

## Patterns of visual search in basketball coaches. An analysis on the level of performance

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### *PATTERNS OF VISUAL SEARCH IN BASKETBALL COACHES . AN ANALYSIS ON THE LEVEL OF PERFORMANCE*

KEY WORDS: Visual search strategies, Eye tracker, Performance level, Coach, Basketball.

ABSTRACT: The present study aimed to analyze sequences of visual basketball coaches with different levels of performance while viewing a set of formal 5x5 game. 8 subjects were analyzed and subdivided by different groups: a group of 4 superior performance coaches (*Top*) and 4 underperformed coaches (*Bottom*), with the classification criteria of its teams playing the championship final. The behavior of the gaze direction of the coach was registered by the eye tracker system, instrument mobile eye 1.35 (Applied Science Laboratories - ALS ®), a simulation of a formal game episode 5x5 basketball practice situation. Later his gaze was categorized by SportsCode ® software in 11 categories. Such categorization allowed the creation of categorical time series that were analyzed by *Recurrence Qualitative Analysis* (RQA) (Webber and Zbilut, 2005). The results appear to indicate that *Top* coaches: preferably use the category interpersonal area to begin the sequence of visual survey, since the *Bottom* coaches often use the sequences of the category offensive player with ball and the offensive player from ball side. It was concluded that basketball coaches with different performance levels having different sequences of visual display when view a formal 5x5 game. Basketball is one of the most popular team games played in almost every country in the world (Ostojic et al. 2006), competitive basketball is played not only in North America, where the game was invented and developed, but also on other continents (Ziv and Lidor, 2009). Although during the last years many scientific evidence had been published about basketball, to our knowledge there is no references about mini basketball (under-12 basketball). In that way, we consider determinant the control of the load of training and the intensity in this population of sportsmen.

Coaches use observation as a fundamental tool of his coaching activity. The diagnosis, analysis and feedback, but why not say it, the whole relationship with the coach's training and competition is based on the use of vision and qualities of their observation. Through them, the coach picks the most relevant information, managing it in search of the decisions that are best suited to different contexts and problems faced.

Unlike the athletes, the coaches haven't been a prime target for research on visual search, yet the few studies conducted suffer from contradictions that are rooted in sports where athletes' income structure has an individual character (Moreno, Avila, Reina and Luis, 2006; Moreno, Reina, Luis and Sabido, 2002; Moreno, Saavedra, Sabido, Luis and Reina, 2006). The study by Petrakis (1986), made with tennis coaches, is the only one known in the literature with tasks closer to the game context. There are no known scientific references on how the coaches of collective sports games involvement capture information through visual perception. It is noticed also that the study of visual search strategies has been to address issues relating to patterns or sequences of visual search.

Given the void related scientific study of visual search strategies of the coaches in sports games, it is important to study how behaves coaches' visual search parameters in their sport specific contexts. Is it possible to find patterns in the way research involving competitive coaches that surround it? These same sequences vary depending on the stage of the game that the coach observes? What are the sequences, where to direct the gaze?

These questions have no answer yet as part of the study of visual search. For a better understanding of the methodological and didactic function that the coach has in conducting the training, the answer to these questions can play a role of great importance. Particularly in the context of training of coaches, where the contrast between what one instructs, observes and where to look can have a potential for increased interest.

Thus, the present study aimed to analyze the visual search strategies of basketball coaches with different performance levels. More concretely defines the specific goal of seeking visual search strings that may indicate how the coach visually explores the involvement in these sports contexts.

### **Method**

The sample consisted in 8 team coaches of under-18 male participants, who participated in the south national championship of Portugal.

The data collection was performed on training environment, through the observation of a specific task of formal game 5x5. Coaches were asked by the researcher to define a team object of observation. The records considered for this study were when coaches were made the observation when his team was in the attack phase.

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The subjects were placed in prolonging the halfway line, two feet from the sideline and watched over a period of 5 minutes a game situation formal 5x5 in every field according to the official

FIBA rules 2010/2011. The displacements and movements of the coaches during the game episode were limited to the area described in figure 1.



Figure 1. Positioning of the coach on the field and the area occupied by him.

It has also limited the involvement of the coach in game situation, he could not stop the game and he could not give any type of feedback to the players.

