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ORIGINAL

THE INTERCEPTION OF A CORNER KICK FROM A CONSTRAINTS-LED PERSPECTIVE

LA INTERCEPCIÓN DE UN LANZAMIENTO DE CÓRNER DESDE LA TEORÍA DE LOS LIMITADORES

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ABSTRACT

Motor behavior arises from the continuous interaction between three constraints (organism, environment and task), which never act in isolation. This paper studies the effect of the constraints on the performance, motor behavior and visual search behavior of soccer goalkeepers during the corner kick. 31 participants, divided into three groups depending on the level of play, tried to catch the ball out of a corner kick in two situations (static and dynamic), while their eye movements were recorded. Among the results it is observed that the experts have a more stable performance, while the other groups perform worse

in the most difficult situation; that the experts make a later start of their run up towards the ball and a faster motor pattern to catch it; and that the information of the players involved is not relevant, goalkeepers dedicate values close to 0% of their visual total time to them.

KEYWORDS: motor behaviour, visual behaviour, football goalkeepers.

INTRODUCTION

The dynamical systems theory (Berstein, 1967) has constituted a functionalist framework to understand neurobiological movement coordination. From this perspective, an individual is composed of many subsystems that interact to build behaviour patterns that are effective in a specific situation (Handford, Davids, Bennett & Button, 1997). The different configurations that the independent elements of these subsystems may adopt are called degrees of freedom (Berstein, 1967).

With the aim to understand how performance varies depending on the selected skill of a specific sport modality, and according to Newell (1986), it is important to identify the constraints that limit the appearance of goal-oriented motor patterns. Newell (1986) proposed three categories of constraint: organism constraints, related with the individual; environmental constraints, external to the individual; and task constraints, focused on the aim of the action (for further information, see Newell & Ranganathan, 2009). According to this approach, the three types of constraint interact generating perception-action compounds. Therefore, in a sports context, task, environmental or organism constraints never act alone.

Traditionally, the effect of constraints on athletes' performance and motor behaviour has been studied by creating different playing situations (Araújo, Davids & Travassos, 2012; Correia et al., 2012; Vilar, Correia, Araújo, Vilar & Davids, 2013). One example is the paper focused on the effects of task constraints on visual behaviour and decision-making in youth football players written by Vaeyens, Lenoir, Williams, Mazyn and Philippaerts (2007). They used film simulations in five different sub-phases (2 vs. 1, 3 vs. 1, 3 vs. 2, 4 vs. 3 and 5 vs. 3) and they found that football player groups (regional, sub-elite and elite levels) were faster and more accurate in the decision-making test than the non-player group. In a subsequent study (Vaeyens, Lenoir, Williams & Philippaerts, 2007), participants were stratified on the basis of their performance in the decision-making test. Successful players showed more appropriate visual behaviour. The differences between successful and less successful participants increased in the most complex analysis situations, where more players were involved (3 vs. 2 and 4 vs. 3). Later, Correia et al. (2012) examined the decision-making of rugby players after manipulating the defenders' starting position in 1 vs. 2 sub-phases. Shorter distances between defenders were identified as the most effective defensive behaviour, revealing that the defenders' situation hinders the attackers' behaviour.

Vilar, Araújo, Davids, Correia and Esteves (2012) analysed the influence of the opponents on the attacking players' decision-making during a shot at goal in futsal. The opponents' speed hinders the decision-making during the shooting action. The results reveal that the closest defender and the goalkeeper are significantly slower when they manage to intercept the ball. Headrick et al. (2012) studied the spatiotemporal constraints in 1 vs. 1 sub-phases in football. The findings indicate that the proximity to the goal influences football players' performance.

Furthermore, regarding the action examined in the present manuscript, the effect of constraints on goalkeepers' motor behaviour, visual behaviour and performance when they have to intercept the ball from a corner kick has been previously studied. In previous studies, the constraints have been manipulated one at a time (Abellán, Savelsbergh, Contreras & Vila-Maldonado, 2016) or two at a time (Abellán, Sáez-Gallego & Contreras, 2015; Abellán, Sáez-Gallego, Vila-Maldonado & Contreras, 2017). Task constraints were defined in Abellán et al. (2016). Failures in intercepting a corner kick (which was considered the aim of the action) were attributed to too early run ups and to poor and inadequate jumping and ball catching coordinative patterns by the goalkeeper. Thus, successful interceptions occurred when goalkeepers started to move, jump and move their hands closer to the end of the action. Additionally, visual behaviour data was obtained in this study, which showed that the most informative area was the ball.

