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THE INFLUENCE OF SITUATIONAL VARIABLES ON THE ATTACKING PROCESS IN FOOTBALL

VPLIV SITUACIJSKIH SPREMNLJIVK NA NAPADALNE PROCESE V NOGOMETU

ABSTRACT

The aim of this study was to identify the influence of situational variables i.e. match venue, opposition quality, match status, key player and interaction of situation variables on the attacking process. Full season match data (n=38) from Premier League Football Club Crystal Palace in 2017/2018 season were analysed. Crystal Palace created more midfield line breaks, zone 14, wide area, penalty box possession and less counter attacks when playing at home compared to away, when playing against bottom teams than middle teams, middle teams than top teams, when drawing than losing, wining than drawing and with key player than without him. These results suggested that different strategy changes, for different levels of situational variables, could have led to more goals being scored. This type of analysis could provide information for better match preparation, where coaches create match strategies for different external situations. However, sample size, pitch area and individual players' contributions will be necessary considerations for this methodology to provide practically useful information for applied practice. This approach helps close the theory-practice gap but also exemplifies why the gap exists and the difficulty in closing it fully.

Keywords: attacking process, situational variables, regression, football

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IZVLEČEK

Namen študije je bil identificirati vpliv situacijskih spremenljivk, tj. tekme doma in v gosteh, kakovost tekmecev, rezultatski status tekme, igranje ključnega igralca in interakcijo situacijskih spremenljivk s procesi v fazi napadanja. Podatki so bili pridobljeni v sezoni 2017/2018 (n=38) na tekmah ekipe Crystal Palace v angleški Premier League. Ekipa Crystal Palace je večkrat preigrala tekmece skozi srednjo linijo, skozi cono 14, igrala več v širino, imela več posesti žoge v tekmečevem kazenskem prostoru in izvedla manj protinapadov, ko je igrala doma v primerjavi z igro v gosteh. Te razlike so bile ugotovljene na tekmah proti slabšim ekipam v primerjavi s tekmami proti ekipam iz sredine lestvice ter na tekmah proti ekipam iz sredine lestvice v primerjavi s tekmami proti najboljšim ekipam, ko je ekipa igrala neodločeno v primerjavi s porazom, ko je ekipa zmagala v primerjavi z neodločenim rezultatom in ko je v ekipi igral najboljši napadalni igralec oziroma je ekipa igrala brez njega. Ti rezultati nakazujejo, da lahko ekipe s taktičnimi spremembami in ob upoštevanju situacijskih spremenljivk dosežejo ugodnejši rezultat. S tovrstnimi analizami trenerji pridobijo pomembne informacije, ki jih je smiselno upoštevati v pripravah na tekme. Pri tem je potrebno analizirati zadostno število tekem, opazovanim spremenljivkam določiti mesto dogodka na igrišču in ustrezno opredeliti doprinos vseh igralcev. S prikazanim metodološkim pristopom bo možno zmanjšati vrzel med teorijo in neposredno prakso, pri čemer je evidentno, da te vrzeli v popolnosti ni možno izničiti.

Ključne besede: taktika napadanja, situacijske spremenljivke, regresija, nogomet

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INTRODUCTION

In football, a better understanding of playing patterns would facilitate an improvement in a team's tactical performance (Tenga et al., 2015). Hewitt et al. (2016) suggested that identifying playing styles would enable coaches to have a clearer understanding of what teams need to do to win. However, the term "playing style" has, until recently, typically been differentiated into rudimentary measures such as 'build-up/possession' and 'direct/counter attack' plays or categorised playing patterns according to the number of passes (Reep & Benjamin, 1968; Bate, 1988; Hughes & Frank, 2005; Redwood-Brown, 2008) or duration of team possessions (James et al., 2002; Jones et al., 2004; Lago, 2009; Lago-Peñas & Dellal, 2010). Recently, factor analysis has been used to discern more complex playing styles by grouping performance variables perceived to be relevant (Fernandez-Navarro et al., 2016; Lago-Peñas et al., 2017; Gomez et al., 2018). For example, Fernandez-Navarro et al. (2016) used 19 variables, which extracted 6 factors to determine whether teams used 1) direct or possession play, 2) crosses, 3) wide or narrow possessions, 4) fast or slow progressions, 5) pressure on wide or central areas and 6) exerted low or high pressure. Thus, Barcelona FC was regarded as a possession play team because they had a high value for factor 1 which loaded on the number of sideward passes, forward passes, average direction of passes, ball possession percentage and passes from the defensive to the attacking third. Whilst this study, and others like it, identified different playing styles they did not distinguish the "how" different attacking procedures evolved (Kim et al., 2019b).

