ORIGINAL

PERCEPTIVE TRAINING OF FEMALE YOUTH VOLLEYBALL BLOCKERS

EL ENTRENAMIENTO PERCEPTIVO DE BLOQUEADORAS JUVENILES DE VOLEIBOL

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ABSTRACT

This study examines the effectiveness of a training program based on perceptual orientation of attention for improving decision-making and performance in the blocking action of volleyball. 16 youth players were divided into three groups: video (n=6), which received eight perceptual training sessions by video; mixed (n=5), which received only half of the sessions by video,

combined with practical training on the field; and control (n=5), which just completed pretest and posttest tests. Results show how orientation of attention to relevant areas of information improved decision-making of the youth volleyball players because they reduced their reaction time ($F(1,13)=9,237$, $p=0,009$, ηp2=0,415) maintaining the same percentage of success. However, the practice on the field is necessary to achieve transfer those learning to the real game, because only mixed group improves the percentage of success in the field performance test ($F(2,13)=8,608$, $p=0,004$, $\eta_p^2=0,570$; $t(4)=-6,216$, $p=0,003$).

KEY WORDS: Effective visual pattern, cognitive training, video.

RESUMEN

Este estudio analiza la eficacia de un programa de entrenamiento perceptivo basado en la orientación de la atención para la mejora de la toma de decisiones y el rendimiento en la acción de bloqueo de voleibol. 16 jugadoras juveniles fueron distribuidas en tres grupos: vídeo (n=6), que recibió ocho sesiones de entrenamiento en vídeo; mixto (n=5), que recibió 4 sesiones en vídeo y 4 sesiones de práctica en campo; y control (n=5), que completó las pruebas de evaluación. Los resultados muestran cómo el programa de entrenamiento mejoró la toma de decisiones de las jugadoras, ya que redujeron su tiempo de reacción ($F(1,13)=9,237$, $p=0,009$, $\eta_p^2=0,415$) manteniendo el mismo porcentaje de aciertos. Sin embargo, es necesaria la práctica en campo para lograr transferir dichos aprendizajes al juego real, ya que sólo el grupo mixto mejora el porcentaje de aciertos en el test de rendimiento en campo ($F(2,13)=8,608$, $p=0,004$, $\eta_p^2=0,570$; $t(4)=-6,216$, $p=0,003$).

PALABRAS CLAVE: Patrón visual efectivo, Entrenamiento cognitivo, Vídeo.

INTRODUCTION

The visual system is of paramount importance to achieve successful performance in sport, providing information about when, where and what to do. In order to conduct an effective information collection, attention must be oriented at the correct moment to those sources where the most important information is available (Savelsbergh, Van der Kamp, Oudejans & Scott, 2004). Visual anticipation becomes an essential aspect of fast ball sports, such as volleyball, and it means to detect and collect the relevant information which determines the upcoming event or which guides the action (Van der Kamp, Rivas, Van Doorn & Saverlsbergh, 2008).

In order to improve the capacity of detecting and using the specific situation information, indirect processes have been usually used, such as the viewing of playing sequences or their simulation to substitute the critical information sources (Ward & Williams, 2003). From a cognitive perspective, these training programmes have been implemented to increase the knowledge about the

situation, to improve the understanding of the information and to orient the attention towards effective visual search strategies. All this with the aim to allow for the development of cognitive skills to remember and recognize playing patterns, for the differentiation of situation possibilities and for the utilization of advanced visual cues to improve the prediction of the action outcome and, therefore, decision-making and anticipation.

In regard to the simulation of the execution environment, the videos shown have been edited in different ways. Some researchers have applied the temporal and/or spatial occlusion technique to hide certain information to the participants, so that they could adapt to the information shown or realise the difficulty of predicting the action outcome without the hidden information (Farrow & Abernethy, 2002; Smeeton, Williams, Hodges & Ward, 2005). Other authors preferred to occlude the action sequence at the key moment to make a decision and provide feedback about the accuracy (Gorman & Farrow, 2009) or to manipulate the attention orientation by means of visual cues in the videos (Hagemann, Strauss & Cañal-Bruland, 2006).

