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Effects of game location and final outcome on game-related statistics in each zone of the pitch in professional football

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ORIGINAL ARTICLE

Effects of game location and final outcome on game-related statistics in each zone of the pitch in professional football

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Abstract

The aim of this large-scale study of elite professional football teams was to identify the independent and interactive effects of game location and final outcome on football game-related statistics according to the zone of the pitch in which they occurred. The sample consisted of 1900 games played over five seasons (from 2003–2004 to 2007–2008) of the Spanish Professional Football League. Factor analysis with principal components was applied to the game-related statistics recorded from the games, which limited the analysis to four factors (Factor 1: Turnovers in zone 5.2 and Crosses in zone 4; Factor 2: Goals and shots in zone 5.1, Turnovers in zone 4, and Ball recover in zone 2; Factor 3: Goals and shots in zone 5.2; and Factor 4: Turnovers in zone 5.1). Zone 2 was between the defensive semi-circle area and midfield circle, Zone 4 was between the midfield circle and offensive semi-circle area, Zone 5.1 was the offensive goal area, and Zone 5.2 was the offensive small area). A mixed linear model was applied to identify the effects of game location and final outcome on the previously identified factors. Game location and final outcome main effects were identified for all factors, with home and winning teams having better values. The interaction Location $\times$ Outcome was only significant for Factor 4 (Turnovers in zone 5.1). When playing at home, teams had higher frequencies for all analysed variables, probably resulting from home advantage factors such as facility familiarity and/or crowd. Additionally, winning teams' exhibited different and consistent profiles from drawing and losing teams, mainly discriminated by their ability to recover the ball in Zone 2 and to organize the offence using penetrative passes to Zones 5.2 and 5.1 to increase the number of shots and consequently goals. The trends identified may provide important information for modelling high-level performances.

Keywords: *Football, notational analysis, principal components analysis, mixed linear models*

Introduction

The last few years have seen a considerable increase in research focused on performance analysis of sports competitions (Carling, Williams, & Reilly, 2005; Sainz de Baranda, Ortega, & Palao, 2008). The assumption implicit in many of these studies is that the recorded data are relevant to performance and to the final outcome of competition. With these expectations, sports coaches should identify critical performance features to change future behaviours on the basis of information gathered from past performances.

Given that football is a team sport dominated by strategic factors, it is reasonable to suspect that contextual factors somehow influence teams' and players' decisions and consequent behaviours. In fact, previous research has suggested that several situational variables influence football performance at a behavioural level. For example, differences have been found in the frequencies of technical variables as a function of match location (i.e. playing at home or away), with better performances for home teams (Pollard, 2006; Pollard & Gómez, 2009), and match status, i.e. whether the team was winning, losing or drawing (Lago, 2009a; Lago & Martin, 2007; Lago-Peñas, Lago-Ballesteros, Dellal, & Gómez, 2010). Sasaki and colleagues (Sasaki, Nevill, & Reilly, 1999) recorded more goal attempts, shots blocked, shots on target, shots wide, successful crosses, and goal

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kicks during home matches than away matches. Similarly, Tucker and colleagues (Tucker, Mellalieu, James, & Taylor, 2005) observed a higher number of corners, crosses, dribbles, passes, and shots during home games.

The effects of situational variables on game-related statistics have also been addressed. Jones and colleagues (Jones, James, & Mellalieu, 2004) reported variations in ball possession durations according to score-line, with possessions being longest when teams were losing and shortest when winning. Similarly, Lago and Martin (2007) found variations in ball possession durations according to match location and the identities of the teams. However, Taylor and colleagues (Taylor, Mellalieu, James, & Shearer, 2008) showed that the outcomes of most behaviours were not influenced by situational variables. In the same context, Lago (2009a) found that playing at home or away was not characterized by an increase or decrease in the time spent in possession of the ball.

It has been suggested that some of the contradictory effects of the situational variables reported previously may be due to limitations of case studies designs: small sample sizes and univariate data analyses or match variables analysed independently, failing to account for the complex and dynamic nature of football performance (Lago, 2009a, 2009b; McGarry & Franks, 2003; Reed & O'Donoghue, 2005; Taylor et al., 2008). Therefore, further research is needed to improve designs and examine the effects of the situational variables on football performance.

