ANTICIPATION IN SOCCER: A SYSTEMATIC REVIEW

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ABSTRACT

Purpose. The present study aimed to examine the current methods employed to assess anticipation in soccer players as well as to elicit the main findings of recent studies. **Methods.** The study was carried out in systematic review form and its sample comprised nine scientific papers published in academic journals. Only the studies involving soccer players (professionals and amateurs, except goalkeepers) were included in this review. **Results and conclusions.** We observed that most of the studies employed video footage obtained from soccer matches, which are occluded at a given point for study participants to quickly and precisely elicit the positions of opponents, teammates and the ball as well as anticipate actions (dribbling, shooting, passing) from surrounding players (teammates and opponents). In addition, the studies compared the performance of players from both high and low competitive levels in anticipation tasks.

Key words: association football, cognition, cognitive assessment, anticipation skills

Introduction

The ability to anticipate actions from teammates, opponents and the movement/direction of the ball has been considered essential to expert performance in soccer [1, 2]. Consequently, better players are not always those who are able to see a move but rather those who are able to foresee it [3]. The ability of the individual to foresee what is the most likely outcome of an event before it occurs is defined as anticipation [4]. This cognitive process has been highlighted by the literature as essential for the performance of soccer players, since the game complexity/dynamics demand from its players the ability to foresee upcoming actions.

Over the years, different experimental designs have been utilized to assess soccer players' anticipation. Among the studies conducted on soccer players, many attempt to distinguish the key skills for success in this sport and some findings have indicated several examples. These include superior ability in recognizing information through opponents' postural cues, thus anticipating forthcoming movements [5], faster and more precise pattern recognition in structured situations that are specific of the task at hand [6] and superior ability to more precisely foresee (within time constraints) the movements of teammates and opponents [7, 8]. Furthermore, research has been conducted with the aim to demonstrate that more experienced players are more precise in anticipating the time and movements of opponents, teammates and the ball [9–11].

The aim of this study was to present a systematic review of the current methods used to assess soccer players' ability to anticipate time and movement and elicit the main findings of such experimental studies with respect to this perceptual-cognitive skill.

Material and methods

The sample of this study comprised nine experimental studies, indexed in the following scientific journal databases: B-On (*n* = 2), Web of Knowledge (*n* = 3), MEDLINE (*n* = 1), Scopus (*n* = 1), ScienceDirect (*n* = 1) and EBSCO (*n* = 1). The process of search and selection of papers followed the model proposed by Domholdt [12] and is presented in Figure 1.

The search for papers was conducted between July and August 2013. The criteria for inclusion of the studies were the following: 1) in journals offering free and complete manuscripts, 2) published between 2003 and 2013, 3) involving human beings and an experimental design and 4) in English.

The search in the databases was conducted through the use of terminologies indexed within the "Descriptors in Health Sciences" established by the Virtual Health Library as developed from the Medical Subject Headings by the U.S. National Library of Medicine, which allows the use of common terminology in Portuguese, English and Spanish. The terms used to perform the search were "football", "soccer" and "anticipation".

Search modes were selected with the aim of refining the search through the following filters: "Title", "full text", "free full text", "abstract" and "humans" within all databases. After the initial search, 93 papers were found. During a consultation for selection which papers

