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The hidden foundation of field vision in English Premier League (EPL) soccer players

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Abstract

Professional team sports are extremely information rich, dynamic and complex, which may provide players with fast and accurate field vision decisive competitive advantages. What then are the underlying processes that make some professional players appear to have better field vision than others? The purpose of this study was to learn more about the ways that some of the best professional soccer players in the world use visual exploratory behaviors (body and head movements initiated to better see their surroundings) in real-world games and to test the relationships between these behaviors and performance. Close-up video images of individual players were obtained from Sky Sport's split screen PlayerCam broadcasts of 1279 game situations with 118 players (midfielders and forwards) in English Premier League (EPL) soccer games. The results show a clear positive relationship between visual exploratory behaviors that are initiated before receiving the ball and performance with the ball. The best players explore more frequently than others and there is a positive relationship between exploratory behavior frequency and pass completion. The impact of exploratory behaviors is the largest for midfielders performing forward passes. These behaviors may have been off the radar for coaches, scouts and fans, and practical implications are offered.

Introduction

> The difference between them and us is we have more players who think before they play, quicker. (...) When you arrive at Barça the first thing they teach you is: think. Think, think, think. Quickly. [Xavi starts doing the actions, looking around himself.] Lift your head up, move, see, think. Look before you get the ball.
> (Xavi, FC Barcelona and Spain midfield player [1])

Skilled perception in dynamic and complex competitive team contexts is probably a critical component of high level performance in these contexts, yet very complicated and difficult to carry out. In soccer (European football), both midfielders and forwards are constantly surrounded by other players, whose positions, movements, and intentions need to be detected for these players to make effective and accurate decisions with the ball. Thus, an important research question is, how are various visual processes related to performance?

The extent to which skilled athletes use more effective visual search strategies than less skilled athletes has been heavily debated by researchers (for research reviews, see [2] and [3]). Moreover, several recent studies have examined the visual search strategies in soccer. For example, researchers find that skilled soccer players fixate their gaze less frequently, but with longer durations, which may imply that they are able to extract more information from each individual visual fixation [4]. Another group of researchers find the opposite, namely that skilled players fixate their gaze on the displayed information more frequently, but with shorter duration [5]. A major limitation with these studies is that they are all conducted in a laboratory, where players are asked to view and act upon photos or films, their actions are analyzed for response time and accuracy, and their visual scanning is measured via eye-movement registration techniques. Thus, a reason for disagreement between scientists may be the different types of laboratory designs, where players are asked to respond to either static photos [4] or filmed game sequences [5].

A more serious and general set of limitations is based on the extent to which laboratory simulations of team ball sports fail to involve tasks and conditions that logically would seem critical to visual perception and subsequent actions in real games. For example, movie screen protocols, using television screens [6] or large film screens [7] only display information that is located in front of the participants. These screens do not display the full amount of ambient information that is found in real world games – information from important events occurring behind a player's back. Related to researchers' preoccupation with frontal vision, most visual behavior analyses have only

included eye movement monitoring [4, 5, 6, 7], to the neglect of body and head movements. No laboratory studies have been carried out with tasks that fully depend on ambient vision. Further, laboratory films have typically been edited from professional level games [8] or from specific game simulations conducted by the researchers [7], none of which meaningfully involve any of the participants. Thus, these films exclude factors that probably have a significant impact on perception and action in real games, such as team playing style, game strategy, and interpersonal coordination with specific teammates. Finally, most studies have employed non sport-specific movement responses; for example verbalization and computer mouse cursor moving [9], stepping on a floor mat [7] and writing with pencil on a paper [8] for football players; as well as moving a joystick back and forth for football goalkeepers [10]. These tasks do not simulate the functional links between perception and natural movements, which may be essential to capture if the goal is to reveal knowledge about real-game visual perception.

These and other aspects related to transfer between laboratories and the real world suggest that there is an urgent need to use more ecologically valid laboratory paradigms and/or to examine athletes' perception and action in real-world competitive situations. Thus, a fundamental question that has yet to be addressed by researchers is, what do we know about visual search strategies in actual games? The purpose of the current study was to learn more about the ways expert professional soccer players use visual exploratory behaviors in actual real-world games and to examine the relationships between these behaviors and performance.