The behavior of the look of the coach was registered by the eye tracker system, instrument mobile eye 1.35 (*Applied Science Laboratories - ALS*®).

With recourse to *SportsCode Pro*® the captured images were divided into episodes (clips) by: Scrimmage drill all court (SDA) and Scrimmage drill half court (SDH). The team chosen by the coach as “his team”, i.e. your “five” was the criterion used to, separating each episode five minutes of play, different clips referring to the two designated situations.

Of the 8 drillings collected there were identified a total of 78 phases of play in which the team that was selected had subjects in attack phase. This data collection identified 54 episodes in SDA and 24 in SDH.

The selected clips analyze the look of the coach that was categorically characterized with the aid of software *SportsCode Pro*®. Then, it was constructed and applied what is termed Observing system of the Gaze Direction of the Basketball Coach (OSGDBC). There were obtained a time series of categorical areas of interest for which the subject glanced over each clip selected from the game: Offensive player with ball (AB), Offensive player from ball side (ASB), Offensive player from the opposite ball side (AOSB), ball (B) Table-basket (TB), Defensive ball player (DB), Defensive player from the ball side (DSB), Defensive player from the opposite ball side (DOSB), Interpersonal ball space (ISB), Interpersonal space without ball (ISNB) and others (O)

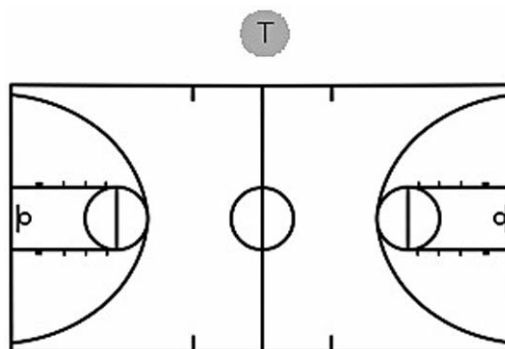


Figure 2. Example frame from the movie, referring to a situation in midfield attack, to code by observing systems. The vertical and horizontal guides that nearly intersect indicate the location of the scene to which the subject is to turn his gaze. The circle and guides associated indicate that the instrument is to measure the pupil diameter.

According to the objectives formulated, the performance level of the coaches was considered as the independent variable. It would appear that the level of performance of the teams participating in the competition in which they were inserted represent an indirect form of the performance of their coaches. Thus, the 8 coaches participants in this study were divided into two groups, with the final classification criteria by the respective teams during Southern National Championship basketball ranking U-18 men: *Top* level (*Top*), who qualified coaches from 1st to 4th place (years of experience  $M = 21$  years,  $SD = 9.49$  years); *Bottom* level (*Bottom*), the remaining coaches who qualified 5th to 8th place (years of experience  $M = 12$  years old,  $SD = 2.83$  years).

Fidelity intra-observer was tested in two occasions. Firstly, in one moment corresponding to the two kinds of clips of game situations considered. Secondly, for testing OSGDBC, and in that sense, categorize the direction of the coach gaze within the specificity of basketball. The procedures for selecting materials research which was produced fidelity intra-observer agreement were identical in both instances:

1<sup>st</sup> – There were selected randomly videos that contained 20-30% of the sample;

2<sup>nd</sup> - Two observations were made with intervals for a week of each other selected videos;

3<sup>rd</sup> - There were performed tests of the levels of agreement between these two moments.

In both cases we used the coefficient of intra-class correlation (ICC) and the extent of *Cohen's Kappa* (Pestana and Gageiro, 2005).

Concerning the identification of phases of the game, the ICC values of fidelity to the start and end times as well as the value of *Cohen's Kappa* were perfect, obtaining a value of 1, which attests to the fidelity intraobserver division of clips forming part of this sample.

Likewise, similar results were found in Table 1 for the OSGDBC. The figures proved the existence of a strong association between the first and second observations and both times loyalty tested, proving loyalty intra-observer observation system and its respective use.

ICC	Kappa	
Initial time	Final time	Cohen Kappa
0.993	0.992	0.996

Table 1. Results fidelity intra-observer observation system OSGDBC between 1<sup>st</sup> and 2<sup>nd</sup> observation, according to Cohen's Kappa Coefficient of Correlation and Intra-Class.