The effect of the environmental constraints (together with the task constraints) were analysed by Abellán et al. (2015), who created two different situations in which goalkeepers had to try to catch the ball from a corner kick: one of them included opponents within the goalkeeper's area of action and the other one did not. The performance results showed that the percentage of catches did not differ between both situations. Nevertheless, differences were found in motor behaviour, specifically at the moment of starting the run up, since goalkeepers began to move significantly earlier when they had to intercept a corner kick with other players inside their area of action. However, these results must be treated carefully due to the lack of differences in the group of goalkeepers that were analysed in both situations.

Finally, Abellán et al. (2017) researched the effect of the organism constraints (together with the task constraints) by grouping the goalkeepers depending on their success in corner kick interception. In this study, more successful goalkeepers achieved better performance thanks to a later start of hand movement and ball catch than less successful goalkeepers.

In the present study, as it occurs in a real match corner kick, goalkeepers of different performance levels (organism constraint) are required to catch the ball coming from a corner kick (task constraint) in two different analysis situations (environmental constraint). In this context, goalkeepers have to choose the optimal solution to the task from the variety of options possible. Goalkeepers' behaviour during the action will depend not only on environmental constraints, such as opponents moving within their area of action, but also on their previous experiences and their degree of success in them (Davids, Williams, Button & Court, 2001). The main intent is to determine the influence of these constraints on success achievement in this specific action, with the aim to enable trainers and teachers to guide the learning process by creating appropriate training tasks (Savelsbergh, Verheul, Van der Kamp & Marple-Horvat, 2007).

With all the above, the present manuscript aims to analyse the differences in performance, motor behaviour and visual behaviour among three groups of young male goalkeepers of different skill levels (expert, upper-intermediate and intermediate) during the interception of a ball coming from a corner kick in two

situations: a static situation, in which there are unmoving players inside the goalkeeper's area of action, and a dynamic situation, in which there are moving players inside the same area. It is hypothesised that expert goalkeepers will show better performance, with a higher percentage of catches, than lower-level goalkeepers, and that they will use a different coordinative pattern. Regarding visual behaviour analysis, and taking the results from previous studies (Abellán et al., 2016; Sáez-Gallego, Vila-Maldonado, Abellán & Contreras, 2013; Vila-Maldonado, Sáez-Gallego, Abellán & Contreras, 2012) into account, the ball is expected to be again the most informative area.

METHOD

Participants

An intentional sample of 31 male youth (under-19) goalkeepers was selected. The goalkeepers who played in the highest youth Spanish football division (*División de Honor*) were regarded as the expert group (*N* = 10, mean age = 18.2±0.63 years, experience = 10.5 years). Those who played in the second youth Spanish football division (*Juvenil Nacional*) were considered the upper-intermediate group (*N* = 11, mean age = 16.45±0.69 years, experience = 7.27 years). The goalkeepers who played in the third youth Spanish football division (*Juvenil Provincial*) were assigned to the intermediate group (*N* = 10, mean age = 16.6±0.84 years, experience = 7 years). Every participant received an invitation to participate in the study explaining its aims and they provided informed consent. In case of minors, informed consent was required from their parents or guardians. All participants, as well as their trainers, participated voluntarily in the study.

Material

Goalkeepers' motor behaviour was recorded by means of two video cameras (Sony Handycam DCR-HC42E PAL). One was placed on the area corner opposite to the corner kick and the other one was in line with the penalty mark and the first camera (Figure 1).

Visual behaviour was recorded by means of an eye tracking system (ASL Mobile Eye). This system consists of two cameras mounted on a glasses-shape structure. One camera films the mirror in which the pupil is reflected with the aim to record the eye movements. The second camera films the scene image. The software combines both signals into one video that shows the scene and a cursor indicating the point on which the participant's eyes lay. The device was calibrated before every participant began the test. Moreover, the calibration was checked every five shots. In order to do so, the participants were asked to look at five dots drawn on a panel behind the goal.