There is empirical evidence that the interventions focused on the improvement of the perceptive-visual capacities have a positive effect on the different tests applied to the participants, such as an increase in the response accuracy and/or a shorter response time. Nevertheless, there is little evidence that an improvement in performance occurred, since either no transference tests were conducted to assess whether the improvement obtained in the laboratory could be extrapolated to performance (e.g. Singer et al., 1994; Starkes & Lindley, 1994), or the improvements found in the laboratory were not found in these transference tests.

According to Chamberlain and Coelho (1993), transferring the improvements obtained with perceptive training to the real game must be the main aim. Therefore, perceptive training programmes should have the same cognitive processing scheme as the real game. For this reason, many programmes include field training as well as video instructions in order to achieve the skill transference (e.g. Farrow & Abernethy, 2002; Williams, Ward, Knowles & Smeeton, 2002) since, without this transference, the activities performed in the laboratory would not lead to a performance improvement (Ford, Ward, Hodges & Williams, 2009).

The main aim of this study was to improve decision making and, consequently, performance in the volleyball blocking action through the design and implementation of a perceptive training programme. More specifically, the intervention focused on orienting the participants' attention towards effective visual search strategies by means of a video training programme, trying to adjust their ocular motility to the action requirements. With the purpose to check that the improvements were not restricted to the laboratory test, the participants' motor behaviour was analysed by means of a field performance test.

MATERIAL AND METHODS

PARTICIPANTS

Sixteen female youth volleyball players playing in six different teams participated in the study (17.13 ± 0.89 years of age; 5.88 ± 2.19 years of experience). They were all involved in official competition and were used to performing the blocking action during the game.

Additionally, four teams have performed the attacking sequences that were used for the perceptive training and the laboratory anticipation test. One of them was playing in the senior First Division and the rest had the same playing level as the study participants. One setter, two middle hitters, two receivers and the libero or player specialised in reception of each team collaborated with the study.

All players, either participating in or collaborating with the study, were familiar with the procedure and participated in the study voluntarily. In order to comply with international ethics rules, they provided an informed consent letter or an authorisation from their legal guardian before the beginning of the study.

EXPERIMENTAL AND CONTROL GROUPS

The participants were divided into three groups in the present research:

– Video training group (n=6). They performed all the sessions included in the perceptive video training programme.

– Mixed training group (n=5). They performed one video training session and one on-court training session per week. The on-court training session consisted of two tasks of the same nature as those practised by the teams during their own training sessions, and were focused on the blocking action.

– Control group (n=5). This group only completed the assessment tests.

There were no significant differences among groups regarding age, years of experience (table 1), number of training hours per week or success rate obtained in the pretest.

Table 1. Group descriptive statistics for age and years of experience.

	Age (years)			Experience (years)		
	M ± SD	RANGE		M ± SD	RANGE	
		Minimum	Maximum		Minimum	Maximum
Video	17.17 ± 0.49	16	19	6.33 ± 0.49	4	7
Mixed	17 ± 0.55	16	19	6.6 ± 0.98	3	9
Control	17.2 ± 0.2	17	18	4.6 ± 1.29	1	8

PROCEDURE

ASSESSMENT TESTS

The players performed two tests before and after the intervention to assess the effects of the training programme.

