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Corner kick performance indicators in elite football

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Abstract

The aim of this study was to analyze situational and behavioral factors associated with successful corner kicks, defined as kicks that ended in a shot, in elite soccer. Within the framework of a systematic observational methodology study, we analyzed 2029 corner kicks taken by first-division (La Liga Santander) and second-division professional teams during the 2016-2017 Spanish soccer league season. A total of 229 kicks were selected that met specific conditions and ended in goal for pattern detection. The Systematic Observational Methodology (OM) was used for its analysis and he execution and outcomes of these technical-tactical set pieces were analyzed using an *ad hoc* observation instrument (SOCOP-1) that contemplates key situational and behavioral factors and was loaded into LINCE PLUS freeware program. Descriptive statistics were calculated in STATA and complemented by temporal pattern (T-pattern) analysis in THEME 6.0. The most successful kicks were those taken by a right- (or left-footed) player from the right (or left) side of the pitch and delivered to the penalty box and those taken by a right- or left-footed player from the opposite side of the pitch and delivered to the near post. Situational factors that influenced corner kick efficacy were match location (home vs away), time of the match and score when the kick was taken, and ranking of the rival team. Corner kicks should be practised under game conditions prior to matches and to train integradamente with the physical condition before to the competition.

Keywords: soccer, observation, set pieces actions (SPA), set piece, corner kick, T-patterns.

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Introduction

Offensive actions in modern-day soccer can be characterized as dynamic (open play) (McGarry et al., 2002) or static, where the ball is returned to play after recovery of the ball or a stoppage (Duch et al., 2010; Maneiro et al., 2019). Set pieces, such as freekicks, throw-ins, and corner kicks, can have an impact on open play and score-lines (Wallace & Norton, 2014), and coaches are increasingly aware that their success is dependent on technical-tactical skills and physical fitness (Bush et al., 2015).

Numerous studies have examined the influence of situational and behavioral factors on performance in soccer (Carling et al., 2005; Casal et al., 2015b; Diznar et al., 2016; Kormelink & Seeverens, 1999; Maneiro, 2014; Maneiro et al., 2017; Pulling et al., 2015), and two of the most powerful indicators in this respect are goals/shots at goal and set pieces (Liu et al., 2013; 2015).

Corner kicks are important set pieces that have been analyzed both quantitatively (number of kicks awarded per match) and qualitatively (success/efficacy rates) (Ardá et al., 2014; Casal et al., 2015; Link et al., 2016; Pulling, 2015; Sainz de Baranda & López Riquelme, 2012; Silva, 2011). Considerable research has been done on behavioral factors associated with corner kicks, such as laterality of kick (Hill & Hughes, 2001), ball path and delivery area, offensive tactics such as feints and disguises (Ardá et al., 2012; Castelo, 2009), and defensive set-ups and goalkeeper position (Borras & Sainz de Baranda, 2005; Casal et al., 2015; Link et al., 2016 and Maneiro, 2014).

Situational factors have received less attention, and include home advantage (and its effects on player psychology and performance) (Carron et al., 2005; Pollard, 2006a), score-line (Bloomfield et al., 2005; Jones et al., 2004; Taylor et al., 2005), ranking or quality of the rival team (Fernández-Hermógenes et al., 2017), critical periods of play, such as the final minutes of the game when performance may be influenced by factors such as fatigue and lack of concentration (Carling et al., 2005; and Armatas et al., 2007), and tactical substitutions intended to cause disruption.

Corner kicks can have a decisive impact on the final score of matches between teams of a similar level, and some authors have stressed the importance of practising these kicks without defenders and when the players are fresh (Bonfanti & Pereni, 2002). More recently, however, there appears to be a growing tendency to work on technical-tactical aspects and physical preparation to recreate situations of physical and mental fatigue (Fernández-Hermógenes et al., 2017).

The aim of this study was to investigate the role of different situational and behavioral factors in corner kick success. A greater understanding of each of these factors and their impact on match outcomes will help coaches design strategies to improve corner kick performance in match situations.