Methods

Video images were obtained from Sky Sport's split screen PlayerCam broadcasts of EPL soccer games. This footage shows a large close-up image of each player, with a smaller overview image of the general game events and the ball. Such video footage makes it possible to examine how players engage in visual exploratory behaviors by moving their bodies and heads to better perceive events taking place behind their backs (see Figure 1, for a still picture taken from this video footage).

Figure 2. Sky Sport's PlayerCam feature. It shows a close-up of Chelsea FC's Frank Lampard engaging in exploratory activity by looking away from the ball (right part of the figure), as well as an overview picture showing the general game events (top left part of the figure). The drawn full circle shows where Lampard is positioned in the overview picture and the dotted circle shows his teammate holding the ball.

We obtained such videos from 64 games in one EPL season. Each game featured 6 players and each player was followed with the close-up function for 15 minutes. Some teams and players were featured multiple times and in total we ended up with footage from 118 players. We were only interested in game situations where a player had relevant information behind his back that would be beneficial for him to detect. Thus, the criterion that was created for a situation to be included for analysis was: "the player has to receive a pass from a teammate located closer to his team's own goal than the participant, which would make it relevant to engage in some type of exploratory behavior to see what is behind his back". A total of 1279 such situations were identified and included for analysis.

The analyses of visual exploratory behavior were based on the operational definition of a visual exploration: "A body and/or head movement in which the player's face is actively and temporarily directed away from the ball, seemingly with the intention of looking for teammates, opponents or other environmental objects or events, relevant to perform a subsequent action with the ball." We counted the number of visual explorations in the 10

seconds leading up to a player receiving the ball (if the ball was turned over to the player's team or put into play from a set piece within that 10-second period we started counting from that moment that the ball was turned over/set into play). Exploratory behavior frequency was then assessed by dividing the number of exploratory searches conducted in one situation with the total number of seconds of that situation.

We did an extensive inter-observer reliability test of the analyses of exploratory behavior (35% of the total sample) and found an absolute agreement on the number of explorations in each situation of 72%. Given that the object of these analyses is complex behavior in a fast paced team sport setting, we think this result is more than acceptable.

Performance was assessed in two ways. First, we identified the players who had received an individual prestigious award (such as FIFA World Player of the Year), which would indicate that this player was at a higher level of performance than players who had not received such award. Second, for each of the included situations, we assessed the pass/action completion rate, i.e., whether the pass/action executed by the player ended up with a continued possession for the player's team or not. We also looked at the pass/action completion rate for forward passes/actions only, i.e., passes/actions directed forward in the field. Given that a large majority of these actions were passes, we will simply denote these variables "pass completion" and "forward pass completion".

To control for game context, we assessed whether the situation took place on the player's own half or the opponent's half of the field.

In terms of statistical analyses, we used a Mann Whitney test to determine whether players at different levels of performance had different exploratory behavior frequencies. To test the impact of exploratory behaviors on performance we first split all the observations of exploratory frequency into three equal groups, where "little exploration" is the 1/3 of these visual explorations with the lowest frequency, "much exploration" is the 1/3 with the highest frequency, and "some" is the 1/3 in the middle. We then conducted a series of categorical logistic regression analyses with pass completion or forward pass completion as the binary dependent variable.

Results

The results show a positive relationship between visual exploratory frequency and performance. First, the better players tend to have a higher exploratory frequency than others players Thus, although all the players in our EPL sample are highly skilled, the ones who at one point in their career had received a prestigious award (such as FIFA World Player of the Year) explore more frequently (M = .33 searches/second, SD = .25) than those without awards (M = .27 searches/second, SD = .22) (Mann Whitney U = 155728.00, $p < .001$). Interestingly, the two individual players with the highest average exploration frequency in the whole sample are Frank Lampard and Steven Gerrard (both with M = .62 searches/second). These two players are perhaps the two most decorated midfield players in the EPL the last 10 years and both are regulars in the England national team.