LABORATORY ANTICIPATION TEST

The aim of this test was to analyse the players' decision-making process and visual behaviour in a situation as similar as possible to real competition (Sáez-Gallego, Vila-Maldonado, Abellán & Contreras, 2015). The pre- and posttest shared the same structure, except for the order of appearance of the attacking sequences. During the test the player was using an eye tracking system. She stood in front of a screen (5x3 m), where a full-size image was projected. The net was between the player and the projector. The test layout on the court is represented in figure 1.
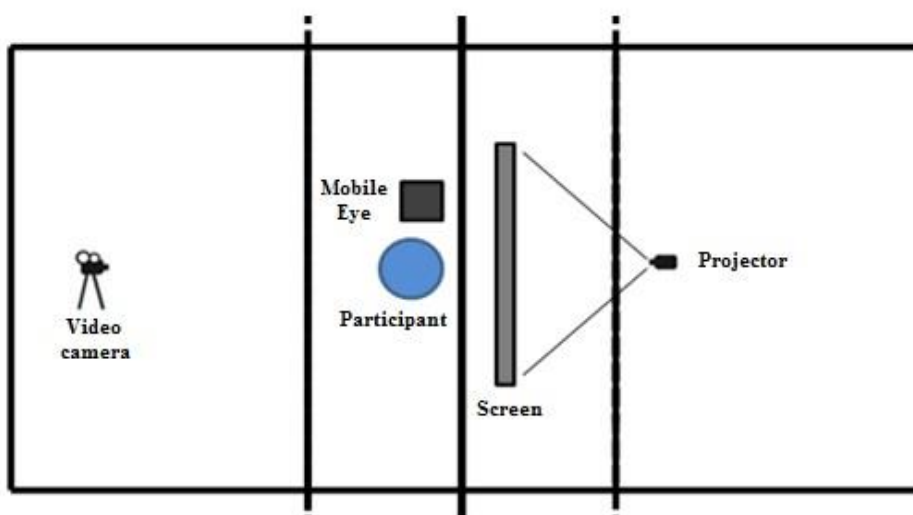

Figure 1. Laboratory anticipation test. Taken from Sáez-Gallego, Vila-Maldonado et al. (2015).

Sixteen practice trials and 24 measurements were performed. In all of them, the participants had to decide where the attack was going to come from. They were instructed to begin the leg flexion prior to the jump if they considered that the set would be directed to zone 3 and to begin the displacement to zone 4 in case they thought this would be the set destination. The blockers' responses were filmed by means of a SONY DCR– HC42E PAL digital video camera and their eye movements were recorded with the Mobile Eye (ASL) system.

FIELD PERFORMANCE TEST

The aim of this test was to analyse the temporal movement aspects and the players' performance in a situation similar to real competition (Sáez-Gallego, Abellán, Vila-Maldonado, & Contreras, 2015). The pre- and posttest shared exactly the same structure. The test started with the attacking team standing on

field A of the volleyball court, ready to perform an attacking action. The setter was standing in zone 2, inside a square where the set had to be performed. Zone 3 and 4 of the field were occupied by two attackers, who were instructed to finish the playing action with a spike. On the other side of the net, on field B, the blocker was standing in zone 3 (figure 2).

Each blocker completed a total of 20 valid actions, performed by two setters. Ten blocking actions executed in zone 3 and ten executed in zone 4 (equally distributed between setters) were analysed. For a sequence to be considered as valid, the ball had to be passed with an overhand set from inside the pre-established area and finish with a spike in which the ball passed over the net and was touched by the blocker or landed within the court boundaries.
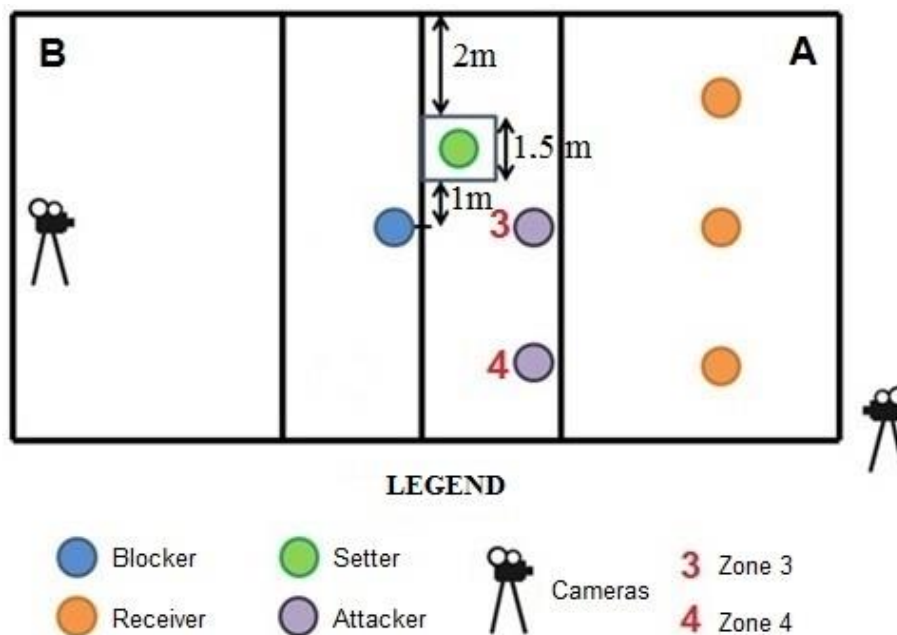

