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ABSTRACT

Visual search behavior was examined *in situ* according to high and low defensive tactical performance of soccer players. Ten university soccer players (24.25±2.51yrs) were evaluated. The field tests consisted of 2 v 1+GK small-sided conditioned game tasks. Player's defensive tactical performance was assessed based on core tactical principles of soccer. Visual search data was recorded using a Tobii pro glasses 2 eye-movement registration system in which the following was defined the total fixation duration per locations, PlayerBall, Ball, SpacePlayer, Space and Undefined. Results displayed significant differences between high and low groups to defensive tactical performance. For visual search the high performance players showed higher to total fixation duration in player in ball possession than low performance players. Fixation Location has no statistical main effect in the high performance group. However, low performance group depicted a longer duration fixating in the ball than player in ball possession location.

Visual search behavior and defensive tactical performance during small-sided conditioned soccer games

KEY-WORDS:

Visual search. Tactical behavior. Soccer.

Comportamento de busca visual e performance tática defensiva durante jogos reduzidos condicionados de futebol

RESUMO

Através do presente estudo procura-se indagar o comportamento de procura visual de futebolistas, de acordo com o respetivo nível de desempenho tático defensivo. Foram avaliados dez participantes (24,25 ± 2,51yrs) através do teste de campo 2v1+GK. O desempenho tático defensivo foi avaliado com base nos princípios táticos do futebol. A procura visual foi registada utilizando o sistema de registo de movimentos oculares *Tobii pro glasses 2*, definindo como medida a duração de fixação total por locais (portador da bola, bola, espaço do portador da bola, espaços livres em campo, e indefinido). Foram encontradas diferenças entre os grupos para o desempenho tático defensivo. Para o comportamento da procura visual, o grupo de alto desempenho apresentou maior duração de fixação total no "portador da bola" quando comparado com o grupo de baixo desempenho. Além disso, o grupo de baixo desempenho indicou maior tempo de duração da fixação total na "bola" do que no "portador da bola".

PALAVRAS CHAVE:

Futebol. Procura visual.
Comportamento tático.

INTRODUCTION

Perceptual-cognitive skills are comprehended by the ability to scan, to pick-up and to process relevant cues from the environment, aiming to select an appropriate action (i.e., tactical-technical skill)⁽¹⁶⁾. In this way, the effective utilization of perceptual-cognitive skills, constantly required during soccer game, have been comprehended as the main support in order to understand the game according to individual and collective tactical performance^(2, 5).

Given the importance of perceptual-cognitive processes underpinning decision-making, researchers have sought an understanding which enhances these yielding skills for better player' performance⁽⁶⁾. Thus, perceptual-cognitive skills have been assessed in distinct situations along with physiological and/or tactical tasks based on video sequences of defensive and/or offensive situations^(1, 7). In terms of perceptual skills (i.e. visual search behavior), these are influenced by the detection of informational signals from the environment, allowing the selection of more relevant information optimising the better motor task response (i.e., tactical-technical behavior)⁽¹³⁾.

Some researches have used different methodological designs to verify how players' visual search behavior of different competitive level groups and skills, responds to the stimuli/tasks applied. Among them, small-sided and conditioned games (SSCG) have been investigated in different situations, mainly based on video (e.g. 2vs.1, 4vs.4, 2vs.1;^(12, 14). Vaeyens, Lenoir, Williams, Mazyn and Philippaerts⁽¹¹⁾ compared SSCG (i.e. 2vs.1, 3vs.1, 3vs.2, 4vs.3 and 5vs.3) during the attack phase based on video. The authors have reported that during games with a small number of participants, elite players performed their attention more often to the player in ball possession and to the available spaces on the field, compared to non-elite. But, when the number of participants increased, the amount of visual search related to sources of short-term information increased, as well.

Therefore, researchers have sought to represent the reality of the game, in order to understand how players' visual search reacts through evaluations using game simulating and protocol simulations in a lab environment^(1, 5). Although such scenarios have offered a significant contribution for understanding players' performance due to the advantage of rigour and laboratory control, some studies focused on the visual search based on video with simple motor tasks linked to SSCG^(8, 11). Despite this, recently visual search behavior has been investigated *in situ* penalty situations environment⁽³⁾. Referring to SSCG, visual search has only been verified based on video simulation test in conjunction with tactical performance on field test measures Notwithstanding, these tests were carried out separately⁽¹³⁾.

Thus, visual search behavior was examined *in situ* according to high and low defensive tactical performance of university soccer players. We hypothesized that high tactical performance group exhibited better defensive tactical performance (i.e., core tactical principles) than low tactical performance group⁽⁹⁾. Based on the study of Vaeyens, Lenoir, Williams and Philippaerts⁽¹²⁾, we admit that high performance players would display more

time fixating in the player in ball possession than their counterparts. Also, we expect that players of both groups (high and low tactical performance) would display different visual search behaviors when compared to fixation locations, fixating more time on the player in possession of the ball and ball than in others locations⁽¹¹⁾.

METHODS

SAMPLE

Ten university male soccer players (24.25±2.51yrs) were evaluated. The study was carried out with the ethical approval of the lead institution, according to the Helsinki Declaration.