Method

Materials

We performed a systematic observational methodology (OM) study in which we used a validated *ad hoc* instrument to systematically capture the spontaneous behavior of attacking players during the execution of corner kicks (Lozano et al., 2016; Lapresa et al., 2015). Observational methodology is a highly suitable approach for studying the dynamics of soccer (Camerino et al., 2012).

Observational design

We used a nomothetic/point/multidimensional design (N/P/M) (Anguera et al., 2011). It was nomothetic because we observed corner kicks taken by first- and second-division teams each considered a separate unit, point because each corner kick was taken at a specific time, and multidimensional because we analyzed various dimensions reflected in the multiple criteria comprising the observation instrument.

Participants

We selected a convenience sample of 20 first-division and 22 second-division teams from the 2016-2017 Spanish soccer league. Of the total 5843 corner kicks released this season and categories we observed 2029 corner kicks taken in 204 games; the kicks selected for analysis had to be succeeded and contain the following conditions: (a) defensive and offensive actions lasting at least 10 seconds, (b) five passes, or (c) a direct shot at goal.

SOCOP -1 observation instrument

To annotate the data, we used the *ad hoc* SOCOP-1 observation instrument (System for Observing Corner Kicks in Offensive Play), which was adapted from the SOFEO-1 instrument for observing strategic offensive play in soccer (Fernández-Hermógenes et al., 2017). The instrument was validated by a panel of 11 experts from the field of elite soccer, including coaches with a UEFA A license. The coding tool includes eleven criteria: 1) match location (LOC), 2) ranking of rival team (RANK), 3) match status (MS), 4) time of corner kick (T), 5) laterality of kick (LAT), 6) rival team defensive set-up (DEF), 7) ball delivery, 8) action area (AA), 9) path of ball (PATH), 10) corner kick outcome, and 11) type of shot (SHOT). The 11 criteria were expanded to create 42 exhaustive and mutually exclusive categories. These are shown in Table 1 together with their definitions. The 10-action area (AA) categories were classified according to where the kick was taken from (right or left corner).

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Coding instrument

The corner kicks were analyzed in LINCE PLUS (Soto et. al., 2019), a freely available software program that simultaneously shows the following information on screen: (a) the SOCOP-1 instrument (criteria and categories), (b) t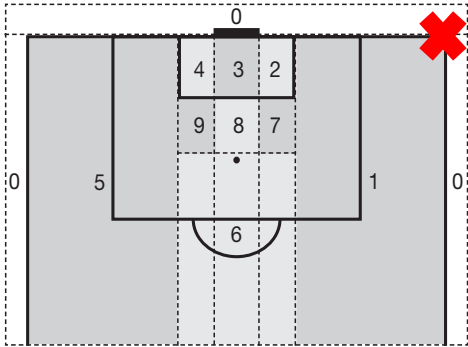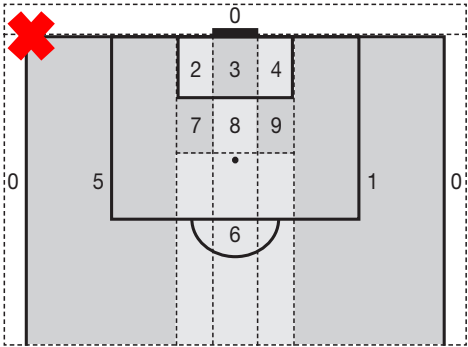he video frame being analyzed, and (c) the codes annotated by the observers (Figure 1). Each sequence analyzed started with a corner kick and ended with a goal or loss of possession/out of play. Actions after 10 seconds were not analyzed, as they were considered to form part of a different tactical strategy.

Table 1.
The SOCOP-1 observation instrument: criteria, categories, and definitions.