Kim et al. (2019b) established a framework for categorising the attacking process to differentiate team playing patterns, referring to the concept of an 'unstable situation', defined as a potential goal scoring opportunity in football (James et al., 2012). Kim et al. (2019a) defined and validated 5 different unstable situations from an analysis of all possessions in 18 English Premier League matches. Kim et al.'s (2019b) attacking process comprised three different situations, stable, advantage and unstable, which enabled the identification of the non-linear developmental attacking process through which teams created goal scoring opportunities. In this case study, Crystal Palace Football Club, frequently utilised wide areas (advantage) to progress their attacks, mostly resulting in unstable situations named penalty box possessions and successful crosses. However, this study did not measure all possessions e.g. stable possessions that did not progress to the advantage situation were not coded, and hence probabilistic information regarding the success and failure of different situations was not possible. Kim et al. (2019b) suggested that future studies should consider all relevant situational variables e.g. match status and opponent quality, as this would generate useful information for the applied world. This reiterates Mackenzie and Cushion's (2013) suggestion that football PA research had typically focused on trying to identify the relationship between performance indicators and match outcomes without providing sufficient context for the variables.

Several studies have identified the influence of situational variables on technical parameters e.g. teams created more shots, passes or longer possessions when playing at home compared to away (Gomez et al., 2012; Armatas & Pollard., 2014; Kim, 2021), playing against weak teams rather than strong teams (Taylor et al., 2008; Bradley et al., 2014; Liu et al., 2015; Kim & Choi, 2021) and when losing compared to drawing or winning (Lago-Peñas & Gomez-Lopez., 2014; Sgro et al., 2017; Redwood-Brown et al., 2019). So, whilst the influence of different situational variables has been shown for various performance parameters, the associated tactical changes which may have accounted for these differences have not. The question of what teams change e.g. playing style, to facilitate different performance outcomes remains unanswered. One situational variable, team quality, has been criticised (Carling et al., 2014) based on how it has been derived. Team quality has typically been calculated using the end of season ranking to split teams into two (Aquino et al., 2017; Mao et al., 2017; Mendez-Dominguez et al., 2019), three (Almeida et al., 2014; Liu et al., 2015; Sgro et al., 2017) or four (Lago-Peñas et al., 2011) levels. Carling et al. (2014) suggested this method could be considered arbitrary as teams could miss out on being classified as a strong team by just a few points, despite potentially having been in the top half of the table for the majority of the season. Another potential problem with this classification scheme is that end of season rank only reflects playing quality at the end of the season and does not account for within season fluctuations. This means that it may not be a very accurate quality measure at the time when a game was played, particularly for teams that have periods of relatively poor and good play and occupy different league positions during a season. Therefore, this study considered four different points per match measures for determining team quality (end of season points, previous season points, points gained during the season prior to match and points gained in the previous 5 matches).

The aim of this paper, therefore, was to 1) code all possessions, irrespective of outcome, to present probabilistic information of the attacking process, 2) examine the influence of relevant situational variables i.e. match venue, opposition quality, match status and key player appearance, and 3) consider the interaction of situational variables to identify whether a team changed their attacking strategy e.g. when losing without key player present. Each independent variable was operationally defined, using appropriate criteria developed from the limitations of some previous studies. The use of this rigorous methodology could, for example, allow players and coaches to collect pertinent information to identify an opponent's attacking patterns under different conditions. This would enable the planning of appropriate training sessions and game models for match preparation.

METHODS

Sample

Match data for all 38 Premier League fixtures of Crystal Palace Football Club in the 2017/2018 season were analysed. Ethical approval for this study was provided by the sports science sub-committee of Middlesex University's ethics committee in accordance with the 1964 Helsinki declaration.