Data were portrayed through categorical time series that were analyzed with the use of Recurrence Qualitative Analysis (RQA) (Webber and Zbilut, 2005). There were extracted and analyzed a set of parameters that constitute the quantitative outputs RQA: the percentage of recurrence (%REC), the percentage of determinism of recurrence (%DET), the maximum line (Maxline) and the midline (Meanline) of recurrence and the difference between them (Max-Mean). As a criterion for selection of sequences of visual research to incorporate the analysis, we used the clips that had Maxline with size greater than 2 categories. Quantitative parameters were analyzed as a function of the parameters of central tendency and dispersion. Qualitative analysis was performed by interpreting the sequence of Maxline

using the relative frequency of the categories presented in the 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> positions following the gaze direction of the coach.

## Results

Figure 3 shows the characterization of the values of Maxline, MeanLine and Maz-Mean in situations SDA and SDH. Regarding Maxline it appears that the average values are higher for the TOP coaches in both situations. As to MeanLine appears that the average values are higher for the *Top* coaches in SDA situations, and for the *Bottom* coaches for SDH situations. With regard to Max-Mean it appears that the average values are higher for the *Top* coaches.

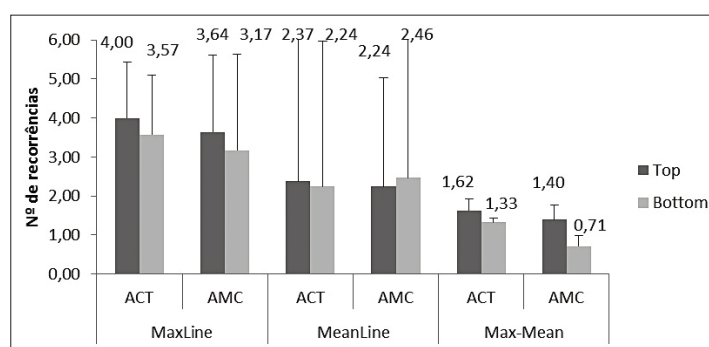


Figure 3. Mean values and graphical representation of the standard deviation of Maxline, MeanLine and Max-Mean in every game situation.

Figure 4 shows the characterization of the %REC and %DET values in situations of SDA and SDH. It is found that the %REC mean values are similar between groups for both situations. With

regard to the %DET mean values appears higher for the TOP coaches.

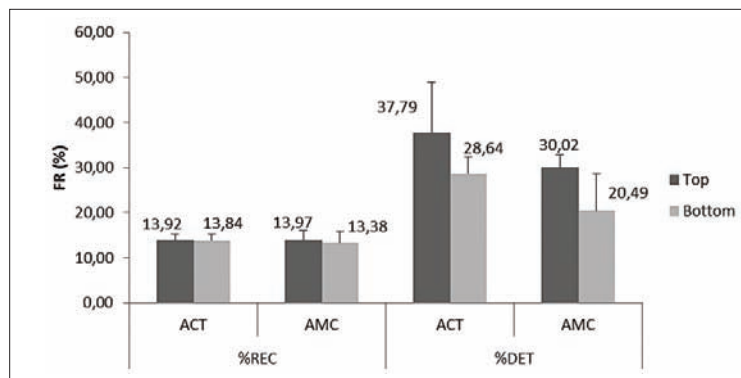


Figure 4. Mean values and graphical representation of the standard deviation of %REC and %DET in every game situation.

Figure 5 represents the characterization of the relative frequencies of the classes relative to the position of the points of recurrence of the MaxLine sequence produced by the Top coaches. It appears that in the first position of the sequence category that has the highest relative frequency is the interpersonal space, followed by category attacker on the side of

the ball. In the second position the interpersonal space without the ball and the defender's side of the ball have higher values and then the category attacker on the side of the ball. Already in position number three is the category attacker on the side of the ball that gets higher values, then the categories attacker with the ball and the interpersonal space without the ball.