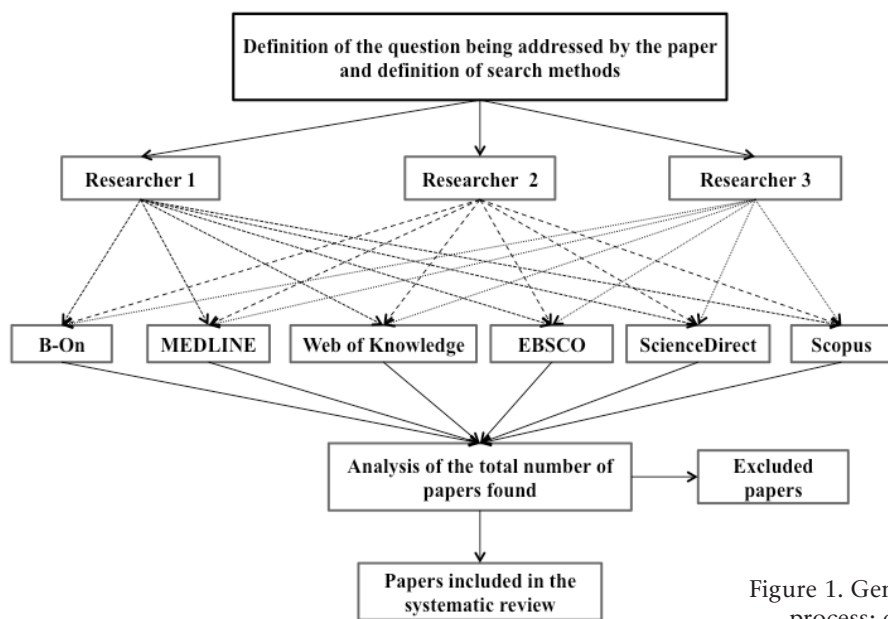---

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Figure 1. General description of the systematic review process; diagram adapted from Domholdt [12]
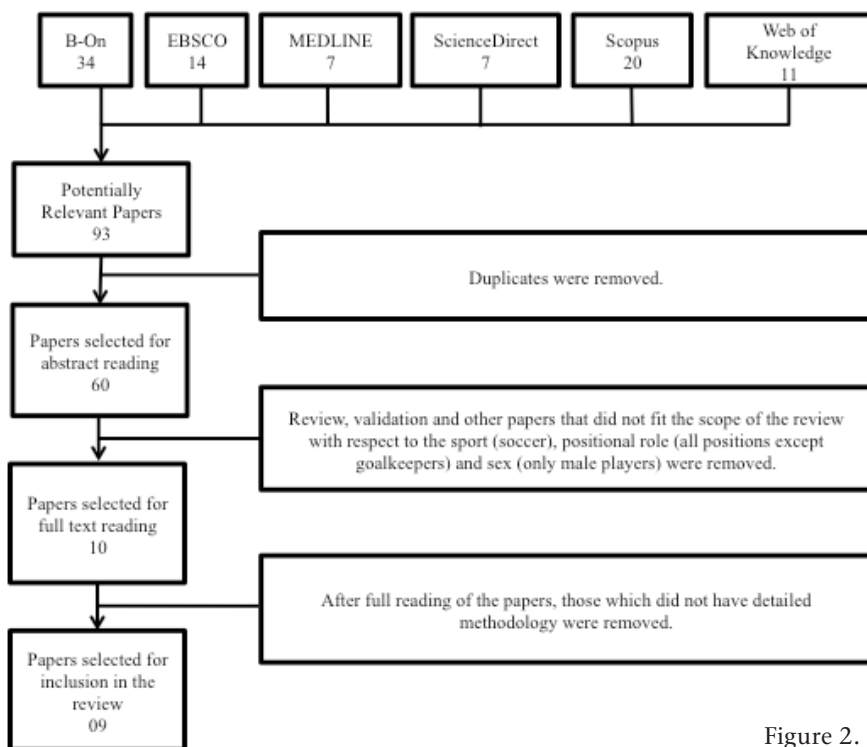

Figure 2. Flowchart of the study selection process

were to be included in this systematic review, exact duplicates of papers were excluded, thus reducing search results to 60 papers.

Hereafter, the study abstracts were read. At this stage 50 additional papers were excluded according to the following criteria: 1) relating anticipation to any other sport, 2) samples with individuals under 10 years and over 30 years old, 3) included participants with any kind of pathology or disability, 4) analysed anticipation in goalkeepers and 5) examined anticipation in female soc-

cer players. After a full reading of the remaining studies, nine papers were selected and subjected to a detailed reading and interpretation as presented in the flowchart in Figure 2.

Results

The papers included in this review are described in Table 1 with respect to the sport, age level, authors and year of publication. Among the studies analysed, all