Variables and procedure

Four independent variables were used to identify the influence of 1) Match Venue (MV): home or away, 2) Opposition Quality (OQ): top, middle or bottom, 3) Match Status (MS): winning, drawing or losing and 4) Key Player (KP): Wilfred Zaha played or not. The level of opposition quality (OQ) was calculated using four different points per match measures i.e. end of season points (divided by 38), previous season points (divided by 38), points gained during the season prior to match (divided by the number of matches already played) and points gained in previous 5 matches (divided by 5). The average of the four measures was then classified into top (≥1.7), middle (>1.1 and <1.7) and bottom (≤1.1) to try to overcome problems associated with only using end of season ranking (e.g. Taylor et al., 2008; Almeida et al., 2014; Bradley et al., 2014; Liu et al., 2015) as suggested by Carling et al. (2014).

Thirteen dependent variables were used. The initial two models assessed the ability of Crystal Palace to achieve advantage and unstable situations. Further models assessed the 11 individual advantage and unstable situations (Midfield Line Break (MLB), Zone 14 (Z14), Wide Area (WA), Counter Attack Chance (CAC), Free Kick (FK), Corner Kick (CK), Penalty Box Possession (PBP), Counter Attack (CA), Ratio of Attacking to Defending players (RAD), Successful Cross (SC) and Successful Shot (SS)) as defined by Kim et al. (2019b).

Statistical analysis

The number of minutes played per match under different levels of match status (winning, drawing or losing) and key player's appearance (Zaha played or did not play) varied. Hence, dependent variables were normalised relative to the average total match minutes (95.3 minutes) for the 38 matches played i.e. (*dependent variable/minutes played under condition) *95.3*. To avoid errors due to unusual patterns occurring in small samples all performances involving less than 15 minutes were excluded.

Mean and standard deviation values were calculated for each attacking situation. Analysis of variance was used to assess the match status and key player interaction for the frequency of 11 attacking situations (6 advantage and 5 unstable) with simple main effects calculated when these were significant. All data were analysed in IBM SPSS 25.0 and the level of significance set at $p<0.05$.

Due to skewed data Poisson log-linear regression analyses were used to identify the influence of situational variables on the frequency of advantage (the 6 different situations combined) and unstable (5 different situations combined) situations as well as the 11 attacking processes individually. Independent variables were changed to dummy variables where the criterion variable for match venue was home, opposition quality was middle team, match status was drawing and key player was Zaha playing.

The Poisson regression model explains the counting variable Y_i using explicative variables x_i, for $1 \leq i \leq n$. This p-dimensional variable x_i contains characteristics for the *i* th observation (Cameron & Trivedi, 2013).

The Poisson distribution was as follows:

$$\Pr(Y = y|\mu) = \frac{e^{-\mu}\mu^{y}}{y!} \quad (y = 0, 1, 2 \ldots)$$

Expectation of Poisson distribution is μ,

Variance = $\mu \cdot E(Y= y|\mu) = \mu$, $\mathrm{Var}(Y= y|\mu) = \mu$

The model of Poisson analysis was as follows:

$$\Pr(Y_i = y_i|\mu_i) = \frac{e^{-\mu_i}(\mu_i)^{y_i}}{y_i!}$$

$$\ln(E(y|\,\mu_i)) = \ln(\mu_i) = (B_1X_1 + B_2X_2 + \cdots + B_kX_k)$$

$$\mu_i = \exp(B_1X_1 + B_2X_2 + \cdots + B_kX_k)$$

If $b>0$, then $\exp(b)>1$, and the expected count $\mu = E(y)$ is $\exp(b)$ times larger than when $X=0$

If $b<0$, then $\exp(b)<1$, and the expected count $\mu = E(y)$ is $\exp(b)$ times smaller than when $X=0$

The likelihood ratio Chi-Square, log likelihood and deviance/df were checked to identify whether the residuals in the model were independent and to control for collinearity effects.

Reliability

Intra- and inter-observer reliability tests determined whether the stable, advantage (n=6) and unstable (n=5) situations were reliably categorised (James et al., 2007). The researcher (intra-, over four weeks after the first coding to nullify memory effects) and an independent experimenter (inter-, who was trained for each operational definition) re-coded three randomly selected matches. Stable situations had high Kappa values (K>0.9) for both intra- (n=256 comparisons) and inter-observer (n=283) tests. Similarly, advantage situations had high Kappa values for intra- (0.86, n=161) and inter-observer (0.81, n=164) tests. Discrepancies tended to arise when an experimenter missed an event, especially counter attack chances, for intra- (n=3) and midfield line breaks for inter-observer tests (n=3). Unstable situations also had high Kappa values for intra- (0.97, n=91) and inter-observer tests (0.87, n=94). A discrepancy occurred for distinguishing the ratio of attacking to depending players during the inter-observer tests (n=2).