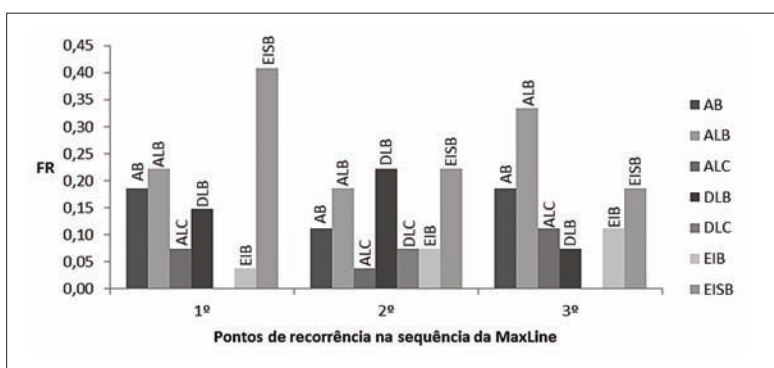


Figure 5. Relative frequencies of the categories on the position of the points of recurrence of the MaxLine sequence produced by the group of Top coaches.

Figure 6 represents the characterization of the relative frequencies of the classes relative to the position of the points of the recurrence of the MaxLine sequence produced by the Bottom coaches. It appears that in the first position of the sequence category that has the highest relative frequency is the attacker with the ball, with almost 50% of relative frequency. In the second

position the relative frequencies are well dispersed although the category attacker on the side of the ball presents higher values. Finally the position number three in the category attacker with ball and the attacker on the side of the ball again showed the higher values.

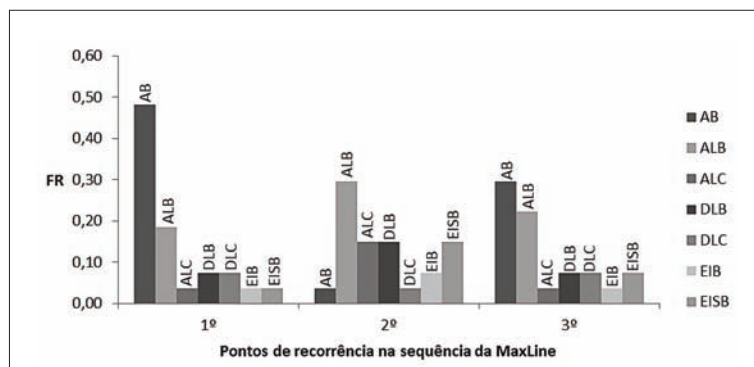


Figure 6. Relative frequencies of the categories on the position of the points of recurrence of the MaxLine sequence produced by the group of Bottom coaches.

## Discussion

For the parameters of recurrence analysis, we found that the TOP coaches showed higher values in the %DET, Maxline, MeanLine and Max-Mean variables, except in the situation of attacking midfield in the variable Meanline.

For the parameter %DET we found that the *Top* coaches have higher values, i.e., greater number of points associated with a recurrent sequence, so we can infer that coaches compared with *Bottom* coaches have a greater determinism in the way visually exploit involvement in which it appears.

The values of Maxline indicate that the *Top* coaches have at least once per episode, sequences of gaze direction higher than *Bottom* coaches. Although the *Top* coaches have higher MaxLines values, the MeanLines values were lower comparatively with *Bottom* coaches, indicating that most of the time sequences using short gaze direction (i.e., to values between 2 and 3 points of recurrence) and occasionally for long sequences using explore the involvement.

*Top* coaches have higher values of MeanLine, and *Bottom* coaches have higher values in the situations of attack in every field in attack and midfield, respectively. Note however that the values have small differences.

Regarding %REC variable there were no great differences in expression with higher values belong to the group *Top* coaches. It is possible to verify that the groups have very close values indicating that both groups of coaches revisit classes with equal relative value, with no significant differences.

Concerning the analysis of the line of maximum recurrence, it appears that the *Bottom* coaches have sequences whose categories are centered in attacking players, particularly attackers

with the ball. This trend is clearly in the first and third position in the sequence. *Top* coaches already have a tendency, irrespective of the position of the sequence, that have the category space without interpersonal ball. Also the attacker and defender side of the ball showed higher values in the positions of the sequence. Thus we can infer that the coaches have *Top* sequences using various interpersonal spaces in order to collect data at more than one point at the same time (i.e., two players without a ball). Already *Bottom* coaches have a certain stabilization of categories that include the sequences of gaze direction, specifically the category attacker with ball arises recurrently in the sequences of this group of coaches. When the category of the attacker with the ball does not come to class attacker on the side of the ball is the most frequent in the sequences of the coaches *Bottom*.