Moreover, few studies have directly examined the effects of situational variables on technical and tactical performances as a function of the zones of play. In fact, tactical performance in football is highly dependent upon player positioning (Greghaine, Godbout, & Bouthier, 1997), thus it is likely that each specific match status or match location could have different effects on behaviour incidence and outcomes in each zone of the pitch (defensive, middle or attacking third). For example, Lago (2009b) found more playing time in the attacking zone of the pitch when playing at home. Moreover, when behind, ball possession was less in the defensive zone and more in the attacking zone, than it was when winning or drawing.

Consequently, the aim of this large-scale study of elite professional football teams was to identify the independent and interactive effects of game location and final outcome on football game-related statistics according to the zone of the pitch in which they occurred. On the basis of these findings, it is hoped that the information will increase tactical knowledge enabling the design and organization of specific drills in practice sessions and analysis of match performances. We hypothesized that playing tactics are influenced by the situational variables: home teams have better values in the analysed game indicators than visiting teams and that the final outcome alters the style of play of the teams during the game.

Methods

Sample and variables

The sample consisted of 1900 games played over five seasons (from 2003–2004 to 2007–2008) of the Spanish Professional Football League ($n = 360$ games per season). Data were obtained from a private company GECASPORT, which is dedicated to performance assessment of teams in the Spanish League (www.sdifutbol.com). The accuracy of the GECASPORT system has been previously verified (Lago-Peñas et al., 2010). Four games were randomly selected from each season and two different observations were made to assess inter-rater reliability. For all game-related statistics, Cohen's kappa was high (>0.95). The following game-related statistics were gathered according to the zone of the pitch (see Figure 1):

- *Goals*: scored when the ball completely crosses the goal line, when no rule has been broken, and when the referee awards a goal.
- *Shots*: all shots taken (shots on and off target) by an offensive player trying to score a goal.
- *Committed fouls*: illegal actions committed by a defensive player when trying to stop an offensive player.
- *Turnovers*: actions that lead offensive players to lose ball possession.

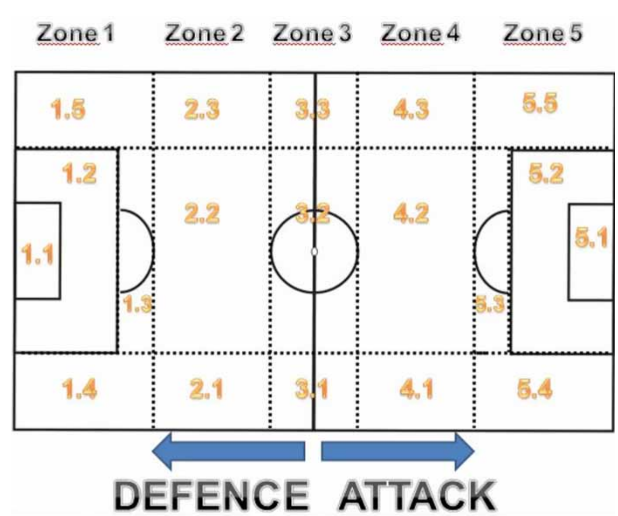

Figure 1. Field zones used in relation to playing tactics.

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- *Ball recovers*: when a defensive team steals the ball or intercepts a pass.
- *Crosses*: when offensive players flight the ball from one side of the pitch to in front of goal.

Dependent variables

A factor analysis using principal components and varimax rotation was performed on the game-related statistics to reduce the dimensions of the analysis. The Kaiser-Meyer-Olkin measure of sampling adequacy was adequate (0.65) and the anti-image correlation matrix revealed that all variables were above the acceptable level of 0.5. Analysis of the commonalities revealed values below an acceptable level of 0.5 (range 0.22–0.48). If the commonality for a variable is less than 50%, the factor solution contains less than half of the variance in the original variable, and thus the explanatory power of that variable might be better represented by the individual variable. The principal components model obtained accounted for 22.3% of the total variance. Four factors were extracted with eigenvalues above 1.5, and a criterion of |0.60| for identifying substantial loadings on factors was used. The extracted factor scores were saved as variables to be used in the data analysis (see Table I).