Table 1. Studies on anticipation in soccer players

Author	Sample	Aim	Findings
Ward P., Williams A.M. [8]	Male, primary and secondary school and Premier League level soccer players ($n = 137$)	Examine the contribution of visual, perceptual and cognitive skills in the development of soccer expertise	– 1 vs. 1 scenarios: players at a higher competitive level displayed higher anticipation skills when compared with those of lower competitive levels ($p < 0.003$) – 3 vs. 3 scenarios: U-13 players displayed lower anticipation accuracy when compared with U-9s and U-17s ($p < 0.001$) – 11 vs. 11 scenarios: players from the highest competitive level displayed better anticipation in respect to pass direction when compared with players from lower competitive levels ($p < 0.001$)
North J.S. et al. [14]	Male, professional soccer players from an English Premier League club ($n = 11$) and recreational players ($n = 15$)	Identify the processes underpinning judgements based in anticipation and recognition	– Professional players displayed higher accuracy in anticipating actions when compared with recreational players ($p < 0.001$). – A moderate but non-significant correlation ($r = 0.44$; $p = 0.18$) was observed between anticipation accuracy and recognition sensitivity only between professional players – Participants performed a higher number of fixations during the anticipation task when compared with the recognition task ($p < 0.01$). – Participants had more fixations per second of longer duration in the recognition phase than in the anticipation phase ($p < 0.001$) – Participants spent more time viewing the ball and less time viewing the attacking team during the recognition phase in comparison with the anticipation phase ($p < 0.001$)
North J.S. et al. [2]	Male, professional, semi-professional ($n = 11$) and amateur and recreational English soccer players ($n = 8$)	Understand the mechanisms underpinning expertise in anticipating movements and recognizing movement patterns in a dynamic and temporally constrained domain	– Semi-professional and professional players displayed higher accuracy in movement anticipation compared with recreational players ($p < 0.001$)
Roca A. et al. [11]	Male, professional and semi-professional ($n = 10$) and amateur and recreational ($n = 10$) soccer players	Examine the differences of performance in perceptive and cognitive skills in a dynamic task	– Semi-professional and professional players displayed higher accuracy in anticipating opponents' actions in comparison with amateur and recreational players ($p < 0.001$) – Semi-professional and professional players displayed higher accuracy in anticipating ball flight in comparison with lower competitive level counterparts ($p < 0.001$)
Roca A. et al. [1]	Male, semi-professional and professional ($n = 48$), and amateur and recreational ($n = 16$) soccer players	Analysis of the contribution of type and amount of activity in which soccer players were engaged in during their development on expertise in perceptual-cognitive skills	– Significant difference between semi-professional and professional players in comparison with amateur and recreational players with respect to movement anticipation accuracy ($p < 0.001$) – Between 13 and 18 years of age, the amount of hours of daily soccer practice explains 13.2% of the variance of perceptual-cognitive performance accuracy ($p < 0.05$) – Between 13 and 18 years of age, the amount of hours of daily soccer-specific training activity explains 21.8% of the variance of perceptual-cognitive performance accuracy ($p < 0.001$) – Participants displayed higher accuracy in anticipating near tasks in comparison with far tasks ($p < 0.001$)
Roca A. et al. [15]	Male, professional and semi-professional ($n = 12$) and amateur and recreational ($n = 12$) soccer players	Analysis of the role and interactions between different perceptual and cognitive skills underpinning anticipation and decision-making	– Professional and semi-professional participants displayed higher accuracy in anticipating opponents' actions ($p < 0.001$) – Participants displayed higher accuracy in anticipating near tasks in comparison with far tasks ($p < 0.001$)

Table 1. Studies on anticipation in soccer players

Author	Sample	Study	Findings
Ward P. et al. [9]	Male, academy players from a Premier League club ($n = 21$) and amateur players ($n = 20$)	Examine how soccer players anticipate movements from other players in a complex environment during a specific task	– Academy players displayed higher accuracy in anticipating actions in different situations ($p < 0.001$) – Academy players were more accurate in anticipating opponents' actions ($p < 0.05$), in anticipating opponents' actions and their direction ($p < 0.001$), and in anticipating opponents' actions, their direction and pass recipient ($p < 0.001$)
Casanova F. et al. [10]	Male, professional and semi-professional ($n = 8$) and amateur ($n = 8$) soccer players	Examine the influence of intermittent exercise on visual search behaviour and movement anticipation in a specific task	– Professional players displayed higher accuracy in anticipating opponents' actions in comparison with amateur players ($p < 0.0001$) – Players displayed higher accuracy in test moments 1, 2 and 3 in comparison to moment 4 ($p < 0.05$)
Bishop D.T. et al. [13]	Male, semi-professional soccer players ($n = 39$)	Analysis of neural bases for expertise in anticipation skills through the use of fMRI	– Prediction accuracy was significantly higher ($p < 0.001$) when players were presented with match scenes in comparison to random scenes – In different situations of video occlusion, different brain areas are activated; the level of activation is different between competitive levels

examined anticipation via videotaping, in which an image was occluded at a certain moment. After occlusion, participants were to determine as fast and precisely as possible the place and final direction of the ball. Videos with point-light display (PLD) were also utilized. In this model, light spots replaced players' video images. Assessment procedures within this model were the same as those of the previous model.