Criterion	Category	Description
Match location (LOC)	HOME	Home match for team being observed
	AWAY	Away match for team being observed
	HIGH	Top four at the end of the league
Ranking of rival team (RANK)	MID	Positions 5-7 at the end of the league
	MED	Positions 8-17 (first-division) or 8-19 (second-division) at the end of the league
	BOTT	Bottom three (first division) or four (second division) at the end of the league
	WIN	Observed team winning
Match status (MS)	TIE	Tie
	LOS	Observed team losing
	T15	Between minute 0' and 14'59"
	T40	Between minute 15' and 39'59"
Time of corner kick (T)	T45	Between minute 40' and end of the first half
	T60	Between minute 45' and 59'59"
	T80	Between minute 60' and 84'59"
	T90	Between minute 85' and end of the first half
Laterality of kick (LAK)	NATU	Natural. Right-footed player takes kick from right corner or left-footed player takes kick from left corner
	SWIT	Switched. Right-footed player takes kick from left corner or left-footed player takes kick from right corner
Rival team defensive set-up (DEF)	MAN	Man-to-man: each defender is responsible for one attacker
	ZONE	Zone: each defender is responsible for an area of the pitch
	MIX	Mixed: each defender is responsible for an area of the pitch and/or a player
Interaction context (IC)	INF1	Offensive numerical inferiority (1 player)
	INF2	Offensive numerical inferiority (≥ 2 players)
	IGU	Numerical equality (same number of attackers and defenders)

Table 1. *(Continuation)*
The SOCOP-1 observation instrument: criteria, categories, and definitions.

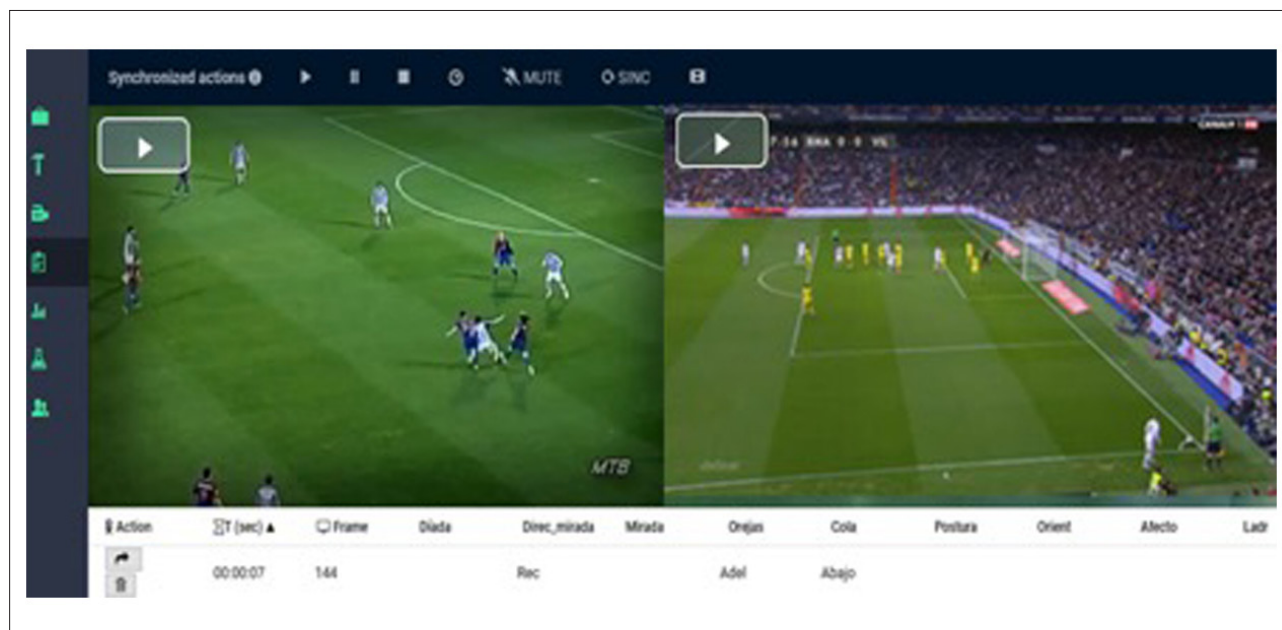| Criterion	Category	Description
Delivery of kick (DoK)	DIR	Direct: ball delivered directly to penalty area.
	IND	Indirect: ball delivered using a short pass
	AA0	Goal line or side line
	AA1	
	AA2	
Action area (AA)	AA3	
	AA4	
	AA5	
	AA6	
	AA7	
	AA8	Goal line between the posts up to height of penalty spot
	AA9	
Path of ball (PATH)	OUT	Out-swinging
	IN	In-swinging
	OTH	Other: long pass along the ground or straight path
Final action (SHOT)	NACT	No shot
	ACT	Shot
	GOAL	Kick ends in a goal
	NGW	Kick ends in a shot wide of the posts
Corner kick outcome	NGP	Kick ends in a shot between the posts but not a goal
	NGD	Kick does not end in goal and there is no chance of a goal being scored because the goalkeeper blocks the ball, the defense clears the ball from the area, a foul is committed, or the observed team takes the corner kick to maintain possession of the ball
	KICK	Kick
Ending (END)	HEAD	Header
	OTH	Other part of the body permitted by the rules