RESULTS

Crystal Palace had an average of 114.8 possessions (SD=15.2) per match which resulted in an average 12.3 shots (SD=4.7; Figure 1). Thus, the attacking process involved, on average, 91.3 stable (SD=12.7), 54 advantage (SD=13.5) and 26 unstable (SD=8.9) situations. 25.8% of stable situations lead to advantage situations (M=23.6, SD=7.5) with 38.3% of all advantage situations becoming unstable situations (M=20.7, SD=6.4).

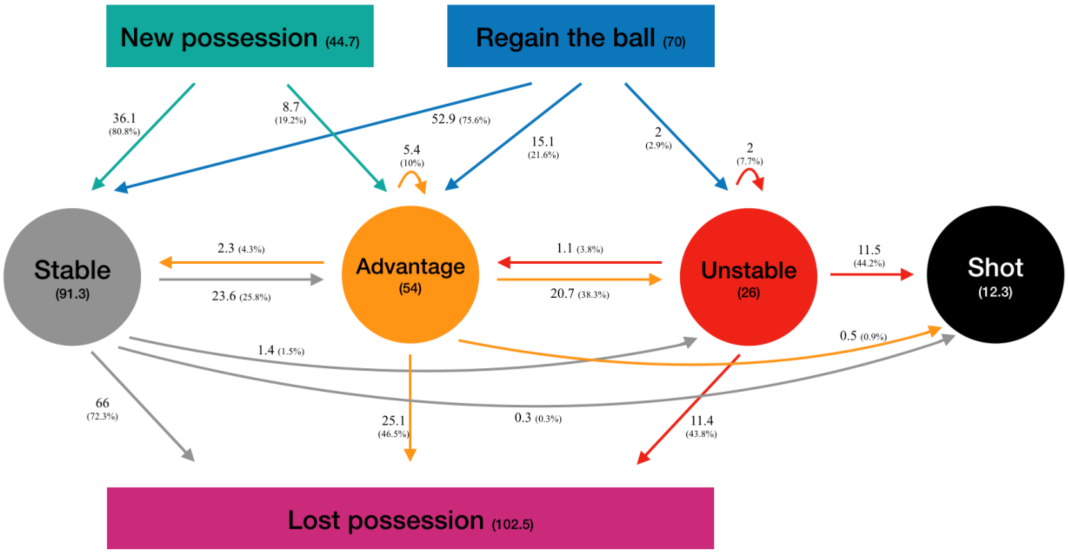

Figure 1. The attacking process for Crystal Palace FC during the 2017/2018 season

To assess whether the ability to create advantage and unstable situations were influenced by four independent variables (match venue, match status, opposition quality and key player involvement) Poisson log-linear regression models were run. These showed that Crystal Palace created significantly less advantage and unstable situations when playing against top teams compared to middle teams ($p<0.05$, Table 1), less advantage situations when winning than drawing and less unstable situations without their key player than when he played ($p<0.05$). Crystal Palace created non-significantly more advantage ($p=0.15$) and unstable ($p=0.53$) situations when playing at home compared to away.

Table 1. The influence of match venue, opposition quality, match status and key player on the total number of advantage and unstable situations.

	Advantage			Unstable		
	B	S.E	Exp(B)	B	S.E	Exp(B)
(intercept)	4.228	0.088	68.550	3.517	0.125	33.700
Match Venue	-0.116	0.080	0.891	-0.072	0.113	0.931
Opposition Quality						
vs Top	-0.317	0.102	**0.729****	-0.299	0.146	**0.742***
vs Bottom	-0.162	0.095	0.850	-0.145	0.134	0.865
Match Status						
Winning	-0.242	0.111	**0.785***	-0.196	0.154	0.822
Losing	0.136	0.090	1.146	0.122	0.130	1.130
Key Player	-0.173	0.104	0.841	-0.337	0.154	**0.714***
	χ^2=24.07, p<0.05 LL= -64.02, deviance/df=5.165			χ^2=14.078, p<0.05 LL= -59.233, deviance/df=5.167		

