Original article (short paper)

Visual search strategy of soccer players according to different age groups

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Abstract - Aims: The aim of this study was to assess the visual search strategy of soccer players from different age groups. **Methods:** The sample comprised 51 youth soccer players. The instrument used to collect and analyse data was the Mobile Eye. This system is used to verify gaze behaviour through visual focus. Players were grouped according to their age group: U-13 (17), U-15 (17), U-17 (17). Participants were presented with a video based test. Visual search stimuli were grouped into five categories: "player in possession of the ball"; "ball"; "teammates"; "opponent"; "space". The number and time of fixations made by players, in each stimuli category was analysed. One-way ANOVA was performed to compare the three groups. **Results:** Results displayed significant differences in one of the categories. The "space" category displayed significant differences in the number of fixations between U-13 (74.35±12.41) compared to U-15 (58.78±14.22) and U-17 (61.88±16.44) soccer players. No other significant differences were found in other categories. **Conclusion:** The U-13 players employed most of their visual search related with "space" compared with players from the U-15 and U-17 age groups. These findings are important for coaches and researchers to understand how visual search strategy change according to age group.

Keywords: youth, assessment, behavior, cognition, football

Introduction

The role of perceptual-cognitive skills in sports domain has been shown as an important process in order to predict performance[1, 2]. As part of the perceptive system, visual search strategy has been considered one of the most important aspects within the process of decision-making in sports domain[3]. Literature shows that there are differences on visual search strategies between players from different competitive levels in different sports, such as cricket[4], judo[5] and soccer[6, 7].

A study carried out by Vaeyens and colleagues[8] comparing visual search in soccer players of different skill levels found differences in performance. These differences were related to various indicators, such as search rate, fixation order and fixation location, allowing differentiation between international and national soccer players. International players employed a higher search order and presented different pattern of visual search compared to national players. This evidence suggests that information may be processed in a different way between these two groups, impacting on players' performance. Others studies found similar results, demonstrating a congruent pattern between visual search behaviour and the level of expertise[6, 7]. It indicates the importance of understand the development of perceptual-cognitive skills in skilled youth players[9].

In this regard, the development of such skills might be important for develop and select talented players[10]. However, although there are many studies in this field comparing differences regarding expertise level, few studies have evaluated differences and the development of perceptual-cognitive skills among different age groups. In this sense, the understanding of how these patterns might change according to age appears to be an important factor in order to systematically evaluate the players in their sport developmental phase[9]. Previous research indicates that expertise influences the visual search behaviour in soccer as early as nine years of age[11, 12]. It suggests an important role of perceptive skills since an early age, which might impact in how the players are able to receive and process the information from game related tasks, impacting on their performance.

During the development phase in youth soccer, an improvement in performance is expected for players. This performance several times is related to decision-making processes, such as in tactical aspects. Studies have shown that some cues are more important than others to make better decisions[13, 14]. Consequently, it is important to gather more relevant information from the environment to perform well. Moreover, there is evidence of the trainability of perceptual and anticipation skills[15, 16]. Therefore, to examine this development over the years it is necessary to understand what to expect from each age group. Acquiring knowledge about how visual search patterns occur in different ages may be a good indicator for clubs and coaches to evaluate players' development and leading the training process with respect to their decision-making capabilities.

In the current study the aim is to assess the visual search strategy of soccer players from different age groups. It is hypothesized that visual search patterns will change between the different age groups, where the older groups will use more relevant cues and more purposeful search behaviour, as used by expert players in previous studies[13,14], for their decision-making. Therefore, we expect the processes of vision will

be used in a different quantitatively manner between groups, with more fixations been spent in areas of free space and teammates as those areas may facilitate decision-making in the offensive phase.

Material and Methods

Participants

The participants comprised 51 male youth soccer players from a Brazilian Serie A club. Players were grouped according to their age level: U-13 (17), U-15 (17), U-17 (17). The inclusion criteria were that players should participate in systematic training sessions, at least three times per week, with 1 hour and 30 minutes per session and should also participate in championships at national and/or international levels.