Figure 1.
Screenshot of LINCE PLUS software program at a given observation moment.

Procedure

Once the selected matches had been downloaded from the international football agency platform *Promoesport*, the observation instrument was validated by an expert panel formed by 11 highly experienced coaches. The observers responsible for coding the data were trained and the reliability of the training sets was checked by calculating Cohen's kappa statistic (Cohen, 1960) for intra- and interobserver agreement in LINCE PLUS (Soto et al., 2019). The resulting kappa statistics for all categories annotated were .95 for intraobserver agreement and .79 for interobserver agreement. The observers then analyzed and coded the full sample. The resulting codes were exported into Microsoft Excel (.xls format), for previous descriptive and into THEME (.txt format) for T-pattern analysis to search for significant patterns hidden in the data.

Statistical and T-pattern analyses

Both behavioral and situational factors were analyzed by descriptive/inferential and T-pattern analyses. The descriptive/inferential analyses of the different study behaviors were performed in Stata/IC v. 15.1 (StataCorp, College Station, TX, USA), while the T-pattern analysis was performed in THEME v.6. (Magnusson, 2000). THEME is a software package featuring algorithms that process the enormous range of combinatorial patterns underlying behaviors; it compares all behavioral patterns and retains only the most complete ones. To guarantee that any T-patterns detected were not due to random events, the following settings were used: (a) presence of a given T-pattern in at least 25% of sequences,

(b) significance level of .005, and (c) redundancy reduction setting of 90% for occurrences of similar T-patterns.

Results

Univariate descriptive analysis

The absolute (*n*) and relative (%) frequencies of the categorical variables (grouped by criteria) analyzed for the 2029 corner kicks are shown in Table 2.

The results of the distribution of the 2029 corner kicks they demonstrate that more likely to be taken towards the end of the second half (minute 60-85) by a team with a home advantage or playing against a rival in the middle of the league. Defenders always outnumbered attackers and a mixed defense (combination of man-to-man and zone) was more common. Overall, 47.3% of in-swinging or out-swinging corners delivered directly to the penalty area were taken using the same foot as the side of the pitch (e.g., right-footed kick from right corner), while 52.7% were taken using a switched foot (e.g., right-footed kick from left corner). While the direct delivery of the ball to the penalty area limited the number of intervention zones, 70.9% of kicks (n = 1439) did not result in a shot at goal.

T-pattern analysis

Based on the initial results of the descriptive analysis, we conducted a T-pattern analysis of the 229 corner kicks that

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Table 2.
Descriptive analysis (absolute and relative frequencies).