The material had already been used in previous studies with similar aims (Abellán, et al., 2015; 2016; 2017).

Procedure

The protocol applied in this study is in accordance with the Declaration of Helsinki. Besides, the procedures previously used by Abellán et al. (2015; 2016; 2017) were followed.

602 shots were finally analysed from a total of 620. Goalkeepers were asked to intercept balls coming from corner kicks from the left side, since no differences were found based on the shooting side in a previous study conducted by Abellán et al. (2016). The goalkeeper was required to stand on the goal line at the beginning of each trial (Figure 1). Two right-footed players performed the corner kicks in turns of two kicks each. These players belonged to the same competitive level as the involved goalkeeper. Both field-players and goalkeepers were asked to behave as they would in a real match, as long as their behaviour did not risk their own integrity or the eye tracking system's. The target of the corner kicks was manipulated in accordance with the results obtained by Abellán et al. (2016). All shots were aimed at a specific 9.32-m-high, 11-m-wide rectangular area (see Figure 1). The analysis situations were balanced for each participant. The target area had already been used by Abellán et al. (2015; 2017). A total of 20 kicks were performed: 10 in a static situation and 10 in a dynamic situation:

Static situation.

Goalkeepers had to try to intercept a corner kick coming from the left side while two players were inside their area of action. These players were standing on the goal area frontal line, one in front of each goal post. The players were not allowed to touch the ball or move; they only acted as a reference (Figure 1, section A).

Dynamic situation

Goalkeepers had to try to intercept a corner kick coming from the left side while two players were inside their area of action. These players were standing in line with the penalty mark, one in front of each goal post. At the moment the ball was kicked, the players started to run straightforward until reaching the goal area line (Figure 1, section B). The players were not allowed to touch the ball; they only acted as a reference.

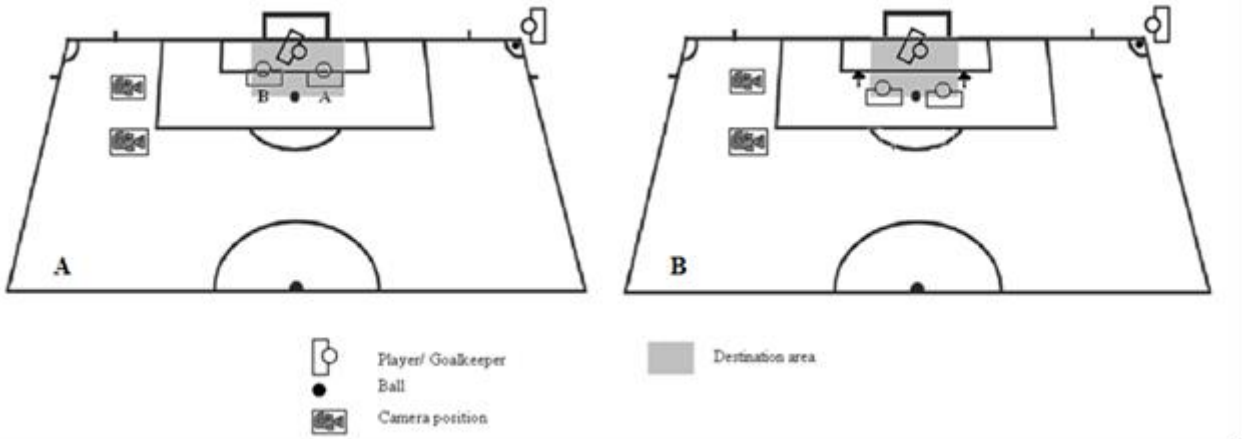

Figure 1. Experimental design of the two analysis situations: static (A) and dynamic (B).