In summary we conclude that:

The *Top* coaches seem to have higher values of determinism, larger lines of recurrence and with higher values compared with *Bottom* coaches, *Top* coaches investigated the involvement of visual information with greater determinism and resorting more frequently to sequences that repeat along the observation time.

The *Top* coaches seem to use preferably the category of interpersonal space in the beginning of a sequence of visual search, using it in more advanced positions in the sequence. Beyond the interpersonal space without ball the *Top* coaches also use with a higher frequency the category of attacker on the side of the ball, defender on the side of the ball and attacker with ball. As *Bottom* coaches, these often use the category of attacker with the ball sequences by visual survey, and the attacker on the side of the ball.

## Acknowledgements

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*PATRONES DE BÚSQUEDA VISUAL EN ENTRENADORES DE BALONCESTO. UN ANÁLISIS DEL NIVEL DE RENDIMIENTO*

**PALABRAS CLAVE:** Entrenadores, Baloncesto, Padrone de búsqueda visual, Nivel de rendimiento.

**RESUMEN:** El presente estudio tuvo como objetivo analizar las secuencias visuales de los entrenadores de baloncesto con diferentes niveles de rendimiento mientras visualizaban un juego formal. Fueron analizados 8 sujetos divididos por dos grupos: un grupo de cuatro entrenadores de rendimiento superior (*Top*) y otro con cuatro entrenadores de rendimiento inferior (*Bottom*). La clasificación final de sus equipos en la competición en la que participaron fue el criterio usado para la construcción de los grupos. El seguimiento de la mirada de los entrenadores fue registrado a través del sistema de eye tracker, mediante el instrumento *Mobile Eye 1.35 (Applied Science Laboratories - ALS®)*, en una simulación de un episodio de juego oficial de baloncesto 5x5 en situación de entrenamiento. Luego su mirada fue clasificada con auxilio del software *SportsCode®* en 11 categorías. Esta análisis permitió la creación de series temporales categóricas que fueron analizadas por el *Recurrence Qualitative Analysis (RQA)*.

Los resultados parecen indicar que los entrenadores *Top* utilizan preferencialmente el espacio interpersonal como la categoría inicial de una secuencia de reconocimiento visual. Los entrenadores *Bottom* utilizan a menudo la categoría atacante con el balón en las secuencias de búsqueda visual, como también el atacante del lado del balón. Se concluyó que los entrenadores de baloncesto con diferentes niveles de rendimiento tienen secuencias visuales distintas cuando visualizan una situación de juego formal de 5x5.

*PADRÕES DE PESQUISA VISUAL EM TREINADORES DE BASQUETEBOL. UMA ANÁLISE SOBRE O NÍVEL DE DESEMPENHO*

**PALAVRAS-CHAVE:** Treinadores, Basquetebol, Padrões de pesquisa visual, Nível de desempenho.

**RESUME:** O presente estudo pretendeu analisar sequências visuais de treinadores de basquetebol com níveis distintos de desempenho durante a visualização de um jogo formal de 5x5. Foram analisados 8 sujeitos, subdivididos por diferentes grupos: um grupo de 4 treinadores de desempenho superior (*TOop*) e um de 4 treinadores de desempenho inferior (*Bottom*), tendo como critério a classificação das suas equipas no final do campeonato. O comportamento do olhar do treinador foi registado através do sistema *eye tracker*, instrumento *mobile eye 1.35 (Applied Science Laboratories - ALS®)*, numa simulação de um episódio de jogo formal de 5x5 de basquetebol em situação de treino. Posteriormente o seu olhar foi categorizado através do software *SportsCode®* em 11 categorias. A referida categorização permitiu a criação de séries temporais categóricas que foram analisadas através da *Recurrence Qualitative Analysis (RQA)* (Webber and Zbilut, 2005).

Os resultados parecem indicar que os treinadores *Top*: recorrem preferencialmente ao espaço interpessoal como a categoria de início duma sequência de pesquisa visual, já os treinadores *Bottom* utilizam frequentemente a categoria atacante com bola nas sequências de pesquisa visual, bem como o atacante do lado da bola. Concluiu-se que treinadores de basquetebol com níveis distintos de desempenho apresentam diferenças nas sequências visuais aquando da visualização duma situação de jogo formal de 5x5.

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