Notes: *p<.05, **p<.01 (reference value was home, vs middle, drawing and with key player i.e. Exp(B) was 1 in that case)

In order to better discriminate how Crystal Palace achieved the advantage and unstable situations further analysis of the 6 different advantage and 5 unstable situations were undertaken. Poisson log-linear regressions found that Crystal Palace created more midfield line breaks, zone 14 entries, wide area possessions in the final third, penalty box possessions and less counter attacks when playing at home compared to away (Table 2). This was also true when playing against bottom teams compared to middle teams, middle teams compared to top teams, when drawing compared to losing, wining compared to drawing and with key player as opposed to without him.

Table 2. The influence of match venue, opposition quality, match status and key player on all advantage and unstable situations (exp(B) value and standard errors into parenthesis).

		Advantage situations						Unstable situations				
		Midfield line break	Zone 14	Wide area	Counter attack chance	Free kick	Corner kick	Penalty box possession	Counter attack	Ratio of attacking to depending players	Successful cross	Successful shot
(Intercept)	e(B)	7.739	11.244	32.713	7.577	3.228	5.575	14.816	3.914	3.392	7.736	3.621
	(s.e)	(0.230)	(0.177)	(0.129)	(0.112)	(0.221)	(0.228)	(0.086)	(0.278)	(0.316)	(0.192)	(0.256)
Match Venue	e(B)	0.966	0.872	0.792	1.172	0.886	1.006	0.852	1.055	0.900	0.886	1.216
	(s.e)	(0.203)	(0.160)	(0.123)	(0.096)	(0.191)	(0.195)	(0.082)	(0.244)	(0.292)	(0.170)	(0.217)
Opposition Quality												
vs Top	e(B)	0.754	0.711	**0.619****	1.137	0.618	0.930	0.711	1.049	1.022	**0.641***	0.685
	(s.e)	(0.270)	(0.206)	**(0.154)**	(0.122)	(0.252)	(0.259)	(0.106)	(0.311)	(0.367)	**(0.216)**	(0.288)
vs Bottom	e(B)	1.003	0.884	**0.724***	0.892	0.962	1.124	0.814	0.927	0.854	0.855	1.087
	(s.e)	(0.241)	(0.189)	**(0.142)**	(0.122)	(0.221)	(0.240)	(0.096)	(0.299)	(0.357)	(0.198)	(0.258)
Match Status												
Winning	e(B)	0.966	0.623	0.747	1.032	1.406	**0.445***	0.769	1.366	0.745	0.812	0.588
	(s.e)	(0.263)	(0.244)	(0.171)	(0.117)	(0.243)	**(0.338)**	(0.11)	(0.282)	(0.383)	(0.250)	(0.340)
Losing	e(B)	1.003	1.344	1.245	**0.510****	1.499	1.442	1.028	0.696	0.810	**1.673****	1.171
	(s.e)	(0.246)	(0.174)	(0.136)	**(0.131)**	(0.221)	(0.207)	(0.096)	(0.332)	(0.356)	**(0.184)**	(0.239)
Key Player	e(B)	0.702	0.867	0.886	0.875	0.988	0.631	**0.499****	0.471	0.449	1.035	1.009
	(s.e)	(0.287)	(0.201)	(0.156)	(0.128)	(0.246)	(0.256)	**(0.125)**	(0.394)	(0.450)	(0.204)	(0.269)
χ^2		4.793	12.946	21.260	11.141	9.674	16.372	19.695	10.336	5.231	15.659	8.193
LL		-53.733	-62.283	-58.630	-57.705	-75.917	-59.594	-62.923	-52.610	-48.411	-65.004	-60.347
deviance/df		4.144	3.463	4.991	3/692	1.762	3.040	3.449	3.203	3.121	3.006	2.567

Notes: *p<.05, **p<.01 (reference value was home, vs middle, drawing and with key player)

Since match venue and opposition quality are fixed for any particular match tactical changes within matches would not be evident since data from each match were treated as a single piece of data. However, match status and key player involvement could change during matches and were hence treated as different data points when changes took place within a match. Thus, tactical changes during matches, potentially influencing these different game moments, were analysed using two-way (match status and key player involvement) ANOVAS for the 6 different advantage and 5 unstable situations.