Variable (code)	Category (code)	*n*	%
Match location (LOC)	Away	901	44.4
	Home	1128	55.6
Ranking of rival team (RANK)	Bottom	443	21.8
	Middle	1054	52.0
	High or top	532	26.2
Match status (MS)	Losing	625	30.8
	Tie	1001	49.3
	Winning	403	19.9
Time of corner kick (T)	Minute 0-15	307	15.1
	Minute 15-40	505	24.9
	Minute 40-45	134	6.6
	Minute 45-60	359	17.7
	Minute 60-85	522	25.7
	Minute 85-90	202	10.0
Laterality of kick (LAK)	Switched foot (0)	1070	52.7
	Natural foot (1)	959	47.3
Rival team defensive set-up (DEF)	Zone	200	9.9
	Man-to-man or mixed	1829	90.1
Interaction context (IC)	Team being observed outnumbered by two or more players	1941	95.7
	Team being observed outnumbered by one or the same number of players	88	4.3
Delivery of kick (DoK)	Indirect	320	15.8
	Direct	1709	84.2
Final action (SHOT)	No shot	1439	70.9
	Shot	590	29.1

Note: N = 2029 corner kicks in total; *n* = number of corner kicks in each category; CI, confidence interval (calculated using the Wilson method); π = proportion of sample converted to percentage; LL = lower limit; UL, upper limit.

they finished in goal, prioritizing the most relevant situational criteria in the SOCOP-1 observation instrument: match location (LOC), match status (MS), time of corner kick (T), and ranking of rival team (RANK).

This analysis detected significant behavioral patterns exhibited by attackers and defenders during the corner kick sequences analyzed. These behaviors are graphically represented in tree diagrams known as dendograms, shown in:

Figures 2 match location (play at home, home groud), Figure 3 match status (tie), Figure 4 time of corner kick (between 15´-40´), and Figure 5 ranking of rival team (middle level). These diagrams show the chronological succession of the most significant offensive and defensive events for each team organized by groups of associated concurrent or sequential categories (patterns) that occur in a chronological sequence within a critical interval (time window) (Jonsson et al., 2006).

Match location

1. Corner kick taken by a player at this **home ground** using the **same foot as the side of pitch** from which the corner is taken and with a **mixed defensive set-up**.

2. **Out-swinging** kick delivered to zone 8 as the attacking players enter.