Game location (playing at home or away) and final outcome (win, draw or lose) were used as independent variables to compare the four factors described above.

Data analysis

A mixed linear model was applied to identify the main effects and interactions of game location (home, away) and final outcome (win, draw, lose) on the previously identified factors, as done previously (Sampaio, Drinkwater, & Leite, 2010). Effects sizes (ES) were calculated to show the magnitude of the effects and their interpretation was based on the following criteria: <0.20 = trivial, 0.20–0.59 = small, 0.60–1.19 = moderate, 1.20–2.0 = large, and >2.0 = very large (Hopkins, 2002). All analyses were performed using SPSS v.16.0 and statistical significance was set at $P < 0.05$.

Results

Figures 2 and 3 present the variation of the principal components analysis factors for winning, drawing and losing matches, for home and away conditions respectively. In almost all cases, winning teams exhibit better values in all factors than losing or drawing teams.

Table I. Factor loadings, eigenvalues, and variance explained using factor analysis (principal component methods)

	Factor			
Variable	1	2	3	4
Goals				
Zone 1-2-3	0.00	−0.01	−0.00	−0.03
Zone 4	−0.27	−0.02	−0.02	0.13
Zone 5.1	−0.03	**0.89**	0.00	−0.06
Zone 5.2	−0.17	−0.08	**0.79**	−0.15
Zone 5.3	−0.10	0.03	−0.02	−0.11
Zone 5.4	−0.06	0.01	−0.02	−0.03
Zone 5.5	0.01	−0.01	−0.03	−0.01
Shots				
Zone 1-2-3	−0.01	0.02	0.00	−0.02
Zone 4	0.24	−0.03	−0.08	−0.00
Zone 5.1	0.04	**0.88**	0.02	0.09
Zone 5.2	0.31	0.07	**0.73**	0.21
Zone 5.3	0.07	0.00	0.09	0.13
Zone 5.4	0.01	0.00	0.02	0.08
Zone 5.5	−0.03	0.02	0.02	0.03
Fouls				
Zone 1	0.15	−0.01	−0.09	0.41
Zone 2	−0.07	0.01	0.03	0.12
Zone 3	−0.11	0.02	0.02	0.04
Zone 4-5	−0.36	−0.02	−0.09	−0.01
Turnovers				
Zone 1-2-3	−0.41	−0.03	−0.14	−0.28
Zone 4	−0.21	**0.78**	−0.04	−0.07
Zone 5.1	0.00	0.01	0.03	**0.71**
Zone 5.2	**0.70**	−0.07	−0.03	−0.04
Zone 5.3	0.18	0.00	−0.04	0.01
Zone 5.4	−0.03	−0.07	−0.06	0.21
Zone 5.5	0.06	0.00	−0.08	0.01
Ball recover				
Zone 1	-0.20	−0.21	**−0.82**	0.33
Zone 2	0.12	**0.73**	−0.00	0.05
Zone 3	0.36	0.02	0.12	−0.14
Zone 4-5	0.33	0.04	0.16	−0.14
Crosses				
Zone 1-2-3	0.11	−0.04	−0.15	0.24
Zone 4	**0.63**	−0.01	−0.02	0.26
Zone 5.1	0.01	−0.01	−0.00	0.02
Zone 5.2	0.23	0.12	0.36	0.06
Zone 5.3	0.15	0.08	0.31	0.10
Zone 5.4	0.45	0.06	0.15	0.42
Zone 5.5	0.39	0.09	0.16	0.40
Eigenvalue	2.9	1.9	1.7	1.5
Variance	8.2	5.4	4.6	4.1

Game location main effects were identified for all variables, with a stronger effect size (ES = 0.11) for Factor 1, which consists of Turnovers in Zone 5.2 and Crosses in zone 4. Similarly, final outcome main effects were identified for all variables, with a stronger effect size for Factor 3, which consists of Goals and shots in Zone 5.2 (Table II). The home and the winning teams had better values in all the variables.