Variables and statistical analysis

The resulting videos (Figure 1) were analysed frame by frame by the same researcher. The researcher wrote down the beginning and end of the analysed variables on a recording sheet according to the video analysis software *VirtualDub.* Three types of data were extracted from the analysis: performance data, motor behaviour data and visual behaviour data. These data were analysed by means of a repeated-measured ANOVA, using group (expert, upper-intermediate and intermediate) x situation (static vs. dynamic) with a significance level of $p \leq 0.05$. Paired T-tests were conducted as *post-hoc* analysis in order to compare significant differences.

Independent variable

Competitive level (within the same under-19 category) was taken as independent variable. The results of the dependent variables were compared based on the belonging to one of the following groups:

Expert group: goalkeepers who played in the first youth Spanish football division (*División de Honor Juvenil*).

Upper-intermediate group: goalkeepers who played in the second youth Spanish football division (*liga Juvenil Nacional*).

Intermediate group: goalkeepers who played in the third youth Spanish football division (*liga Juvenil Provincial*).

Dependent variables

Performance.

Goalkeepers' performance was analysed by means of the following variable:

Error percentage: percentage of shots in which the goalkeeper did not manage to catch the ball.

Motor behaviour.

Goalkeepers' motor behaviour was examined through temporal movement aspects from two reference moments: the moment when the field player kicked the ball and the moment when the goalkeeper caught the ball. All variables were calculated in seconds. The variables analysed from the moment of the kick were:

Run time: time lapse since the player kicks the ball until the goalkeeper begins to move.

Jump time: time lapse since the player kicks the ball until the goalkeeper begins to jump.

Hand movement time: time lapse since the player kicks the ball until the goalkeeper begins to move his hands towards the ball.

Catch time: time lapse since the player kicks the ball until the goalkeeper catches the ball. In case the goalkeeper does not manage to catch the ball, the moment when he touches the ball or the ball flies close to his hands is used to determine the catch time.

The variables analysed from the moment of the catch were:

Hand movement time: time interval since the goalkeeper begins to move his hands until he catches the ball.

Jump time: time interval since the goalkeeper begins to jump until he catches the ball.

Run time: time interval since the goalkeeper begins to run until he catches the ball.

Ball flight time: time interval since the field player kicks the ball until the goalkeeper catches the ball.

Visual behaviour.

Due to calibration problems, visual behaviour data of 15 goalkeepers was obtained (5 expert, 5 upper-intermediate and 5 intermediate). The eye tracking system was used to analyse the goalkeepers' visual behaviour while they tried to catch a ball coming from a corner kick. The following two time periods were selected for analysis:

Pre-contact period: one-second time interval, during which the player runs, immediately previous to the ball hit (the running player location was recorded during this period).

Ball flight period: time interval since the field player kicks the ball until the goalkeeper starts to run in order to catch the ball (the ball location was recorded during this period).

The percentage of time looking at each location compared to the period's total percentage of time was calculated for both variables.

RESULTS

Performance

Table 1 contains the error percentage in ball catch, divided by group and analysis situation (static or dynamic). The total number of errors is included with the aim to complete the information on goalkeepers' performance.

Table 1. *Error percentage in ball catch by goalkeepers, divided by group and analysis situation. Asterisks (*) indicate significant differences for p ≤ 0.05.*

	Expert	Upper-intermediate	Intermediate
Static*	6	7.76	18.33
Dynamic*	2	12.83	21.29
Total*	4.03	10.31	19.96

As it can be seen in Table 1, the group of expert goalkeepers had a lower error percentage in both analysis situations. Besides, the upper-intermediate group had a lower error percentage than the intermediate group in both analysis situations.

The repeated-measures ANOVA using group (expert, upper-intermediate and intermediate) x situation (static vs. dynamic) revealed significant differences in error percentage [$F(1,28) = 11.238$, $p = 0.000$].

The T-test used as *post-hoc* analysis showed significant differences when comparing expert vs. upper-intermediate goalkeepers. The expert group made significantly fewer errors in the dynamic condition [$t(19) = 3.46$, $p = 0.003$] and in total [$t(19) = 2.78$, $p = 0.012$].

Furthermore, the T-test revealed significant differences when comparing the expert vs. the intermediate group. The expert group was more successful than the intermediate group in both situations and in total. The results were as follows: $t(18) = 2.76$, $p = 0.013$ for the static situation; $t(18) = 3.85$, $p = 0.001$ for the dynamic situation; and $t(18) = 4.36$, $p = 0.000$ for the total (static and dynamic situations together).