Figure 2. Field performance test. Taken from Sáez-Gallego, Abellán et al. (2015).

THE PERCEPTIVE TRAINING PROGRAMME

Eight sessions (two sessions per week, 20 minutes per session) were implemented in a month. The main aim was to let the participants acquire an effective visual pattern which enabled them to take advantage of highly-informative areas in key action moments. The program had been previously validated by three experts. To implement the program, Superlab 4.0 stimulus presentation software and a CEDRUS response pad, model RB – 530 were used. Both were installed on an HP Compaq 6710B laptop.

In accordance with previous studies (Vila-Maldonado, Sáez-Gallego, Abellán & Contreras, 2012; Sáez-Gallego, Vila-Maldonado, Abellán & Contreras, 2013; Sáez-Gallego, Vila-Maldonado et al., 2015), an effective visual pattern during the blocking action would be as follows: 1. fixing the receiver while she comes in contact with the ball (beginning of the action), 2. tracking the first flight phase

of the ball (resulting from the reception), 3. fixing the setter's elbow-wrist area since she starts moving her arms until her elbow angle is higher than 90º (contact with the ball), and 4. fixing the ball-wrist area until the frame immediately after the contact with the ball (visual pivot).

Each training session consisted of four parts, which combined all different video editing methods described in the introduction, with the purpose to ensure an improvement:

- Attention-orienting video. 16 setting sequences in which highly-informative areas were highlighted, 8 in slow motion and 8 at regular speed.

- Training with feedback regarding setting direction. 24 sequences which were paused at the key moment to make a decision (Sáez-Gallego, Abellán et al., 2015). Once the participant conveyed the selected area, she was provided with feedback about the accuracy of her answer.

- Training with feedback regarding reaction time. The players received feedback about the time available to make a decision in 24 sequences. 12 were stopped at the key moment and 12 were edited with a light signal at that moment.

- Random training. 12 setting sequences were shown to the players without modifying their speed or duration.

All sequences included in the perceptive training were filmed with a digital video camera (SONY DCR – TRV15EPAL), placed in zone 6 of the opponents' field. The ball was thrown from the other side of the court, simulating an easy serve. The ball was received by the libero (or another receiver), passed to the setter and spiked by one of the two attackers standing in zone 3 and 4 of the court. The playing situations were digitised with *Pinnacle Studio Plus 9.3.* software and edited with *Sony Vegas 10.0.*

DEPENDENT VARIABLES

LABORATORY ANTICIPATION TEST

Decision making. The decision making variables include:
- Response accuracy: success rate of each participant.
- Reaction time: mean of the time lapse (ms) since the setter comes in contact with the ball until the participant starts moving.

Visual behaviour. It refers to the percentage of total time spent by each participant in each analysis phase on looking at each location and making saccadic movements:

− Locations: a total of 13 areas have been defined in each phase, corresponding to the setter's body and the surrounding area (figure 3).
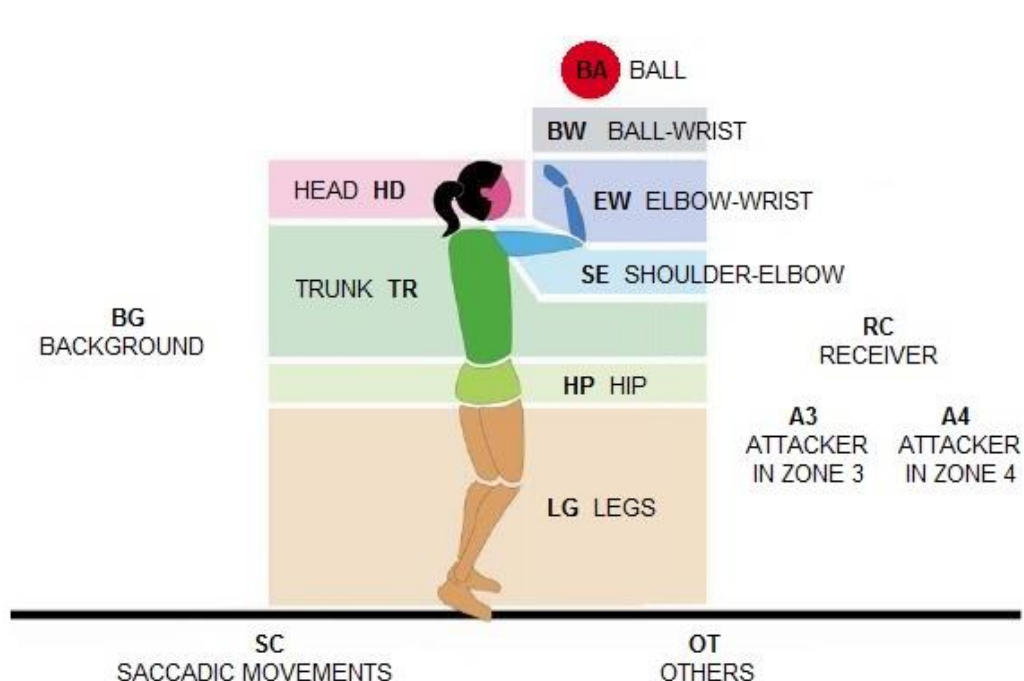
Figure 3. Fixation location. Adapted from Vila-Maldonado et al. (2012).

− Phases: each video sequence has been divided into three phases:

1. Precontact 1 (1,199 ± 121 ms), spanning since the libero receives the ball until the setter puts her elbows at 90º.

2. Precontact 2 (378 ± 72 ms), spanning until the moment prior to the contact with the ball.

3. Contact and Postcontact (406 ± 63 ms), covering the time since the setter completes her pass until her elbows are again at 90º.

FIELD PERFORMANCE TEST

Motor behaviour was measured by means of two types of data:

Temporal movement aspects (ms):

− Reaction time (RT): time lapse since the setter touches the ball until 40 ms before the beginning of the blocker's movement.

− Jump time (JT): time lapse since the blocker starts moving until 40 ms before the beginning of her jump.

- Flight time (FT): time lapse spanning from the beginning of the blocker's jump until the ball overcomes the net.

- Movement time (MT): time lapse since the blocker starts moving until the action ends.

Execution: four different types were identified:

- Successful (S): the blocker touched the ball and it returned to the opponents' court.

- Correct (C): the blocker touched the ball, leaving it in a favourable condition for the second line of defence; the blocker did not touch the ball because it passed over her hands while she was in the correct place and position; or the blocker did not touch the ball because it passed next to her hands (while she was in the correct place and position) and it landed on one of the defence lines (cut shot, cross-court shot or line shot).

- Type I mistake (MI): the blocker's execution was not successful since: the blocker touched the ball and it landed on the defended court; the blocker touched the ball and it landed out of the court (block out); the blocker did not touch the ball because it passed next to her hands and it did not land on any of the defence lines, or the ball passed between the blocker's hands.

- Type II mistake (MII): the blocker was not in the final blocking position when the ball overcame the net.

DATA PROCESSING

The videos regarding decision making, visual behaviour and performance were analysed frame by frame with *Virtual Dub* software. The data analysis was conducted with SPSS 19.0. A repeated-measures ANOVA, with an alpha significance level of 0.05, has been applied for inferential statistics. The group (video, mixed and control) was taken as inter-subject factor and the test (pre- and posttest) was taken as intra-subject factor in all cases. A mixed-model repeated-measures ANOVA has been applied under the assumption that the variances of the variables are equal, which is known as sphericity. The Huyn-Feldt correction was applied in order to prevent type I error, with the purpose to adjust the degrees of freedom used for training and the error effects. The effect size has been obtained calculating partial eta squared (η_p^2). Subsequently, a paired Student's t test with Bonferroni correction was conducted as *post-hoc* test, with the aim to determine which groups showed differences after the implementation of the perceptive training programme in the variables where significant group interaction was observed along the tests.