The interaction between game location and final outcome was statistically significant only for Factor 4, which mainly refers to Turnovers in Zone 5.1.

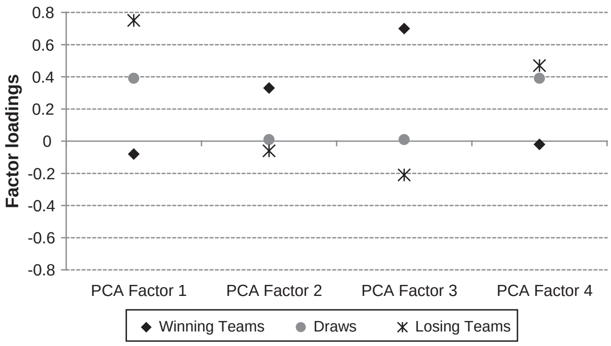

Figure 2. Variation of the principal components analysis factors in home matches (Win, $n = 880$; Draw, $n = 485$; Lose, $n = 535$). ◆, Winning teams; ●, Drawing teams; ★, Losing teams.

Discussion

The aim of this study was to identify the independent and interactive effects of game location and final outcome on football game-related statistics according to the zone of the pitch in which they occurred. It was reasoned that results could contribute to increase tactical knowledge both for the prescription of specific exercises within training sessions and for analysis of match performance.

Principal components analysis allowed us to reduce previously available variables to four main factors, although the uncorrelated nature of the original variables and difficulties in creating factors with a substantial amount of explained variance was evident (range 4.1–8.2%). It is likely that this is a reflection of football complexity, as can be seen by the number of possible interactions between all variables (McGarry & Franks, 2003; Reed & O'Donoghue, 2005). However, it also is evident that including pitch zone added tactical and situational information that was previously unavailable. Thus, identifying the performed technical action and corresponding pitch location (as some indirect tactical information) may allow important game determinants to be revealed.

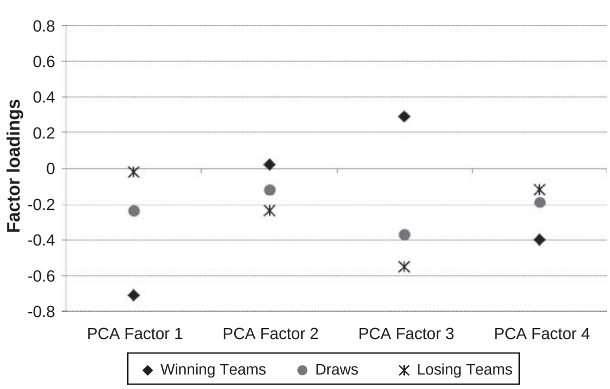

Figure 3. Variation of the principal components analysis factors in away matches (Win, n = 535; Draw, n = 485; Lose, n = 880). ◆, Winning teams; ●, Drawing teams; ★, Losing teams.

Table II. Results of the effects of game location and final outcome and their interaction on the previously identified factors (principal components analysis, PCA)

Variable	Effect	F	P	Effect size
PCA Factor 1 (Turnovers 5.2; Crosses 4)	Game location	513.78	0.00	0.11
	Final outcome	242.41	0.00	0.12 (DL; WL; WD)
	Game location × final outcome	2.65	0.71	—
PCA Factor 2 (Goals 5.1; Shoots 5.1;	Game location	39.13	0.00	0.01
Turnovers 4; Ball recover 2)	Final outcome	42.44	0.00	0.02 (DL; WL; WD)
	Game location × final outcome	2.73	0.65	—
PCA Factor 3 (Goals 5.2; Shots 5.2)	Game location	161.87	0.00	0.04
	Final outcome	363.75	0.00	0.16 (DL; WL; WD)
	Game location × final outcome	0.39	0.60	—
PCA Factor 4 (Turnovers 5.1)	Game location	266.34	0.00	0.06
	Final outcome	61.18	0.03	0.03 (WD)
	Game location × final outcome	5.79	0.01	0.01

Note: WD = statistically significant differences between win and draw games ($P \leq 0.05$); WL = statistically significant differences between win and lose games ($P \leq 0.05$); DL = statistically significant differences between draw and lose games ($P \leq 0.05$).