Lastly, the T-test also yielded significant differences between the upper-intermediate and the intermediate groups. The upper-intermediate group was

significantly more successful than the intermediate group in the static situation [$t(19) = 2.47$, $p = 0.023$] and in total [$t(19) = 2.46$, $p = 0.024$].

Temporal movement aspects

The mean values (in seconds) of motor behaviour analysed from the moment of the kick are presented in Table 2.

Table 2. *Means and standard deviations of motor behaviour (in seconds) analysed from the moment of the kick. Asterisks (*) indicate significant differences for p ≤ 0.05.*

	Expert		Upper-intermediate		Intermediate	
	Static	Dynamic	Static	Dynamic	Static	Dynamic
Run	0.34±0.08	0.33 ± 0.07	0.31±0.12	0.31±0.10	0.31±0.06	0.29±0.14
Jump*	1.50±0.22	1.51±0.23	1.60±0.14	1.56±0.09	1.70±0.19	1.73±0.08
Hand movement*	1.55±0.20	1.55±0.21	1.63±0.14	1.60±0.11	1.75±0.13	1.71±0.10
Catch*	1.82±0.19	1.82±0.20	1.87±0.14	1.85±0.11	2.04±0.13	1.96±0.15

Expert goalkeepers began to run later than upper-intermediate or intermediate ones; however, they performed the rest of the variables analysed earlier: jump time, hand movement time and catch time.

A repeated-measures ANOVA was conducted for each individual variable, considering the group (expert, upper-intermediate and intermediate) and the situation (static and dynamic). The test yielded significant differences in jump time [$F(1,28) = 4.94$, $p = 0.015$], hand movement time [$F(1,28) = 3.78$, $p = 0.035$] and catch time [$F(1,28) = 4.65$, $p = 0.018$].

The T-test used as *post-hoc* analysis for the jump revealed significant differences between the expert and intermediate groups in the static [$t(18)=2.22$, $p=0.039$] and dynamic [$t(18) = 2.81$, $p = 0.012$] analysis situations, as well as between the upper-intermediate and intermediate groups in the dynamic situation [$t(19) = 4.65$, $p = 0.000$]. The expert group started to jump significantly earlier than the other two groups, while the upper-intermediate group did it earlier than the group of intermediate goalkeepers.

The T-test used as *post-hoc* analysis for the hand movement time showed significant differences between the expert and intermediate groups in both situations analysed: static [$t(18) = 2.69$, $p = 0.012$] and dynamic [$t(18) = 2.15$, $p = 0.045$]. Significant differences were also found between the upper-intermediate and intermediate groups in the dynamic situation [$t(19) = 2.23$, $p = 0.038$]. Expert and upper-intermediate goalkeepers began to move their hands to try to catch the ball significantly earlier than intermediate goalkeepers. Regarding the catch, the *post-hoc* analysis conducted by means of the T-test showed significant differences between expert and intermediate goalkeepers in the static analysis situation [$t(18) = 3.1$, $p = 0.006$]. Moreover, significant

differences were found between the upper-intermediate and intermediate groups in the static [$t(19) = 3.02$, $p = 0.007$] and dynamic [$t(19) = 2.46$, $p = 0.024$] situations. Intermediate goalkeepers tried to catch the ball significantly later than expert or upper-intermediate goalkeepers.

The mean values (in seconds) of motor behaviour analysed from the moment of the catch are presented in Table 3.