RESULTS

DECISION MAKING

Table 2 shows the descriptive statistics (M ± SD) of the success rate and reaction time for each group in the laboratory anticipation test, before and after the intervention.

Table 2. Descriptive statistics of decision making for each group.

Variable		Groups		
		Video (n = 6)	Mixed (n = 5)	Control (n = 5)
Response accuracy (%)	Pretest	79.86 ± 15.68	75 ± 8.33	64.17 ± 7.57
	Posttest	74.31 ± 8.08	68.33 ± 4.75	65.83 ± 17.03
Reaction time (ms)*	Pretest	174 ± 362	385 ±165	- 41 ± 299
	Posttest	- 85 ± 193	5 ± 64	77 ± 216

Note: (*) Denotes a significant test effect on the variable for $p \leq 0.05$.

The repeated-measures ANOVA did not show a significant test effect or significantly different Group x Test interaction when pre- and posttest success rates were compared. Nonetheless, a significant test effect was obtained for total reaction time ($F(1,13)=9.237$, $p=0.009$, $\eta_p^2=0.415$), which was lower in the posttest (27 ms) compared to the pretest (202 ms). The paired Student's t test with Bonferroni correction revealed that such significant differences were due to the change produced in the group which received mixed training ($t(4)=5.112$, $p=0.007$).

VISUAL BEHAVIOUR

The repeated-measures ANOVA showed a significant test effect in all phases. Table 3 presents the percentage of time spent in each location where significance was found before and after the intervention.

Table 3. Significant test effect in the percentage of time spent.

Variable		Percentage of time		F (1,12)	Sig.	Effect size (η_p^2)
		Pretest	Posttest			
Precontact Phase 1	EW	3.59	8.54	6.367	0.027	0.347
	SE	8.09	13.79	5.057	0.044	0.296
Precontact Phase 2	BW	17.73	29.91	6.308	0.027	0.345
	SE	6.42	2.96	10.086	0.008	0.457
	HD	7.13	1.98	5.355	0.039	0.309
Contact and Postcontact Phase	BW	9.94	19.51	6.785	0.023	0.361
	SE	1.31	0.45	4.990	0.045	0.294
	A4	2.78	0.02	7.434	0.018	0.383

MOTOR BEHAVIOUR

TEMPORAL MOVEMENT ASPECTS

Table 4 shows the descriptive statistics (M ± SD) of the temporal movement aspects for each group, before and after the intervention. The repeated-measures ANOVA showed no significant Group x Test interaction when comparing the temporal movement aspects of all executions together. A significant test effect was only observed when comparing JT ($F(1,13)=9.893$, $p=0.008$, $\eta_p^2=0.432$), as well as MT ($F(1,13)=7.499$, $p=0.017$, $\eta_p^2=0.366$). In both cases, the whole group mean was higher in the posttest.

Table 4. Descriptive statistics of the temporal movement aspects depending on the test.

Variables (ms)		Groups		
		Video (n=6)	Mixed (n=5)	Control (n=5)
RT	Pretest	150 ± 115	256 ± 61	31 ± 241
	Posttest	38 ± 131	153 ± 97	86 ± 200
JT**	Pretest	1,108 ± 147	1,200 ± 113	1,177 ± 267
	Posttest	1,250 ± 142	1,379 ± 79	1,287 ± 217
FT	Pretest	132 ± 43	123 ± 29	136 ± 41
	Posttest	149 ± 35	98 ± 37	109 ± 62
MT**	Pretest	1,240 ± 144	1,320 ± 93	1,314 ± 278
	Posttest	1,410 ± 171	1,475 ± 54	1,390 ± 199

Note: (**) Denotes a significant test effect on the variable for $p ≤ 0.01$.