Further, when we analyze the relationship between visual exploration and performance across all 1279 game situations, we find a positive relationship between exploratory behavior frequency and pass completion rate, where players who explore more frequently reach their teammates with more successful passes (see Figure 1).

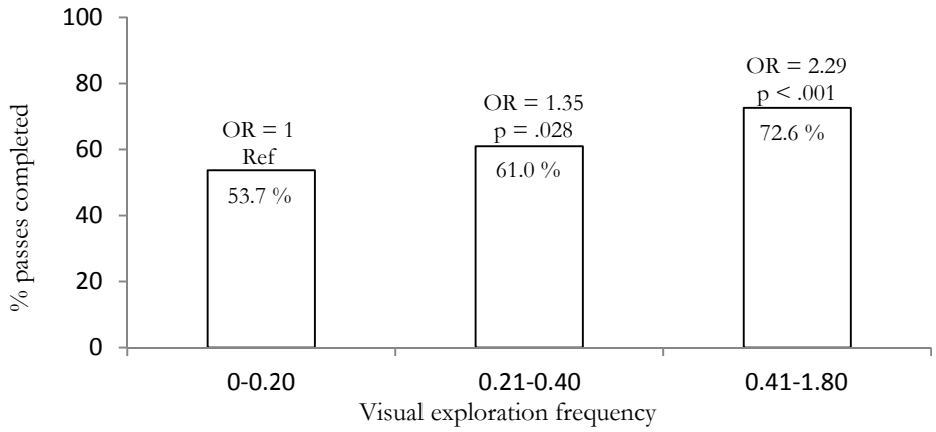

Figure 1. Visual exploration frequency (visual explorations/seconds) and pass completion (n = 118 players/1279 game situations).

This effect holds when we look at different game conditions, such as the location of the player. For example, when we only look at actions at the opponents' half of the field (n = 1029 situations)), players who explore little complete 52.1% and players who explore much complete 65.8% of their passes (OR = 1.77, p < .001). At the players' own half of the field, players with little exploration complete 59.8% while players who explore much complete 82.8% of their passes, (OR = 3.24, p = .003).

The relationship between exploratory behavior and performance remains both for forwards and midfielders. When only examining forwards (n = 63 players/837 situations), players who explore little complete 51.2% of their passes and players who explore much complete 63.4% of their passes (OR = 1.65, p = .003). As for midfielders (n = 55 players/442 situations), players who explore little complete 56.5% of their passes and players who explore much complete 75.6% of their passes (OR = 2.39, p = .001).

A limitation with using pass completion as the performance measure is that it is relatively simple to find a teammate with a pass if you never make any risky decisions. One way to control for this is to look at forward passes only, as these passes tend to be directed to where opposing teams set up their defense, which requires both creativity and accuracy to be successful (to complete the pass).When we only examine situations that end with a forward pass (n = 589 game situations), the same relationship between exploratory behaviors and performance is found. In situations where players explore little, they complete 39.8% of their passes, while when they explore much, they complete 57.7% of their passes (OR = 2.01, p < .001). However, this relationship is only valid for midfield players. Midfield players that explore little only complete 38.2% of their forward passes, compared to 73.2% when they explore much (OR = 4.42, p < .001). The relationship is in the same direction for forwards, but this is not significant (OR = 1.52, p = .107). For midfielders, the relationship between exploratory behaviors and forward pass completion remains valid under different game conditions, both for situations on their own half (OR = 3.67, p = .023) and on their opponent's half (OR = 5.18, p = .002).

Conclusions

The results of this study clearly show that professional EPL soccer players who engage in extensive visual exploratory behaviors (thus moving their bodies and heads to perceive what is going on behind their backs), in the period right before receiving the ball, are more successful with the ball than players who exhibit less of these behaviors. These results largely remain significant across positional roles (midfielders and forwards), under different contextual conditions (one's own and opponent's half), and with different types of performances (pass completion and forward pass completion). The most substantial effect though is found with midfielders and forward pass completion. In total, this suggests that visual exploratory behavior is something all offensive players (both midfielders and forwards) may benefit from engaging in, under all types of contextual conditions, and with all types of actions, but that the maximum effect can be gained for midfielders when they attempt to hit creative forward passes.

