group reached greater results in speed than the traditionally trained one. Concerning Schönherr, & Schölhorn (2003), a similar design with basketball players was employed by them. Significant differences were observed in the test performed after four training sessions that was favorable to variable training.

Another study carried out by Beckman, & Schölhorn (2003), also employed this training method in shot put with non-experienced individuals. The study concluded that variable conditions provided significantly beneficial effects reflected in the retention test that was performed after the acquisition period. In this case, variable practice would be appropriate to keep the ball shot speed levels demonstrated by the players at the beginning of the learning period.

In view of the results obtained, the importance of carrying out further investigation to join conclusions regarding the effects of practice in variability conditions should be highlighted. Determining how acquisition and retention by sets of motor skills (jumps, spins, throws, receptions or shots with or without implement) would be essential. Similarly, it is necessary to determine whether the effects of variable practice are common when performance is measured in terms of speed, accuracy, jump height, scores or technical efficiency, among other outcome measures.

5 CONCLUSIONS

According to this study's objectives established to determine the effects of variable and specific practice on long distance shot at goal in football, it can be concluded that both training practices increase shot accuracy, with the specific practice group obtaining better results after non-practicing periods.
Furthermore, regarding shot speed results have shown that the variable practice group achieves a higher shooting speed against the specific practice one, in both the post-test and the retention test.

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