EXECUTION

Table 5 presents the descriptive statistics (M ± SD) of the execution type for each group in both tests. The repeated-measures ANOVA showed a significant test effect in the success rate ($F(1,13)=42.166$, $p=0.000$, $\eta_p^2=0.764$), which increased from 59 % before the intervention to 75.83 % after it. Moreover, the repeated-measures ANOVA revealed a significantly different interaction between the test and the group when comparing the total success rate ($F(2,13)=8.608$, $p=0.004$, $\eta_p^2=0.570$). The success rate of the group which completed the mixed training increased significantly after the intervention ($t(4)=-6.216$, $p=0.003$).

Table 5. Descriptive statistics of the execution variable for each group.

VARIABLE (%)		Groups		
		Video (n=6)	Mixed (n=5)	Control (n=5)
Success rate*	Pretest	70 ± 17.03	51 ± 7.42	56 ± 10.84
	Posttest	77.5 ± 14.05	83 ± 6.71	67 ± 13.51
S	Pretest	13.33 ± 8.76	14 ± 8.94	10 ± 7.91
	Posttest	18.33 ± 17.22	12 ± 5.70	17 ± 21.10
C*	Pretest	56.67 ± 14.02	37 ± 14.40	46 ± 15.57
	Posttest	59.17 ± 10.68	71 ± 10.84	50 ± 21.51
MI	Pretest	10 ± 6.32	17 ± 13.04	20 ± 10
	Posttest	12.5 ± 9.35	11 ± 8.22	9 ± 7.42
MII*	Pretest	20 ± 22.14	32 ± 15.65	24 ± 13.87
	Posttest	10 ± 7.75	6 ± 2.24	24 ± 13.87

Note: (*) Denotes a significant test effect for $p \leq 0.05$.

On the other hand, the repeated-measures ANOVA showed a significant test effect in the total percentage of C executions ($F(1,13)=15.827$, $p=0.002$, $\eta_p^2=0.549$), as well as in the total percentage of executions with MII ($F(1,13)=13.701$, $p=0.003$, $\eta_p^2=0.513$). The total percentage of C executions increased and the total percentage of executions with MII decreased after the intervention. Moreover, a significantly different interaction between the test and the group was observed in all the variables in which a significant test effect was found, i.e., in the total percentage of C executions ($F(2,13)=8.943$, $p=0.004$, $\eta_p^2=0.579$) and in the total percentage of executions with MII ($F(2,13)=5.163$, $p=0.022$, $\eta_p^2=0.443$). The *post-hoc* test revealed that the percentage of C executions increased significantly ($t(4)=-4.445$, $p=0.011$) and the percentage of executions with MII decreased significantly in the mixed group after the intervention ($t(4)=3.833$, $p=0.019$).

DISCUSSION

The main aim of the present study was to determine whether a perceptive training programme would lead to an improvement in the anticipatory capacity and performance. In order to do this, the effects of the intervention on decision making, visual behaviour and motor behaviour were analysed.

Regarding response accuracy in decision making, the results did not reveal a significantly different interaction among groups along the tests, indicating that all groups obtained a success rate in the posttest which was similar to the one achieved in the pretest, in accordance with previous studies (Singer et al., 1994; Williams et al., 2002; Williams, Ward & Chapman, 2003). This was due to the fact that perceptive training produces an improvement in the collection of advanced postural cues, leading to shorter reaction time with the same success rate (Goldstone, 1998).

On the other hand, in regard to reaction time, the results showed a significant test effect and significant group interaction. This decrease in reaction time was

produced by the reduction found in all experimental groups, especially in the group which underwent mixed training. By contrast, reaction time increased in all cases in the control group. Consequently, the experimental groups were able to respond before the ball direction became evident, based on the advanced information coming from the setter. In keeping with our results, the reaction time shortening has been one of the most frequently reported effects in studies where the perceptive capacities were trained with video simulations (Williams et al., 2003; Smeeton et al., 2005) or with a combination of these simulations and field training (Singer et al., 1994; Williams et al., 2002; Williams, Ward, Smeeton & Allen, 2004). Faster decision making would allow for limitation of coordinative patterns emerging during the motor action, thus decreasing the execution of motor patterns which would prevent from achieving the goal (Davids, Button & Bennett, 2008).