Although visual exploratory behaviors are not completely unknown in player, coaching, and fan communities (e.g., see the quote from Xavi in this paper's introduction [1] and selected coaching manuals [11]), the behaviors' exact role for field vision is rarely addressed in research, practice, or media, and thus, it remains essentially unknown or hidden. Given the results of this study, where visual exploratory behaviors clearly are linked to performance in soccer – the largest and most popular sport in the world, it seems strange that they are so anonymous. The reason for this obscurity may be that these behaviors take place before the player is in possession of the ball. In this time interval, coaches and fans probably tend to either pay attention to the ball or to larger patterns and configurations of players off the ball, and they simply do not attend to behavioral characteristics of individual players off the ball. This can lead to statements such as "He played the pass without even looking", as the player may have looked so far in advance of him receiving the ball that observers failed to spot the looking behavior.

A limitation of this study is that it only examines the observable correlates of field vision in these players, and not what players actually see. Visual exploratory behaviors can never be a sufficient explanation for why some players have better field vision than others, given that these behaviors do not directly say anything about essential perceptual-cognitive processes such as cue detection, information extraction, pattern recognition, and anticipation (for a review of research on the role that these processes play in sport, see [2]). However, visual exploratory behaviors are likely to be a necessary foundation that will provide players access to information that they otherwise would not have. In this sense, researchers and coaches/players/fans should always assess these behaviors in players when making inferences about their vision, as it is impossible for players to see information that their eyes are not oriented towards. The results of this study support such a view.

There are many theoretical implications of the results from this study. However, given as this paper is not written for a psychology community, the reader should consult other references for more theoretical discussion [12]. What then are some of the practical implications of the findings in this paper?

First, it seems that these visual behaviors discriminate the better performers from less proficient performers, and thus, scouts may want to use these types of analyses when assessing prospective players for their teams. In short, scouts should look at what players do when the ball is not around, as the players' behavior in these time intervals can say something about how well attuned they are to the unfolding information in the game, and how well prepared they are to make good decisions when they ultimately get the ball. Doing this systematically would require that scouts direct a video camera in on a particular player that they are interested in, and follow the steps shown in the method section of this paper to conduct a proper analysis.

Second, players and coaches may obtain performance development benefits from deliberately practicing these behaviors. Soccer players should be encouraged, particularly in the period prior to receiving the ball, to engage in extensive visual exploratory behavior using body, head and eyes, and maintain exploring until the ball is received. We published a study a few years ago, demonstrating that these behaviors were highly trainable in professional soccer players, where only a few weeks practice gave immediate increases in exploratory behavior frequency and that this for some players also produced immediate gains in performance [13]. However, players also have to learn to flexibly adapt their exploratory behavior to each situation and learn the ideal points in time for implementing exploratory behavior. Close-up films of each player can be an effective tool to give feedback to players about their exploratory behavior patterns. Repeated filming and analyses during training periods, to systematically track changes in the players' levels of exploratory behavior, can be used by coaches to establish control of the training process and tailor training to each individual players' needs.

In conclusion, based on a relatively large data set involving 118 players and 1279 game situations from the best soccer league in the world (EPL), there seems to be a consistent positive relationship between visual exploratory behaviors engaged in before receiving the ball and performance with the ball. The more these players explore, the better they perform. Although more research is needed to replicate these findings and to reveal more of the nuances of this relationship – e.g., at what level can find this, under what conditions does it occur, with what type of players and so forth – it is interesting to speculate about what such results may mean for scouts, players and coaches. The findings can have major implications for both what scouts look for in players and for how coaches work to improve players' receiving and passing skills. Because these visual behaviors take place before players are in possession of the ball, the behaviors may, until now, have been somewhat off the radar for coaches and fans. Finally, players, coaches, and fans of other team ball sports, such as American football, basketball, ice hockey, and rugby, but also of certain individual sports, such as cycling, formula one car racing and short track speed skating, where athletes constantly have to perceive and act based on information from surrounding teammates, opponents and/or other moving objects, are recommended to address, analyze, and work with similar exploratory behaviors in their sports.

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