Ethical Procedures

All participants and tutors signed a consent form before the start of the experiments. All research procedures were conducted in accordance with the standards established by the National Health Council (466/2012) and by the Declaration of Helsinki (1996) for research on human beings. The project had the approval of the Research Ethics Committee of Universidade Federal de Viçosa (Protocol N. 412816-08/10/2013).

Instrument

The Mobile Eye Tracking-XG (Applied Science Laboratories, Bedford, MA, EUA) was used to analyse visual search data. This instrument is used to verify participant's gaze behaviour through a camera system mounted on the glass.

Film Test

The participants were presented with a video based test[17]. This test consists of eleven soccer offensive video sequences, recorded from and watched through a third person perspective. These scenes were edited from European professional matches from national championships. In these sequences, the interactions are shown six times between the player with the ball, teammates, defenders and goalkeeper and five times the goalkeeper was not presented in the scene. It is due the video sequences were edited from television broadcasting, in which six times the offensive sequences were close to the opposing goal (including the opposite goalkeeper) and five times it was far from the opposing goal (not including the opposite goalkeeper). Test scenes were presented to participants via projection screen (TES – TRM 150V with a "Matte White" surface projection) on a 3,04 x 2,28m size. An HD projector (Epson PowerLite X14) was used to project the scenes. Participants stood 2.5 meters away from the screen in a standing position.

Prior to starting the practical task the Mobile Eye Tracking-XG was adjusted and the calibration procedure was carried out. The test procedures were explained before the start of the task and them two trial scenes were presented in order to avoid task familiarity issues. Afterwards, the actual test was started. The calibration of the equipment was periodically checked to ensure measurement accuracy. Each video sequence was presented, and was paused for a moment with the participants being instructed to respond as quickly as possible to "What should the player with ball possession do?". The answers were compared to the answer of a panel of five experts (qualified soccer coaches) that agreed in the correct solution for each sequence. The whole procedure took approximately 30 minutes for each participant.

Visual Search Strategy

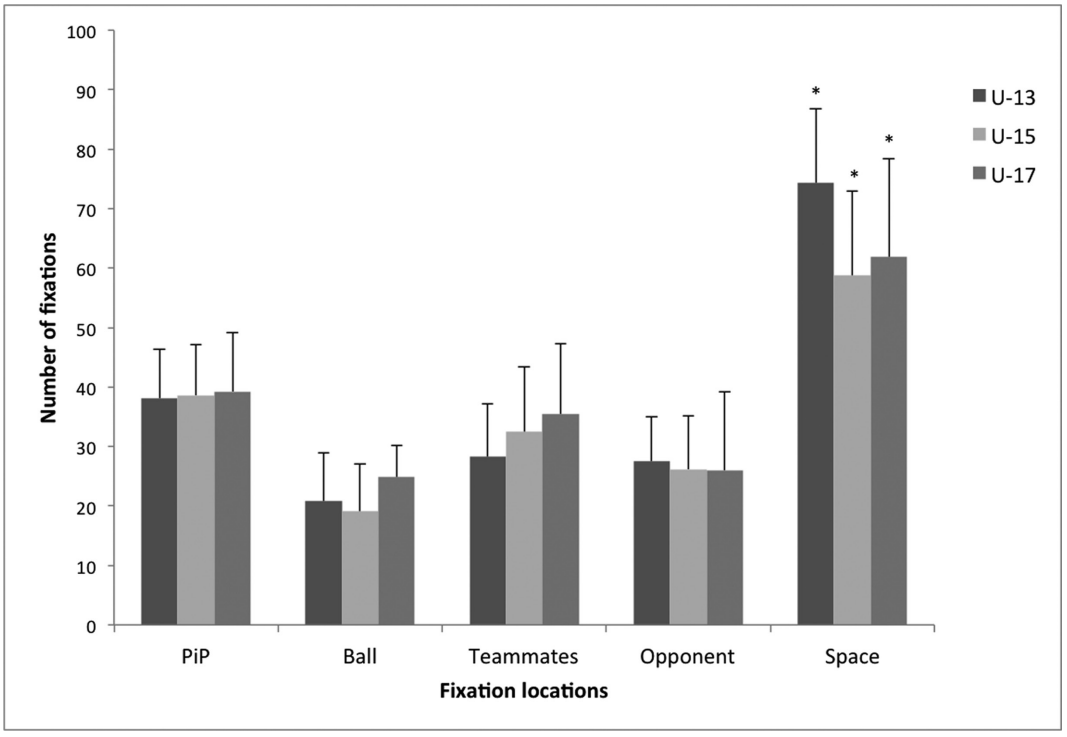
A mobile eye tracker measured the number of fixations and the time of fixation in pre-defined locations made by each participant in the video. In this experiment five different locales of fixation were defined: i) player in possession of the ball; ii) ball; iii) teammates; iv) opponent and v) space (e.g. areas of free space on the soccer pitch in which no player is located). These location were chosen based in previous studies[8, 13]. Data was assessed using a 60 Hz frequency. The calibration method used was the 12 points, which was necessary nine valid points. This value is superior to recommendations by the fabricant, which use a calibration of nine points, been necessary five valid points.