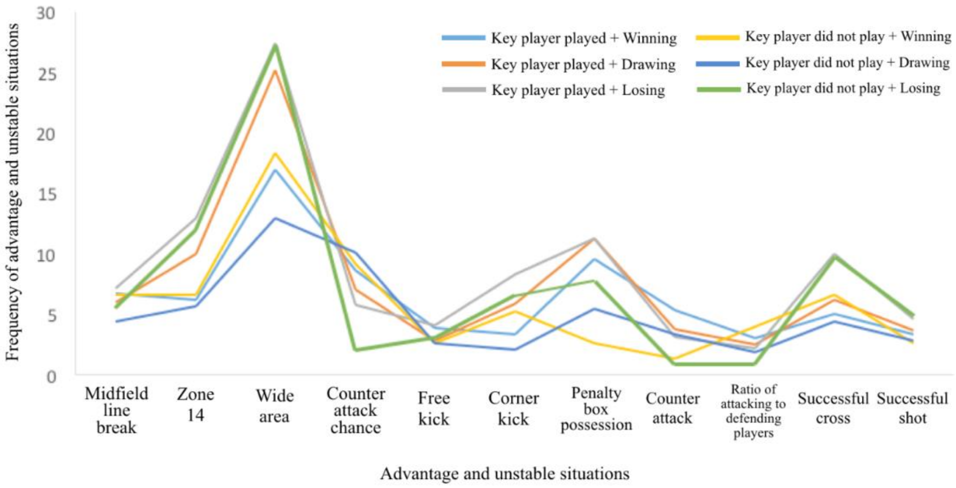

Figure 2. The frequency of advantage and unstable situations per match according to the match status/key player interaction.

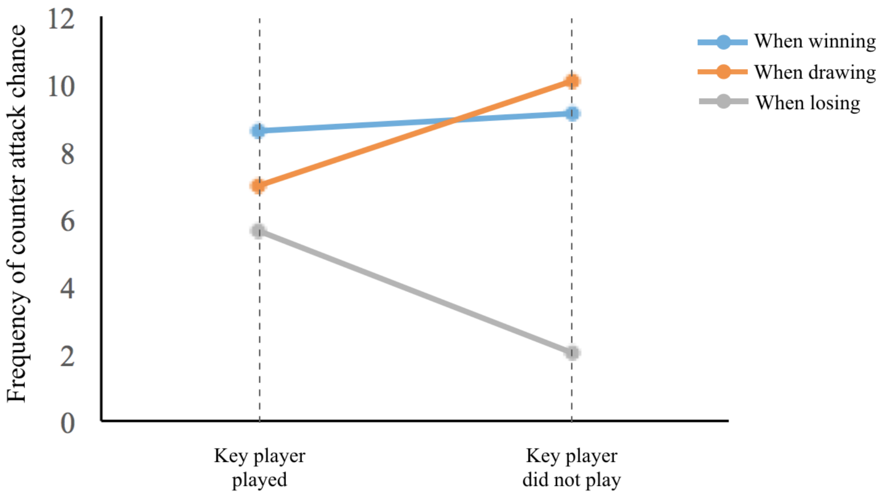

Figure 3. The frequency of counter attack chance according to the match status/key player interaction.

No significant interactions were found although for counter attack chances this was close to significance (F= 2.94, df= 2, 58, p=0.06; Figure 2). Simple main effects revealed that when the key player was absent counter attack chances were significantly different depending on the match status (F=7.03, df = 2, 63, p<.05; Figure 3).

All illustrations (photographs, sketches, schemata, diagrams, algorithms and other graphical material) should be provided in camera-ready form, suitable for reproduction. A chart, photograph or diagram are all to be referred to as "Figure" and should be numbered consecutively in the order in which they are referred to. Figures should always be cited in the text. Figure parts should be denoted with lowercase letters (a, b, c,...). A maximum of 6 figures (together with tables) should be included in a manuscript submission. They should accompany the manuscript and should be included in the text. All illustrations should be prepared by computer software and suitable for black- and-white printing. Each figure should be in good resolution (at least 300 dpi) and placed in the right position in the manuscript. All figures must have a caption. Each illustration should have a number and a title. Legends to illustrations should be given at the foot of the illustration. If illustrations contain symbols, arrows, numbers or letters, these should be explained in detail in the legend. Figures should be designed to fit a one-column (13.5 cm) or 1/2 column width (6.75 cm). Figures should not exceed the page length (19.5 cm).