Table 3. *Means and standard deviations of motor behaviour (in seconds) analysed from the moment of the catch. Asterisks (*) indicate significant differences for p≤0.05.*

	Expert		Upper-intermediate		Intermediate	
	Static	Dynamic	Static	Dynamic	Static	Dynamic
Hand movement	0.26±0.03	0.27±0.04	0.24±0.06	0.25±0.05	0.29±0.06	0.26±0.04
Jump*	0.33±0.04	0.33±0.04	0.29±0.04	0.30±0.04	0.30±0.08	0.25±0.06
Run*	1.45±0.24	1.49±0.22	1.56±0.23	1.54±0.16	1.74±0.14	1.67±0.13
Ball flight*	1.81±0.19	1.82±0.20	1.87±0.14	1.85±0.11	2.04±0.13	1.96±0.09

A repeated-measures ANOVA was conducted for each variable separately, taking into account the group (expert, upper-intermediate and intermediate) and the situation (static and dynamic). The results showed a significant effect of the group on hand movement time [$F(1,28) = 3.85$, $p = 0.035$], run time [$F(1,28) = 4.33$, $p = 0.023$] and ball flight time [$F(1,28) = 4.7$, $p = 0.017$].

The T-test used as *post-hoc* analysis revealed significant differences in jump time between the expert and intermediate groups [$t(18) = 3.66$, $p = 0.002$], as well as between the upper-intermediate and intermediate groups [$t(19) = 2.23$, $p = 0.038$] in the dynamic situation. Intermediate goalkeepers performed the jump in the dynamic situation closer to the ball catch compared with expert and upper- intermediate goalkeepers.

Regarding run time, the *post-hoc* analysis conducted by means of the T-test showed significant differences between the expert and intermediate groups in both static [$t(18)=3.24$, $p=0.005$] and dynamic situations [$t(18) = 2.27$, $p = 0.036$]. Expert goalkeepers began to run closer to the catch moment than intermediate goalkeepers.

Finally, regarding ball flight, the T-test used as *post-hoc* analysis yielded significant differences between the expert and intermediate groups in the static analysis situation [$t(18) = 3.12$, $p = 0.006$], as well as between the upper-intermediate and intermediate groups in both situations: static [$t(19) = 3.06$, $p=0.06$] and dynamic [$t(19) = 2.46$, $p=0.024$]. The ball flight time was significantly longer when a goalkeeper from the intermediate group tried to intercept the ball coming from a corner kick, compared with expert and upper-intermediate goalkeepers.

Visual behaviour

The mean values (in percentage of time looking) of visual behaviour of all groups are displayed in Figure 2. In the static situation, the expert group (n = 5) spent a higher percentage of time looking in both periods analysed (30.72% at running player location and 34.13% at ball location) compared with the upper-intermediate (n = 5) (26.43% at running player location and 28.22% at ball location) and the intermediate (n = 5) (23.65% at running player location and 17.06% at ball location) groups. In the dynamic situation, the upper-intermediate group spent a higher percentage of time looking at the running player location (37.4%) than the expert (29.68%) and the intermediate groups (25.78%). Expert goalkeepers spent a higher percentage of time looking at the ball location (34.27%) than upper-intermediate (29.34%) and intermediate ones (21.73%). Locations associated with attacking players received values of approximately 0%.