Results obtained through mixed lineal modelling allowed identification of several important trends regarding game location and final outcome effects and interactions. As suggested in the literature, home teams had higher values in all studied variables (Sasaki et al., 1999; Tucker et al., 2005), including those for which a higher frequency meant performing worse (e.g. turnovers). As some authors have noted, the home advantage effect is constant over the last years in the Spanish professional football league with values near to 60%, which may reflect a higher importance of rule changes (i.e. 3 points for a win) for the game tactics used by home and away teams (Pollard & Gómez, 2009; Sánchez, García-Calvo, Leo, Pollard, & Gómez, 2009). In this way, results may be explained by a stronger assertive attitude of home teams (Sampaio, Ibanez, Gomez, Lorenzo, & Ortega, 2008; Varca, 1980) suggested by an effect of match constraints, that is, home teams have increased knowledge regarding the environment (e.g., crowd, pitch area, pitch lightening) and may decide to play with more risky decisions, having the consequence of increasing the frequencies of the performed actions.

Results from final outcome effects are interesting and add new insights to available literature regarding this scope. It should be noted that football is a

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low-scoring team sport and this opens the possibility of the best performing teams losing games because, although they may be dominating all variables, they might be surprised by one winning "lucky shot" from the opponents. That is probably one of the reasons that available research was never able to explain final outcome using game-related statistics or other related variables. Figure 1 and Figure 2 show that results from all factors when winning were always better than results when drawing and these were always better than results when losing. Therefore, it is evident that using pitch zone to provide context to technical actions may help to discriminate between final outcomes in games. Another interesting trend regarding these results is that performance in drawn games is always closer to performance in losing than it is to performance in winning games. Therefore, this may be evidence that winning consistently (1900 games were analysed) is associated with a performance standard in these variables that is different from the performance when drawing and losing.

The final outcome effect was particularly noticeable in Factor 3, which consists of goals and shots in Zone 5.2. That winning teams had more shots and goals inside the six-yard box than drawing and losing teams should not be a surprising result. However, associating these results with all factors the profile of winning teams becomes more specific, that is, winning teams do not lose the ball in Zone 5.2, and consequently have more shots and goals. They also had fewer crosses to Zone 4, which means that the ball reached Zone 5.2, which may be explained by an increased use of long passes and penetrative passes that are more effective (Tenga, Holme, Ronglan, & Bahr, 2010). Other explanations include more side passes from sides (Zones 5.4 and 5.5). Additionally, they had more shots and goals and less turnovers in Zone 5.1 (goal area) and more turnovers in Zone 4 and ball recovering in Zone 2. Explanation regarding the turnovers results may be related to increased ball possessions times by winning teams (Lago, 2009a, b; Lago & Martin, 2007; Lago-Peñas et al., 2010), that is, having the ball more frequently will result in more actions and more turnovers, and these occurred in Zone 4. Regarding ball recovery, it is interesting that it was the only defensive-related variable able to have some discriminating effect, it is suggested that winning teams had their defensive pressure organized to promote recovering the ball in Zone 2.

From these results, it may be suggested that planning practice sessions should consider the way of which the offensive team obtains a good shooting position, and then exercises may emphasize focus on longer ball possessions that involve short passes sequences and penetrative passes to obtain a better position to shoot. Also, tactical exercises must be trained in offensive and defensive sequences that allow the players to recover the ball in defensive positions and prevent penetrative passes, and also to have better decision-making processes during the offensive play with more penetrative passes.

Conclusions

The present results provide some evidence that game-related statistics in a low-scoring team sport such as football may help in modelling high-level performances. When playing at home teams had higher frequencies in all analysed variables, probably resulting from home advantage factors such as facility familiarity and/or crowd. Additionally, winning teams exhibit different and consistent profiles from drawing and losing teams, mainly discriminated by their ability to recover the ball in Zone 2 and to organize the offence through long passing sequences (penetrative passes) to Zones 5.2 and 5.1 to increase the number of shots and consequently goals.

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