One study investigated the influence of activities performed during their development on anticipation skills [1]. In this study, the duration of soccer practice and soccer-related activities was analysed and its aim was to identify the contribution of each of these variables in the development of perceptual-cognitive processes such as anticipation and decision-making. Another study assessed the activated brain regions and the magnitude of such activation in an anticipation task [13]. The results of this study indicated that different brain regions are activated in different perceptual-cognitive tasks. All papers included in this review grouped their samples by competitive level or by performance in the adopted task of their analyses.

Discussion

The aim of this systematic review was to present the current methods used to assess soccer players' ability to anticipate time and movement and elicit the main findings of experimental studies with respect to this perceptual-cognitive skill.

The method of having players visualize videotaped soccer scenes, with images being occluded at a given moment, was employed in a large degree as were videos with point-light displays (PLD). We found that these analyses were performed with the aim of comparing players regarding their competitive level [1, 2, 8–11, 13–15]. In the study of Ward and Williams [8], videotaped scenes were used to assess (besides anticipation), memory and situational probabilities (i.e. which player was better positioned to receive a pass). Video sequences comprised 1 vs. 1, 3 vs. 3 and 11 vs. 11 scenarios. Participants were grouped according to their competitive level, with youth academy players (U-9, U-11, U-13, U-15 and U-17) from English Premier League clubs being considered as high-level players. Participants categorized as low competitive level players were those who played at the recreational or university levels. In this study, the authors identified significant differences in the accuracy of anticipatory responses between the high and low competitive level players in the 1 vs. 1 and 11 vs. 11 situations ($p < 0.003$ and $p < 0.001$, respectively). When comparison took age into consideration, statistically significant differences were found only in the 3 vs. 3 scenario ($p < 0.001$). In this case, U-13 players displayed the poorest results compared with those from the U-9 and U-17 levels ($p < 0.001$). It is noteworthy that differences between players from dif-

ferent competitive levels in the 11 vs. 11 scenario were only observed in the anticipation of pass destination. According to the authors, the complexity of playing patterns in 11 vs. 11 scenarios requires very specific and sophisticated knowledge and memory in order to anticipate an appropriate solution [8].

North et al. [14] examined whether performance in anticipation and recognition tasks is related and also if there were any differences in visual search behaviours employed in such tasks. The results indicated that players at higher competitive levels (11 professional soccer players from an English Premier League club, age = 20.6 ± 3.1) displayed more sensitivity in distinguishing new stimuli from those already seen in comparison with recreational level players ($n = 15$, age = 25.8 ± 4.7). This indicated a higher capacity among high-level players to extract information and temporal relations from such scenarios. In addition, high-level players were more efficient in an anticipation task and fixated more locations per second than recreational players. In the same study, a moderate but non-significant correlation ($r = 0.44$, $p = 0.18$) was verified between anticipation accuracy and recognition sensitivity only in high-level participants. Generally, participants had more fixations during the anticipation phase, had more fixations of longer duration in the recognition phase, and spent more time viewing the ball and less time viewing the attacking team in the recognition phase. These data reveal important differences regarding the characteristics of these two cognitive tasks, which are considered very important in soccer performance.

Employing a similar approach as the previous study, Roca et al. [11] presented low and high competitive level soccer players with life-size video sequences. Their aim was to measure participants' anticipation accuracy and visual search strategy to anticipate and make decisions in dynamic soccer situations (11 vs. 11 scenarios). The results indicate, similar to that in the study of Ward and Williams [8], that high level players are more accurate in soccer-specific anticipation tasks such as anticipating opponents' movements and final pass destination. Results from these study reinforce the findings of Ward and Williams [8] on the importance of the ability to anticipate opponents' actions in order to obtain higher performance levels in soccer.

In a similar vein with using video sequences, Roca et al. [1] analysed the influence of activities by soccer players at different competitive levels during their development process on perceptual-cognitive skills. Their results indicate that players who were engaged in a higher amount of soccer-specific activities are more likely to develop perceptual-cognitive skills at high performance levels. With respect to anticipation skills, the amount of hours of daily soccer practice explained 13.2% of the development of anticipation accuracy in players aged 13 and 18 years of age. Additionally, also in the same age range, the amount of hours of daily soccer practice explained 21.8% of the development of accurate anticipation of ball and opponents' movements.