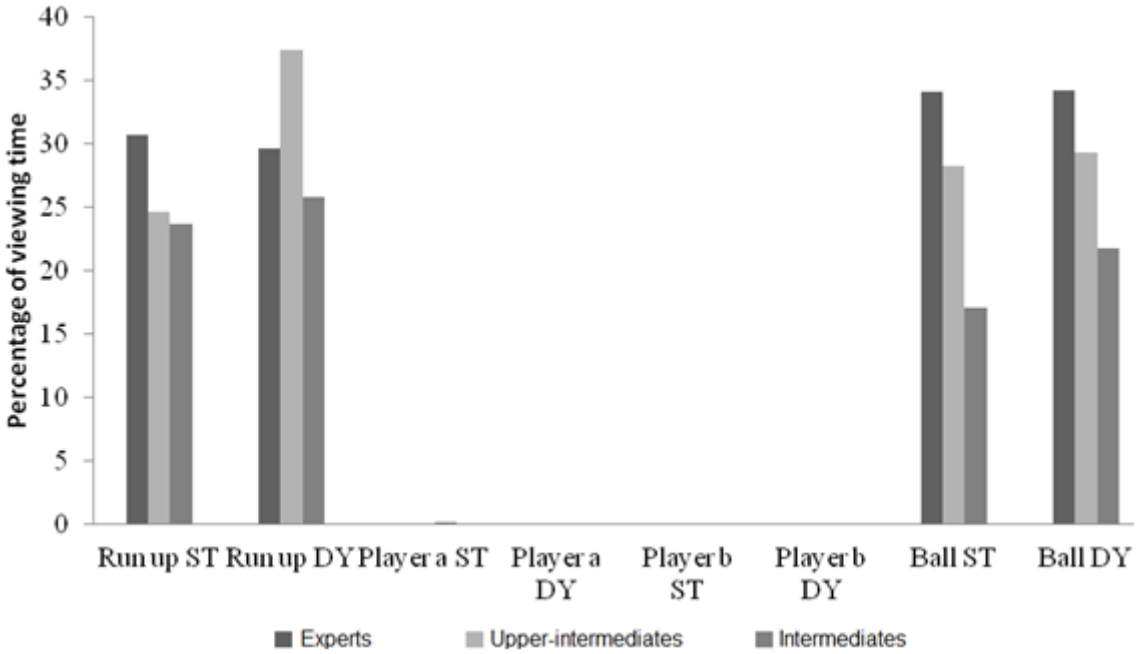

Figure 2 Mean values (in percentage of time looking) of visual behaviour for both time periods analysed: pre-contact (percentage of time looking at the running player location) and ball flight (percentage of time looking at the ball location). Letters ST after the variable's name means static situation and letters DY after the variable's name means dynamic situation.

The group of expert goalkeepers spent a higher percentage of time looking at all locations analysed (except at running player location in the dynamic situation) than the rest of the groups. Nevertheless, the repeated-measures ANOVA did not reveal any significant differences among groups regarding visual behaviour.

DISCUSSION

The main aim of the present study was to analyse the differences in motor behaviour, performance and visual behaviour of young football goalkeepers when trying to intercept a ball coming from a corner kick. The framework

developed by Newell (1986) was applied, manipulating the continuous interaction among the three constraints that affect performance (task, organism and environment).

The group of expert goalkeepers was more successful in catching the ball coming from a corner kick than the other two groups in both situations created, confirming the first hypothesis of this study. This better performance is produced by a more accurate and efficient movement pattern, waiting longer before starting the run up to catch the ball and completing the action as fast as possible. Goalkeepers from the upper-intermediate and intermediate groups started the run up earlier, then they showed a slower coordinative pattern and, consequently, they also performed the catch later than experts. With this coordinative pattern, upper-intermediate and intermediate goalkeepers presented a significantly higher error percentage in both situations analysed. The analysis conducted from the moment of the kick revealed goalkeepers' anticipatory behaviour. The results showed expert goalkeepers' tendency to wait longer until they started running before the catch. A similar strategy was reported by Oudejans, Michaels and Bakker (1997), who found that expert baseball players waited longer before catching high balls, achieving a higher success rate. Likewise, in a previous study by Abellán et al. (2016), it was found that errors in ball catch were caused, among other factors, by excessive anticipation and too early beginning of the run up, maybe without having enough information about the ball destination.

Intermediate-level goalkeepers (intermediate and upper-intermediate) were more influenced by environmental constraints, as it can be concluded from the better performance in the static than in the dynamic situation. The expert group made significantly fewer errors than intermediate goalkeepers in both situations analysed. Nevertheless, when compared with the upper-intermediate group, experts made fewer catching errors only in the dynamic situation. From these results, it can be concluded that lower-level goalkeepers are more affected (they show worse performance) as the task gets more complex. These results are in keeping with the data reported by previous studies. Vaeyens, Lenoir, Williams, Mazyn et al. (2007) showed that participants who were not football players were less accurate in a decision-making test than football players in all the analysis situations created in that study (2 vs. 1, 3 vs.1, 3 vs. 2, 4 vs. 3 and 5 vs. 3). Moreover, elite and sub-elite players were better than regional-level players in all conditions, except in the 2 vs. 1 sub-phase. In a later study, Vaeyens, Lenoir, Williams and Philippaerts (2007) classified the participants based on their success rate in decision-making and obtained similar results. Most successful players performed better than less successful ones in all situations analysed, again except in the 2 vs. 1 sub-phase. Athletes' performance and decision-making varies depending on the task constraints studied (Vaeyens, Lenoir, Williams & Philippaerts, 2007). The effect of environmental constraints has also been examined in a previous study by Abellán et al. (2015). The goalkeepers analysed showed similar performance when their motor behaviour during a ball catch coming from a corner kick was assessed, measured as catch success rate, in two different analysis situations (with or without attacking players inside the goalkeeper's area of action).