The dependent variable measured in this experiment was the number of fixations and the time of fixations made by participants in one of the five different locales. The independent variable was the player age group (U-13; U-15; U-17). The data distribution was verified through Shapiro-Wilk's test.

Data Analyses

One-way ANOVA was performed to compare mean values and the Tukey's post-hoc test was used to compare differences in the number of fixations and the time of fixations between the three age groups. In addition, the Kappa of Cohen coefficient was used to check the reliability of the observation. This procedure was realized by three trained observers, who reviewed 13% of the fixations from the first observation[18]. The test-retest method was performed using the same video footage of players' performances to obtain the reliability coefficient. The results revealed an inter-observers agreement coefficient of 89% and intra-observers' agreement coefficient of 96%. Statistical procedures were performed through SPSS for Windows®, version 18.0. The significance level was set at $P < 0.05$.

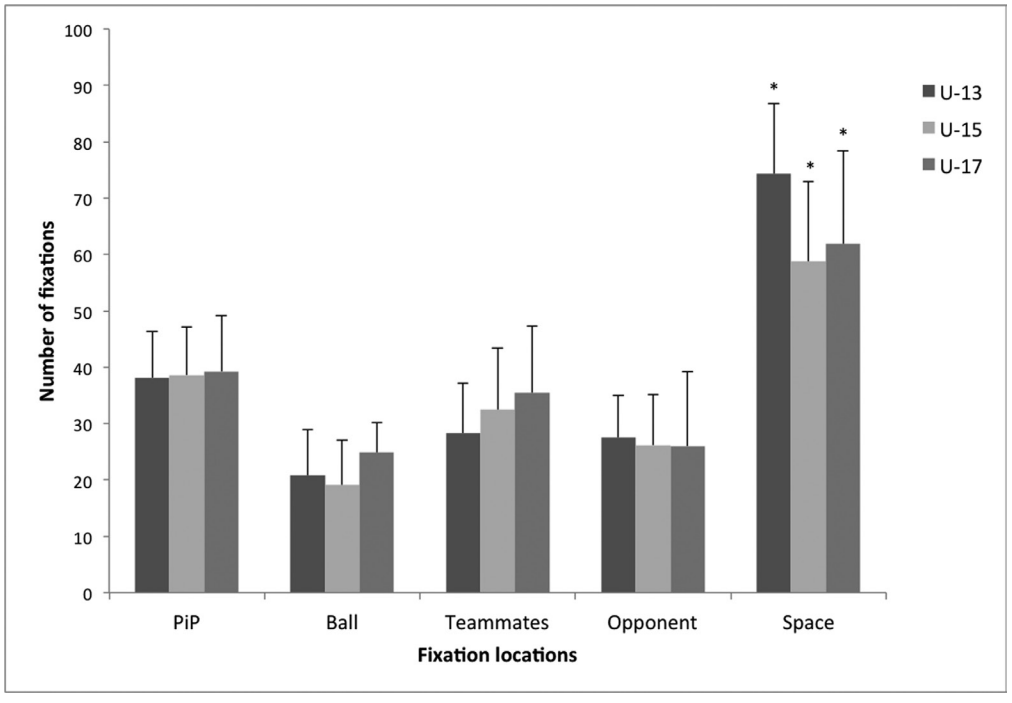
Figure 1. Means and standard deviation for the number of fixations made by each group in pre-defined locations in the video sequences.