Regarding visual behaviour, a significant test effect was found in all phases. An increase in the time spent in the areas related to the setter's arm, such as EW and BW, was observed. The lack of significant differences among groups may be due to the fact that the players already spent a large percentage of time in these areas in the pretest. However, considering the response time before the intervention, it seems that the information contained in these areas was insufficient to predict the ball direction. All experimental groups reduced their response time after the intervention and were able to begin the movement before the contact with the ball. This indicates that not only their interest in the information coming from the setter's arm increased slightly, but they were also able to interpret it better. Hagemann et al. (2006) and Savelsbergh, Van Gastel and Van Kampen (2010) also stated that their participants improved their performance thanks to better interpretation of the information prior to the contact. Hence, perceptive training may lead to better decisional and anticipatory performance (Farrow & Abernethy, 2002; Williams et al., 2002; Williams et al., 2003; Smeeton et al., 2005; Savelsbergh et al., 2010). Nevertheless, most of these studies did not conclude whether there was an improvement in field performance.

On the other hand, the temporal movement and execution aspects were analysed with the purpose to discover whether the different perceptive training programmes would have an effect on real practice. With regard to the temporal movement aspects, an increase in JT and MT was observed after the intervention, which may have been caused by the trend already found in the laboratory test: despite no significant differences being found, reaction time decreased in all groups, except in the control group, where it increased. The reduction in RT in the experimental groups produced an increase in their JT and MT, since they started moving earlier in relation to the setter's contact with the ball, affecting the total mean of the mentioned variables.

As regards the execution, a significant test effect in the percentage of C executions and in the percentage of executions with MII was observed. The former increased while the latter decreased, producing a significant increase in total success rate, which rose from 59.69 % to 75.94 %. This significant test effect was caused by the changes experienced by the mixed group, which

completed the on-court training. This group's total success rate increased significantly owing to an increase in C executions and a decrease in executions with MII. These results are in line with those obtained by Antúnez, García, Argudo, Ruiz and Arias (2010), who managed to improve the performance of two female handball goalkeepers by means of perceptive training with field training.

In agreement with this, Farrow and Abernethy (2002) considered essential to introduce one practical training session among several video simulation training sessions in order to give the participants the opportunity to continuously adjust the changes produced on perceptive-visual capacities to the task requirements on the motor system. This underlines the importance of maintaining a functional linkage between perception and action, since training the perceptive capacities without taking movement aspects into account may be ineffective (Gibson, 1986). Nevertheless, not all credit should be given to field training, since isolating it from attention orientation to relevant information areas may be unsuccessful to improve perceptive and decisional aspects, as Singer et al. (1994) proved in their study on tennis.

According to Milner and Goodale (2008), two visual systems come into play in the course of the action: the ventral stream, crucial for visual perception and object identification, and the dorsal stream, responsible for the visual control of action. Perceptual training should be specific to the functional demands that the task places upon both visual systems (Williams et al., 2004). Simulations that require the participant to respond similarly to actual performance may imply the use of both visual systems, whereas those that merely require the participant to recognise the relevant game events and give a judgement about the action outcome may only imply the ventral stream (Williams et al., 2004). Given the results obtained, the introduction of field training sessions that involve both visual systems seems essential to improve the blocking action in volleyball, since without these sessions there would be no transference of the improvements in decision making achieved with the video sessions.

CONCLUSIONS

The attention orientation to relevant information areas improved the decision making in female youth volleyball players, since they reduced their reaction time maintaining the same success rate. This decrease in reaction time was related with better interpretation of advanced visual cues, since the participants were able to respond based on the information coming from the setter just prior to and during her contact with the ball. Faster decision making would allow for limitation of coordinative patterns which would prevent from achieving the goal. However, training on the field is necessary in order to adjust the changes produced on perceptive-visual capacities to the task requirements on the motor system.

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