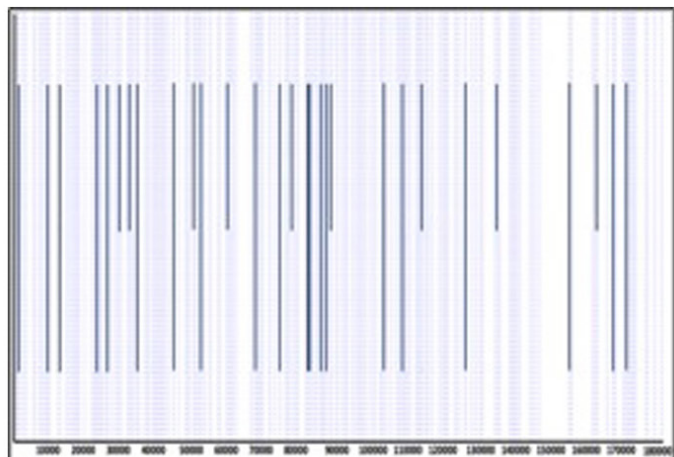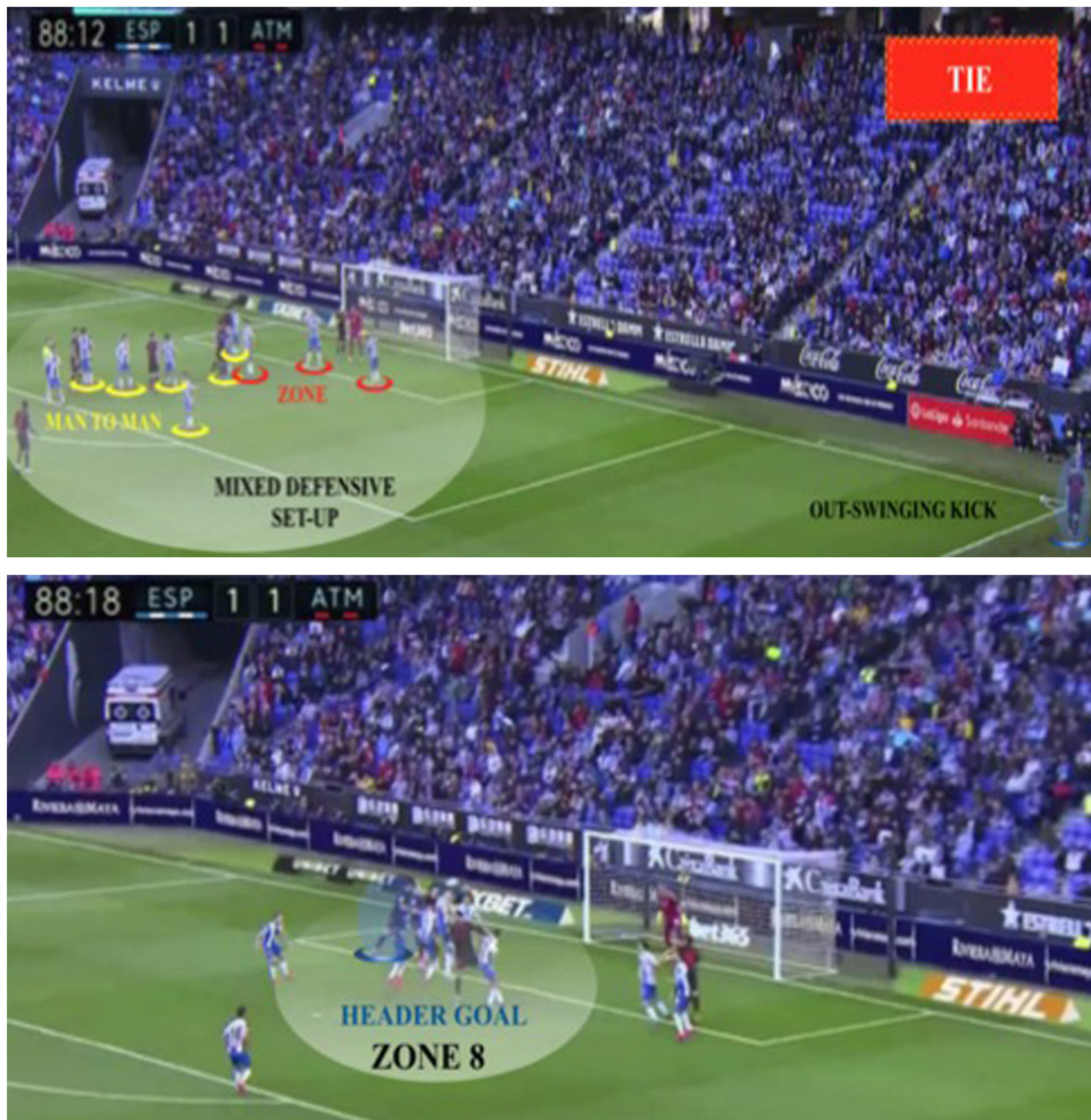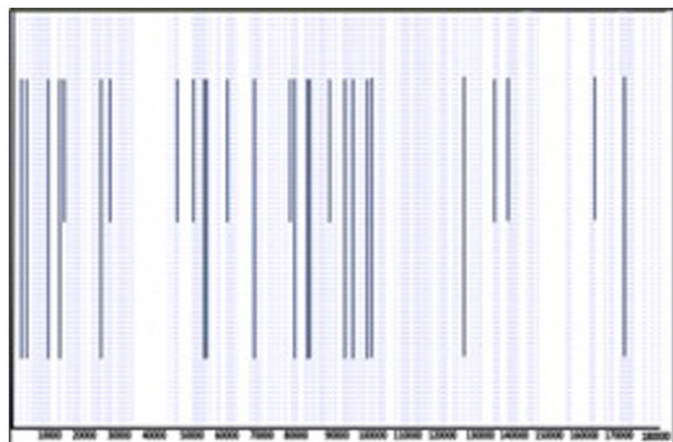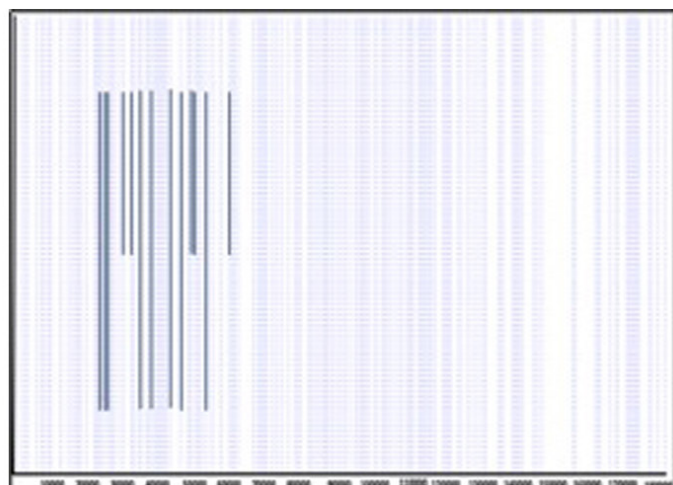3. The action ends with a **header** that results in a **GOAL**.