Results

The results displayed significant differences in one of the categories. The "space" category displayed significant differences between U-13 (74.35±12.41) $F(2,49) = 5.62$, $P = 0.006$, $\eta 2 = .47$ compared to U-15 (58.78±14.22) and U-17 (61.88±16.44) soccer players. No other significant differences were found in another category.

Figure 2. Means and standard deviation for the time of fixations made by each group in pre-defined locations in the video sequences.



There was found no significant differences for the mean and standard deviation of time of fixation according to the different age groups ($P > 0.05$). Players from the different age groups have spent a similar time fixating the different locations in the video.

Discussion

The aim of the present study was to assess the visual search strategy of soccer players according to different age groups. As hypothesized, the results showed that visual search strategy related to the number of fixations were able to discriminate U-13 players from the U-15 and U-17 age groups. The U-15 and U-17 players did not present significant differences in their visual search strategy for both number of fixation and time of fixation. This finding can be explained by two causes: first, these two older age groups have a similar knowledge about soccer as shown in previous study[19]; second, the variables used to assess the visual search strategy were not sensitive enough to identify differences between U-15 and U-17 players. This study adds to the literature showing the influence of age in visual search strategy.

The three age groups have performed more number of fixations at the "space" category, than any other location in the video. This result might be related with the importance to identify free space in the pitch to "read the game", mainly in the offensive phase, in order to find the best option for the upcoming action (e.g. passing, dribbling or shooting)[3]. Another explanation might be linked to the "visual pivot", which is a behaviour of the gaze centred between points of interests (e.g. ball and teammates), thus enabling the optimal usage of both parafoveal and foveal vision[20]. In this study, the visual search for "space" could be have used also as pivot to facilitate the gaze switch to other areas of interests. This behaviour might facilitate players to pick up important cues and also relate such information based on structural relation, which is essential for tactical problem-solving[21].

In relation to the age groups, the U-13 players were the group that employed more number of fixations related with "space" unlike the U-15 and U-17 age groups. These findings may be related to the specific sports development phase of each group[22] and the specific knowledge of soccer, which is usually lower in younger players[9, 23]. Some researchers showed that the more knowledge about the task the participants have, the more able to recognize patterns linked with better decision-making they are[8, 24]. This advantage is seen to be related to the specific knowledge memory, which is associated with the amount and quality of practice developed along the years[25].

Ward and Williams[11] found that players between 9 and 13 years of age are more likely to use task-irrelevant information when compared with U-15 and U-17 players. Our findings suggest that although of "space" looks to be the most important source of information in this task and also a visual pivot, spend too much time looking it might impairs player's decision making, as a cost benefit between "reading" the game and acting[20, 26], because the older categories used this information less frequently. Additionally, an alternative explanation is related to the film task, which was used in an aerial perspective in our study. Mann and colleagues[27] found that players exposed to this type of view look more frequently to the "space", when compared with a player perspective view.

The U-15 and U-17 age groups were not discriminated by the number of fixations or fixation duration in each location. One explanation might be related to the task applied in this study, which did not include scenes with 11v11 players. Previous research demonstrated that scenes with 11v11 players were more likely to identify specific knowledge than scenes with fewer players[13, 28]. Therefore, for players in the investment phase of sports development[22] (>14 years of age), which are used to play official matches with 11v11 players, the videos including such configuration could be more sensitive to find differences between visual search behaviour of U-15 and U-17 age groups.

Furthermore, these results might indicate that other cognitive process must be involved in the performance of players regarding their visual behaviour, such as peripheral vision and the attention process[7, 29]. Alternatively, it also has implications for the assessment or training of soccer players' decision-making or tactical knowledge based on video tests. It might be interesting that the players are grouped according to their decision-making skills or tactical knowledge rather than their age groups. By their turn, decision-making and tactical knowledge may be assessed through players' performance in laboratory or field tasks for both research and training control purposes.