DISCUSSION

Match analysis, from a coach’s perspective in the applied world, will invariably focus on the why and how events occurred (Lames & McGarry, 2007) rather than the simple statistics prevalent in the research literature, the so called theory-practice gap (Mackenzie & Cushion, 2013). Mackenzie and Cushion (2013) suggested PA research in football simply focused on key performance indicators rather than for developing a deeper understanding of performance e.g. the analysis of the “developmental processes”. This study attempted to identify the attacking process objectively to provide a framework for deriving relevant answers in the applied world.

In this study, an average of 26 unstable situations occurred for Crystal Palace per match, which was higher than the 19 found for the Coca-Cola League One team playing at home (12 for away teams) in James et al.’s (2012) study. Crystal Palace tended to create more advantage and unstable situations at particular levels of each situational variable, which was in line with previous studies. Hence, better performance at home compared to away was similarly found for frequency of possessions, shots and goals (Gomez et al., 2012; Armatas & Pollard., 2014; Kim, 2021), against bottom teams compared to middle (Taylor et al., 2008; Bradley et al., 2014; Liu et al., 2015; Kim & Choi, 2021) and losing compared to drawing (Lago-Peñas & Gomez-Lopez., 2014; Sgro et al., 2017; Redwood-Brown et al., 2019). Crystal Palace had more possessions in zone 14, the wide areas in the final third and penalty box possessions with less counter attack chances at home, when losing, against middle teams compared to top teams and with the key player playing. These findings suggest that strategy changes and/or opponent performance, during these moments of the match, have impacted performance outcomes. The results lend weight to the suggestion that analyses without recourse to relevant independent variables (Mackenzie & Cushion, 2013) are of limited applied value.

A detailed analysis of the match status and key player involvement interaction found that interactions were not significant although from an applied perspective important differences for performance outcomes were evident. For example, when the key player was missing the frequency of counter attack chances was very low when losing. This suggests the key player's involvement in this aspect of play was very influential and tactically changes need to be made during these moments in his absence.

Strengths and limitations

This model of the attacking process did not consider the duration of possessions either for the whole match, within each team possession or within each situation. This information could be useful in the applied world e.g. in which situations do a team attack quickly, but also could have facilitated the alignment of the attacking process described here with previous literature that described possession in terms of how quickly the ball was moved forward. From a statistical perspective, the fact that some situations occurred more frequently than others meant that sample sizes were relatively small in some cases and even not present e.g. there were no situations when Crystal Palace was winning away without the key player against a top team. To rectify this, future studies would need to use much larger sample sizes. However, this causes new problems. If a generic profile for a combination of teams was presented the validity of the results for individual teams would be low. If enough data for one team was analysed the validity of the older data (from previous seasons) for a current team would also be low. These are intractable problems in the academic world if practical solutions for the applied world are sought and identifies one of the problems associated with trying to close Mackenzie and Cushion's (2013) theory-practice gap. If enough data is used, for an analysis of this type to satisfy academic purposes, the answers are unlikely to be of value to the applied world. Alternatively, if data sets of relevance to the applied world are used, the likelihood is, they will be too small to satisfy academic rigour. The approach here has been to present an academically rigorous methodology using data of relevance to the applied world. Hence, the results presented here, are limited in the academic world because of low sample sizes and limited in the applied world because of the lack of detail regarding players and pitch areas. However, this approach does provide a robust and novel methodology which can be adapted for both academic and applied purposes in the future.

CONCLUSION

The influences of match venue, opposition quality, match status and key player involvement on the attacking process were presented. This determined how attacking performance changed during different match scenarios such as when losing, without the key player when away against a top team. This methodology will enable practically useful information for applied practice if further details such as player involvement and pitch area are included in the analysis. This approach helps close the theory-practice gap but also exemplifies why the gap exists and the difficulty in closing it fully. The academic rigour of the novel methodology can be used to inform practical problems but further developments should include the duration of possessions and retain the sequence of events to facilitate more detailed analyses.

Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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