Figure 2.
Representation of the first T-Pattern found to occur in match location criteria.

Match status

1. Corner kick taken when the teams are **tied** by a player using the **same foot as the side of pitch** from which the corner is taken and with a **mixed defensive set-up**.

2. **Out-swinging** kick delivered to zone 8 as the attacking players enter.

3. The action ends with a **header** that results in a **GOAL**.

Figure 3.
Representation of the first T-Pattern found to occur in match status criteria.

Time of match

1. Corner kick taken between minutes 15 and 40 by a player using the **same foot as the side of pitch** from which the corner is taken and with a **mixed defensive set-up**.

2. **Out-swinging** kick delivered to zone 8 as the attacking players enter.

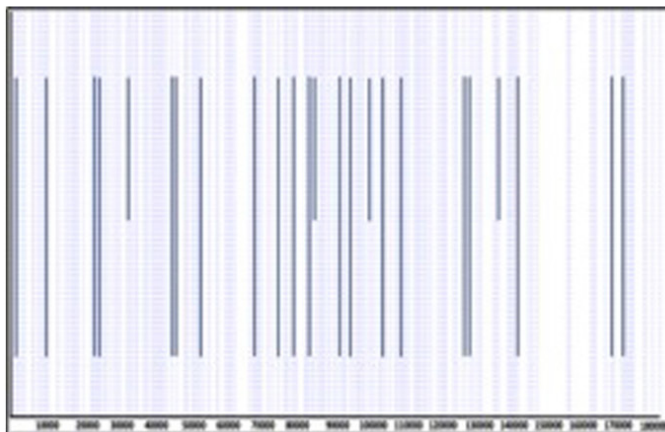3. The action ends with a **header** that results in a **GOAL**.

Figure 4.
Representation of the first T-Pattern found to occur in time of match criteria.

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Figure 5.
Representation of the first T-Pattern found to occur in ranking of rival team criteria.

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Discusión

Our analysis of corner kick performance supports previous findings showing that various behavioral and situational factors have a decisive effect on match outcome (Alonso, 2001; Fernández-Hermógenes et al., 2017; Teixeira, et al., 2015). Just 29.1% of the kicks analyzed resulted in a shot, again supporting previous findings (Casal et al., 2016; Jiménez et al., 2016; Maneiro et al., 2016; Silva, 2011) and highlighting the low efficacy of this set piece. Even lower rates, have been reported by Borrás et al. (2005) (21.8%), Sainz de Baranda et al. (2012) (23.77%), and Sánchez-Flores et al. (2012) (17.2%).