The study developed by North et al. [2] examined the mechanisms underlying skilled anticipation in a dynamic, interactive and temporally constrained domain. For this purpose, soccer players at different competitive levels were tested (11 skilled and 8 less-skilled male soccer players aged 25.5 ± 4 and 24 ± 1.6 years, respectively), through the use of video sequences. A stimuli was presented and players were to respond as fast and accurately as possible. In this study, statistically significant differences were found ($p < 0.001$) between semi-professional (among which 9 participants had played at the English Premier League level) and recreational players in the accuracy of the anticipation task. The means regarding the anticipation accuracy of the semi-professional players was 65.3 ± 8.16% and of the recreational players 46.8 ± 8.7%. These results supported the authors' original hypothesis that players from higher competitive levels are more accurate in anticipation tasks when compared to those from lower competitive levels.

Another analysis on anticipation in soccer examined the influence of intermittent exercise on anticipation accuracy in tasks where the participant observes soccer-specific video sequences [10]. In this study, differences between groups with distinct competitive levels were examined in regards to exercise intensity. Inter-group comparisons indicated, once more, that players at higher competitive levels (8 semi-professional and professional players; age 24.6 ± 3.9 years, training experience = 5.1 ± 2.4 years) are more effective in anticipating opponents' actions than amateur players ($n = 8$; age = 26.3 ± 2.9, training experience = 2.1 ± 2.4). In addition, exercise intensity did not significantly influence the ability to anticipate opponents' actions, and significant differences were found in anticipation accuracy during the exercise protocol in both groups.

In a more recent study, Roca et al. [15] assessed two groups of soccer players, composed by skilled ($n = 12$) and less-skilled ($n = 12$) participants. The skilled participants were professional soccer players, with more than 14 years of soccer experience, whereas the less-skilled players were amateurs with less than 11 years of soccer experience. Both groups were submitted to a test that consisted of watching video sequences and providing a verbal report with respect to a number of decisions that needed to be made. The results revealed that skilled players are more accurate in anticipating opponents' actions and, consequently, in deciding on the more appropriate course of action than less-skilled players. The findings of this study corroborated those from a previous study of the same first author [1, 11] as well as from Ward and Williams [8].

Furthermore, Ward et al. [9] examined how soccer players anticipate other players' movements in a complex

environment. For this experiment, the authors selected 41 soccer players of whom 21 were classified as skilled and 20 as less-skilled. The skilled players were youth academy players from a Premier League club, in which nine had already signed professional contracts with the club. Less-skilled participants were amateur players from local high schools. The task of the study consisted of watching video of 11 vs. 11 professional and semi-professional matches. After a sequence of game actions, a scene was occluded and the participant was asked to verbalize the action that the player in possession of the ball was about to perform. The authors noted that skilled players were both quicker and more accurate in anticipatory behaviour when compared to the less-skilled group of players.

In a recently published study, Bishop et al. [13] took a multidisciplinary approach and included robust assessment tools such as fMRI to compare anticipation accuracy in players from different competitive levels and with different accuracy levels (low-, intermediate- and high-skill anticipators) in a soccer-specific anticipation task, [13]. They also studied which brain regions are more activate during the anticipation task and the levels of activation of these regions. Among the three hypotheses raised by the authors about anticipation skill, two of them were confirmed and only one was rejected. They first concluded that skilled players were more effective in predicting opponents' actions and that anticipation accuracy did not vary according to the moment in which the scenes were occluded. Another confirmed hypothesis was that the understanding of other player actions resulted in higher brain activation, as high-skill anticipators showed higher mirror neuron system (MNS) and medial frontal cortex activations. The MNS was described by Gallese et al. [16] and Rizzolatti et al. [17] in research on apes and subsequently observed in human beings by Buccino et al. [18]. The latter authors stated that these are neurons that are activated when the individual observes other people's actions.

Conclusions

The most widely used method to assess soccer players' anticipation skills was by presenting video sequences that involved occlusion and inquiry regarding ball position and final destination. The studies included in this review concluded that players at higher competitive levels are more accurate in anticipating opponents' actions, action direction and final pass destination than those from lower competitive levels.

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