From a practical view, an important role of the coach in young athletes' development is relating to improve the way these athletes "read the game". From a training perspective, the understanding of how these athletes gathers information from the environment may help coaches to give more appropriate instructions for athletes. Because mirroring the experts patterns is not easy, the skill development approach that focuses on integrated learning, such as the Teaching Games for Understanding, rather than an decontextualized skill acquisition[30] is needed. The findings of our study may help coaches to structure more specific trainings by understanding perceptual-cognitive patterns of different age categories[16].

For future research other perceptual-cognitive abilities might be evaluated, such as visual search rate, fixation order, visual pivot, peripheral vision and attention process. In terms of methods, films in first person view and 11v11 videos also can be applied. This approach can help to understand if other ages present differences or similarities with respect to their visual search strategies so as to identify what are the best variables to discriminate the patterns of each age group.

Conclusion

The U-13 players employed more number of fixations related with "space" compared with players from the U-15 and U-17 age groups. These findings are important for coaches and researchers to understand how visual search strategy change according to age group.

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Where it was written

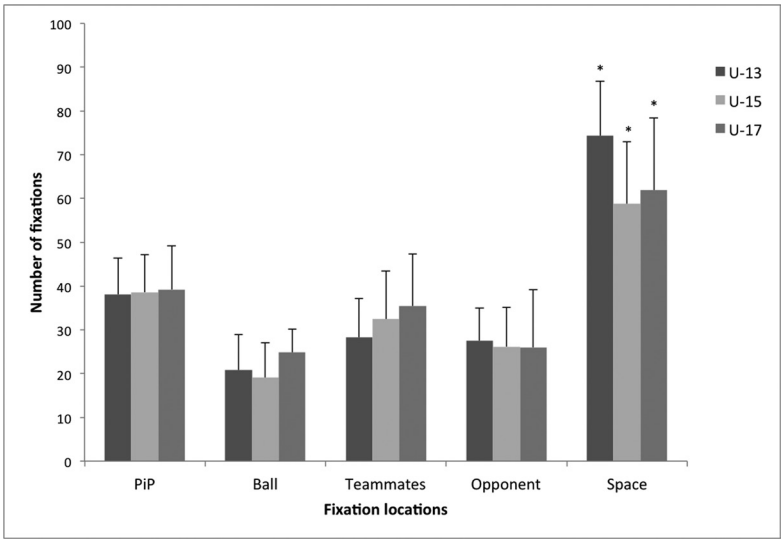

Figure 2. Means and standard deviation for the time of fixations made by each group in pre-defined locations in the video sequences

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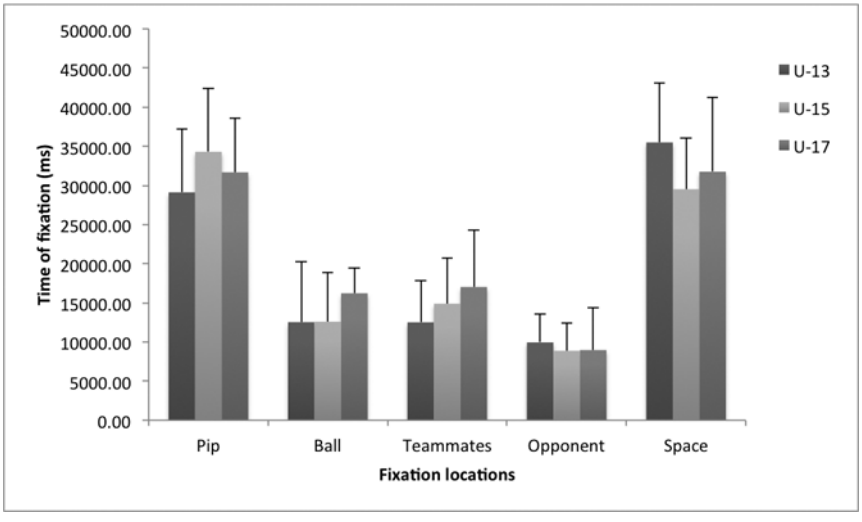

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