A total of 2029 corner kicks were taken by first- and second-division teams in the 2016-2017 Spanish league (943 and 1086 kicks, respectively). This corresponds to a mean of 10.04 kicks per match (9.92 in the first division and 10.25 in the second), which is consistent with the mean figures ranging from 9 to 11 reported by Acar et al. 2009; Ardá et al. 2014; Casal et al., 2015b; Maneiro et al., 2016; Maneiro, 2014; Pulling et al., 2013; Sainz de Baranda et al., 2012; Sánchez-Flores et al., 2012; and Silva, 2011), higher than the figures of 7.88 and 6.2 reported by Jiménez et al. (2016) and Yamanaka et al. (1997) respectively, and lower than the figure of 13 reported by Castelo (1999).

The results of our T-pattern analysis show that teams with a home advantage took more corner kicks than visiting teams (Fig 2), supporting the results of the descriptive analyses (1128 kicks taken by teams playing at home versus 901 by those playing away). These results coincide with those obtained in our descriptive analysis that teams with a home advantage took more corner kicks, although Ardá et al. (2014) reported the opposite.

The number of corner kicks taken also varied according to match status (Fig 3) (score at the time of the kick). Our results support previous findings showing that goals resulting from set pieces are decisive for leveling the score (Lago, et al., 2009). As reported by Maneiro (2014) and Maneiro et al. (2016), corner kicks appear to be more successful when taken by a team that is losing or tied. Fernández-Hermógenes et al. (2017), in turn, found that goals resulting from set pieces helped first-division teams increase their lead and second-division teams to equalize or take the lead.

The T-patterns detected in relation to the moment of the match (Fig. 4) when the corner kicks were taken contrast with the findings of our descriptive analysis. According to the T-pattern analysis, corner kicks resulting in a shot were more common in the middle of the first and second halves, whereas the descriptive analysis showed that they were more common at the end of each half, supporting reports by Carling et al. (2005) and Armatas et al. (2007). This difference can be explained by the fact that T-pattern analysis does not focus on a single criterion (in this case, time of kick), but searches for associations between success rates according to a range of criteria, such as kick laterality, ball path, and delivery area.

Few studies have analyzed the influence of rival team ranking on corner kick efficacy. Our T-pattern analysis showed than kicks were more successful when taken by teams playing against teams that finished in the middle or bottom of the league. Fernández-Hermógenes et al. (2017), in turn, found differences between first- and second-division teams, with the latter taking fewer kicks but scoring more as a result. Our results show the contrary: first-division teams took fewer corner kicks but scored more goals.

Conclusions

Our descriptive analysis of factors associated with corner kick efficacy in first- and second-division soccer in Spain shows low success rates. Success was influenced by situational factors (home vs visiting team, ranking, score, time of match), but the influence may be relative as certain categories are larger than others (e.g., there are more teams in the middle of the league than at the bottom). However, if we analyze the situations in greater detail, they all involve factors indirectly related to concentration and physical and mental fatigue.

T-pattern analyses of social interactions are lacking in soccer, but are necessary to uncover recurring patterns that are not visible to the naked eye. The similarities observed between our descriptive analysis of situational variables and the T-patterns detected highlight the potential of this methodology.

The T-pattern analysis showed that the most common corner kick ending in a shot is an out-swinging kick taken using the same foot as the side of the pitch in which the ball is directly delivered to the penalty area and ends in a header. In-swinging corners taken using a switched foot and delivered to the near post and ending in a header were also common. These findings show the potential of T-pattern analysis and provide important information that could be used by both players and coaches to work on improving corner kick performance.

Analysis of situational factors showed that corner kicks were most effective when taken during the middle of the first or second half by a team with a home advantage that was losing or tied and playing against a team ranked in the middle or at the bottom of the league.

One particularly attractive aspect of T-pattern analysis is that despite its complexity it produces very useful visual information, such as tree patterns, histograms, time plots, and tables of concurrent behaviors (in our case with corner kick efficacy as a reference). Time plots could be especially useful for coaches, who could appoint someone to analyze

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corner kicks (or other set pieces) during matches and monitor these weekly according to different situational factors, such as the league ranking of the rival team and match location. Over time, this information could provide important insights into how to improve corner kick.

Funding

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