FIELD TASK

The field task consisted of game sequences in the format of SSCG (Gk + 1 vs. 2; 27m x 20m) of 1min. and 40secs (SEE FIGURE 1). The standardization of field measures used in the SSCG was based on the number of players' proportion⁽⁴⁾. Each field area was determined by calculating the game space ratio used by soccer players according to the maximum length and width dimensions, established by the International Football Association Board for international games⁽¹⁰⁾.

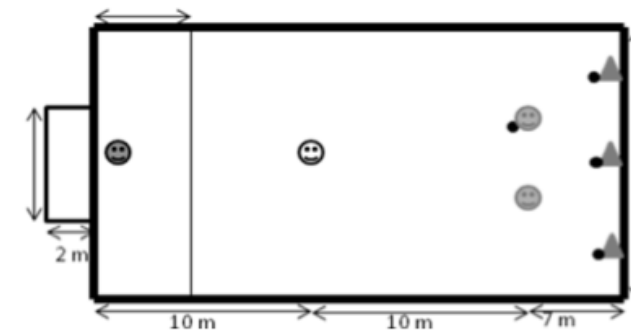


FIGURA 1. Pitch dimensions and its representativeness (Gk + 1 vs. 2).

APPARATUS

The SSCGs were recorded by using a Rollei Ac415 *actioncam* (Rollei GmbH & Co. KG, Norderstedt, Germany). The videos were used to evaluate the defensive tactical performance of soccer players. The Tobbi Pro Glasses 2° eye-movement registration system was worn by participants for the whole duration of field task and used for recording the visual search behaviors. The system works recording the point-of-gaze onto a video image of the binocular corneal reflection with respect to an integrated camera. The system measures the relative

position of the pupil and corneal reflection. The record process is done through Tobii Glasses Controller Software, running on a Dell Venue 11 Pro 7130, Windows 8/8.1 Pro tablet. The image is transferred to a computer and analyzed by running Tobii Glasses Analysis Software. System accuracy was a precision of 0.5°, in both the horizontal and vertical directions.

PROCEDURE

Before the beginning of the test the procedure was explained and the eye-movement system fitted onto the participant's (defender). To calibrate the Tobii eye-movement system the participant has to focus on the center of the calibration card held in-front of him for a few seconds. To ensure that players were familiar with the test procedure, they were subject to practice three trials on the field⁽¹⁵⁾.

Field tests were performed in game sequences (trials) during two times of 1.40 min. The trial finished when: (i) the defender recovered the ball possession, or (ii) attackers shot at the goal and scored/outlined, or (iii) when a fault is marked. To begin a new trial, the attackers have to return to the start point to pick up the ball. All the trials were performed according to the official laws of the game, except for the offside rule, and were recorded on video for further expert analysis and assessment of the participants defensive playing behaviors.

ANALYSIS METHODS

Defensive Tactical Performance: The player's defensive tactical performance was assessed based on core tactical principles of soccer, and the calculation of the performance tactical values were adapted on Teoldo, Garganta, Mesquita, Maia and Greco⁽¹⁰⁾. Based on the tactical performance assessed on the field test, we ranked players as part of the high tactical performance group and low tactical performance group. *Visual search:* Total time of fixation was analyzed per location from the onset of each game sequence. A fixation was defined as the period of 100 ms when the eye remained stationary within 0.5° of movement tolerance⁽¹⁵⁾. Thereby, we divided the fixation settings into five locations: (i) player in possession of the ball (i.e. body parts; PlayerBall), (ii) ball, (iii) space of player in ball possession (i.e. space around player and between legs; SpacePlayer), (iv) free space on the pitch (Space), and (v) undefined. The undefined category was excluded.

STATISTICAL ANALYSIS

Independent *t*-test were performed to compare defensive tactical performance between groups (high/low). We have analyzed Separate Factorial Two-way ANOVAs with group performance (high/low) as the between-participants factor and the number of fixation per location (player in possession of the ball, ball; space of player in ball possession, free space on the pitch and undefined) were the within-participants factors. Partial eta squared (η^2) values were provided as a measure of effect size for all main effects and interactions. Any

significant main and interaction effects were followed up using Bonferroni-corrected pairwise comparisons and Bonferroni post hoc tests, respectively. Alpha level of significance was set at $p < 0.05$.

RESULTS

We obtained significant differences between high and low groups in the defensive tactical performance variable ($t_{(8)} = 2.413$, $p = .042$; see TABLE 1).

TABLE 1. Pitch dimensions and its representativeness (Gk + 1 vs. 2).

GROUP	HIGH	LOW
Defensive Tactical Performance	83,40 (3,36)*	68,3 (13,58)

* $p < .05$: Significance difference.

Afterwards, we obtained statistical significant main effects in Group for PlayerBall ($F_{(1,17)} = 6,337$; $p = .022$; $\eta^2_p = .260$; see Figure 2), indicating that high performance players spent more time fixating the PlayerBall than low performance players ($p = .022$). There was no significant difference for the others fixation locations (i.e., ball, free space on the pitch and space of the player in ball possession).