Nonetheless, goalkeepers did modify their coordinative pattern to adapt to the different analysis situations and, consequently, to the different task demands. The findings regarding hand movement time, jump time and catch time are especially important for the design of future training programmes. Expert goalkeepers began to move their hands and to jump closer in time to the ball contact (catch) than the other groups (upper-intermediate and intermediate) and, therefore, they caught the ball earlier. These results are in opposition to the findings of previous studies (Abellán et al., 2016; 2017). In Abellán et al. (2017) the group of successful goalkeepers achieved higher ball flight time values and, therefore, they caught the ball later than the less successful group. In Abellán et al. (2016) the errors were due to a beginning of the hand movement that was too close to the interception moment. The differences observed depend on the presence or absence of players within the goalkeeper's area of action. While in previous studies conducted by Abellán et al. (2016; 2017) there were no players inside the goalkeeper's area of action, in the present study and in one of the situations created in Abellán et al. (2015) there were two players within this area, what probably has an effect on the goalkeepers' behaviour. In a real match, the earlier the goalkeeper is able to catch the ball, the more effective his strategy is, since this means that the earlier the possibility of scoring a goal by the attacking team disappears. Besides, the three goalkeeper groups showed very similar visual behaviour during both situations analysed, characterised by a negligible percentage (very close to 0%) of time looking at locations associated with the attacking players. This indicates that this area does not contain relevant information for goalkeepers in order to perform a ball catch. The statistical analysis did not yield significant differences among groups in the situations created, what does not allow for confirmation of the second study hypothesis. However, the expert group showed more exhaustive visual search strategies, with longer time looking at the most informative areas (the field player's run during the pre-contact period and the ball flight during the ball-contact period). Previous research has suggested that visual behaviour is determined by the specific characteristics of every situation (Roca, Ford, McRoberts & Williams, 2013). The idea that experts show better visual behaviour, based on the most informative areas, is supported by studies such as the ones conducted by Savelsbergh et al. (2002; 2005). The results regarding the locations associated with attacking players (which are in no case higher than 0.5% of the time looking) may be explained as follows: since goalkeepers knew prior to the experiment that the attacking players would only move but were not allowed to touch the ball, they may probably have not considered them as informative areas. Therefore, more experiments on visual behaviour involving tasks that are like real competition, with real contact between the goalkeeper and the attacking players during corner kicks, are needed in order to get a completer and more reliable image of goalkeepers' visual behaviour during corner kicks.

Considering the aims established for this research, the following conclusions may be drawn: a successful strategy to intercept a high ball coming from a corner kick consists in waiting longer in order to obtain more information about the ball flight and then begin the run up to try to catch the ball as soon as possible. This has been the strategy used by expert goalkeepers, who have shown better performance in intercepting the ball coming from a corner kick.

Given the systematic loss of visual behaviour data due to the fact that the tests were outdoor field tests, it was not possible to gather enough information to implement, based on these results, a perceptive training programme to improve performance when intercepting a ball coming from a corner kick. This data loss is considered a limitation of the present study.

Furthermore, despite the continuous interaction of the three constraints analysed in this study being the same as in a real playing action, the analysed task cannot be considered to be the same, yet it does not include exactly the same requirements as a real match. Due to the fragility of the eye tracking system, the players located within the goalkeeper's area of action were not allowed to shoot the ball, as they would do in a real match. Future studies should incorporate attacking players who try to score a goal, as it would happen in a real match, in order to get a more complete image of the analysed task. These findings should be considered by football practitioners, such as trainers and goalkeeper trainers, who aim to improve their goalkeepers' performance. To do so, they must instruct goalkeepers not to begin the run up until gathering enough information about the ball's destination in a corner kick, as well as not to begin the run up at the moment when the field player kicks the ball.

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