For the location of fixation, there were no main effect in the high performance group ($F_{(3,36)} = 0.217$; $p = 0.884$; $\eta^2_p = .018$). However, the data revealed a main effect in the total time of fixation for the low performance group ($F_{(3,33)} = 3.281$; $p = .033$; $\eta^2_p = .230$). Participants spent more time fixating the Ball than the PlayerBall location ($p = .031$). There were no significant differences among the others fixation locations.

There was no significant Group*Fixation Location interaction ($F_{(7,69)} = 1,773$; $p = .160$; $\eta^2_p = .072$).

DISCUSSION

The main purpose of this study was to examine the visual search behavior according to high and low defensive tactical performance level of university soccer players. As we have hypothesized, high tactical performance group performed better defensive tactical performance than the low tactical performance group. Yet, our results have confirmed differences in visual search when compared both groups. The high performance group displayed more time fixating in Playerball than low tactical performance group. In contrast to what we have predicted the high performance group showed no difference in visual search

based on location. The low performance group displayed a significant difference between the Ball and Playerball when compared with other locations.

As we expected, the main findings of our study identified that high performance group fixated more time in Playerball than their counterparts. Moreover, the low tactical performance group displayed more time fixating on the Ball than the Playerball. Nevertheless, Vaeyens, Lenoir, Williams and Philippaerts⁽¹²⁾ verified the players' perceptual-cognitive skills on the film-based SSCG tasks (i.e. 2vs.1, 3vs.1, 3vs.2, 4vs.3 and 5vs.3). These authors supported that players fixated more time on the PlayerBall and on the Ball than other locations in the field in 2vs.1, 3vs.1 SSCG tasks.

Despite our study presents similar results compared with other studies^(11, 12), some of the differences identified in our results appear to have what was owing to our task design, once it was applied on field (i.e., *in situ*)⁽⁹⁾. Thereby, independently of task or stimuli applied by researchers when compared the players' perceptual-cognitive skills according to performance level groups, players with better performance showed different visual search strategies for picking-up information from the field when compared with players with a lower performance^(1, 5, 12). With regard to the fixation locations investigated by researchers, the more skilled players fixated more time in the player in possession of the ball than in other locations^(7, 11, 13).

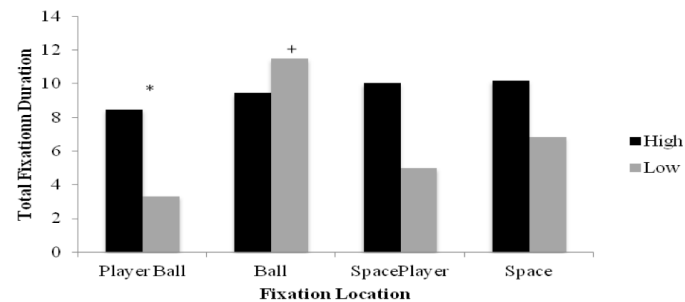


FIGURE 2. Mean total fixation duration spent to each location across group level. (PlayerBall: player in possession of the ball; SpacePlayer: Space of the player in ball possession; Space: free space on the pitch). *Significant difference between high performance level and low performance level groups ($P > .05$). + Significant difference between PlayerBall and Ball Fixation Location for low performance level group

In this way, players' perception have been considered as an important component of superior performance, supporting player to seek better sources of information on the field. It influences players' decision-making and their actions in different skill levels⁽¹¹⁾. Indeed, soccer players must be confronted with some practical interventions, aiming to achieve superior performance. It could improve the tactical and perception skills, for example, training sessions prescribed crossing tactical situations under different game complexities, such as 2vs.1 and 1vs.1 SSCG. Furthermore, to better understand the perceptual-cognitive skills underpinning decision-making, in future researchers we will focus on

the effects of workload on players' visual search behaviors. Another issue may verify how player' perceptual-cognitive skills contribute to their position.

In summary, high performance group spend more time fixated on player in ball possession than low tactical performance group. Low tactical performance group showed to spends more time fixating the ball. By so, high tactical performance group have alternated their visual search pattern according to locals of interest.

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ABSTRACT

The aim of this study was to compare defensive tactical behavior and the visual search behavior according to different levels of perceived effort in small-sided and conditioned games (SSCG). Ten universities (24.25±2.51yrs) were evaluated. The field tests consisted of 2 vs 1+GK SCCG. Players' tactical behavior was assessed based on core tactical principles of soccer. Visual search data was recorded using a Tobii Pro Glasses 2 eye-movement registration system in which the following categories were defined; the fixation duration per locations and number of fixations per locations, such as ball, space, spaceplayer, play-erball and undefined. The participants were separated in two groups, high intensity group and low intensity group according their perceived exertion. There were no significant differences in defensive tactical performance and number of fixations per location. A statistical significant decreased was found in fixation duration in space of the player in ball possession between first and second moment in high intensity group.

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Perception and action in soccer: Performance comparison under different perceived effort intensities in Small-Sided and Conditioned Games

KEY-WORDS:

Visual search. Tactical behavior. Soccer.