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Ball recovery patterns as a performance indicator in elite soccer

Daniel Barreira^{1,2}, Júlio Garganta^{1,2}, Pedro Guimarães¹, João Machado¹
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Abstract

In soccer, it seems relevant to understand the relationship between the ball recovering and the subsequent success or failure of attacking play. However, few studies have considered the links between the type of ball recovery in different pitch zones, the competition stages and the overall teams success. The present study aims to analyze the attacks ($n = 1619$) carried out by the semi-finalist teams in the 2010 FIFA World Cup in order to explore ball recovery patterns as a performance indicator. SoccerEye observational instrument, SoccerEye recording software, Sequential Data Interchange Standard-Generalized Sequential Querier (SDIS-GSEQ) and SPSS analytic software—one-way analysis of variance, two-way analysis of variance and regressions—were applied. Direct ball recovery, in specific by interception and defensive behavior followed by a pass, was the mostly frequent behavior, with the later inducing attacking play efficacy ($p < 0.017$). Differences were detected between the group and play-off stages with regard to the types of direct ball recoveries. The ball was most often regained in defensive and mid-defensive central zones, evidencing differences to all other pitch zones ($p \leq 0.001$). Throw-ins were the only type of ball recovery that differentiated the semi-finalists, namely Germany and Spain ($p < 0.009$). It was found that recovering directly the ball possession in mid-defensive central zones increases attacking efficacy. Consequently, coaches should consider this tactical determinant in order to organize the training process. Specifically, it is fundamental to improve the collective defensive organization protecting central strip zones and simultaneously performing high-pitched pressure to constrain the ball carrier.

Keywords

Match analysis, tactical determinants, competition stage, team patterns, FIFA World Cup, SoccerEye software

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Introduction

The overall tactics of soccer entail a permanent interrelationship between the patterns of attacking and defensive play. The variability in these patterns of play arises from the ways as the players (and teams) manage the constraints that emerge from their cooperation/opposition behavior, and with situational variables such as match status,^{1,2} game location,³ quality and identity of the opposing teams,⁴ pitch size⁵ and competition stage.⁶

Notational research concerning elite soccer competitions has mostly focused in the attacking play:⁷ on the one hand, with the measurement of scoring indicators such as goals,⁸ efficacy of shots⁹ and the ratios of winners to errors and goals to shots,³ and on the other hand, with the analysis of performance indicators such as the type⁹ and number of passes,¹⁰ ball possessions¹¹ and entries in the penalty area.² Accordingly, the majority of published research has mostly studied the determinants of ball possession and their relationship

to attack efficacy whether in single matches, tournaments, seasons or groups of seasons¹² or even in a single move in one match.¹³

The success of attacking play among elite soccer teams also depends on ball recovery patterns, that is, on the types of ball recovery and the zones where it occurs.¹⁴ Thus, considering ball recovery as the purpose of the defensive phase and the first phase of attack¹⁵ is

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fundamental. In this regard, the influence of ball recovery patterns, considered as a performance indicator selection or combination of action variables that aims to define some or all features of performance⁷ and predicts success,⁶ needs to be understood so as to be able to implement adequate training regimes and to obtain objective feedback.¹⁶ Moreover, it is important to scrutinize ball recovery patterns according to the team and competition stages, as well as the influence that the way the ball is regained has on the final attacking events, that is, considering the patterns of ball recovery as a performance indicator that possibly predicts the attacking success on elite soccer.

Indeed, research on ball recovery patterns has been applied to a lesser extent. Specifically, the influence of the zone in which the ball is recovered and its relationship to attack efficacy has been determined.^{17–19} Research in World Cups between 1982 and 1990 and in European clubs and national teams showed that the ball was mainly recovered in the central strip of the pitch due to the higher concentration of players in this zone. However, in World Cups between 1982 and 1990, ball recoveries mostly occurred in the defensive sector,²⁰ whereas in European clubs and national teams, the midfield sector was the predominant zone of ball recovery.²¹ In the 1996 Euro Cup, it was observed that most of the goals scored resulted from ball recoveries in the offensive sector,²² which confirmed that attacking success is associated with fast and frequent recovery of the ball,²³ in other words, in zones in which attack efficacy is greater.²⁰ By contrast, an analysis of the 2002 World Cup concluded that goals in open play occurred due to ball recoveries in the mid-defensive sector,²⁴ which suggests that attack efficacy probably appears when the attack starts at some distance from the opponent's goal. In the 1994 World Cup, it was found that different playing styles were related to different patterns of ball recovery, with a fast defence/attack transition yielding benefits to attack efficiency.²⁵ Hence, the attacking game-pattern configuration is a consequence of ball recovery patterns.²⁵

We noted, however, a lack of research considering the ball recovery patterns according to the level of team feat and the stage of the competition, while taking into account the number of attacks performed and the relationships between the type of ball recovery, the respective pitch zone(s), and with the final attacking event.

In light of this, the following tools were used: updated version of SoccerEye observational instrument,^{26,27} SoccerEye recording software (v3.0, October 2012); and SDIS-GSEQ v5.1²⁸ and IBM SPSS v19.0 statistical analysis software to analyze the 1619 attacks recorded from the group and play-off (PO) stage matches played by the semi-finalists in the 2010 FIFA World Cup.

In summary, the aims of this study are (a) to characterize the attacks performed and to look into differences according to competition stage, observed teams and each type of ball recovery; (b) to characterize ball

recovery patterns in relation to pitch zones, competition stage and observed team; and (c) to investigate the relationship between the ball recovery patterns and finishing attacking events.

Method

Design

The flexibility and rigor of observational methodology make it fully consistent with the characteristics of the study.²⁹ The observational design, in accordance with the specific taxonomy,³⁰ was nomothetic (four teams), followed-up (continuous recording across matches, with independent observation of each of the two opposing teams) and multidimensional (three criteria included in the observational instrument). This approach allowed us to identify attacks in the observed matches.

Sample

We recorded 1619 attacks from public TV broadcasts during 24 matches (six per semi-finalist team) played by Germany, The Netherlands, Spain and Uruguay—the 2010 FIFA World Cup semi-finalists—also considered as successful teams.³¹ The 16-round stage was not attended. Matches were observed for the regular period (i.e. 90 min, excluding extra time). The attacks in which players left the camera's recording field or in which a team had 10 or fewer players on the pitch were excluded from the analysis.

Instruments

Observational instrument. An updated version of the SoccerEye observational instrument^{26,27} was used in this study and has been used in recent research.^{32,33} This tool follows an updated version of the Organizational Model of Soccer^{26,27} (Figure 1).

The present study focused exclusively on the offensive phase, in particular in the two corresponding types of ball recovering: (a) direct, that is, game flow was preserved, with no interruption, and a player performed at least three consecutive ball touches, a positive pass, a shot at the opponent's goal³⁴ or the goalkeeper controlled the ball³⁵ and (b) indirect, that is, game flow was broken up due to an opponent's violation of the laws of the game or because the ball leaves the pitch. Moreover, the final attacking events and the patterns of pitch space position were considered (Table 1).

Recording instrument. The SoccerEye recording software (v3.0, October 2012) (Figure 2), written in Visual Basic Express 2010, is a soccer-specific tool that was designed to be used with the SoccerEye observational instrument.^{32,33} This tool makes possible to observe and record the occurrence of perceivable behaviors in natural context and data exporting in multiple formats that suits sequential data analysis with SDIS-GSEQ

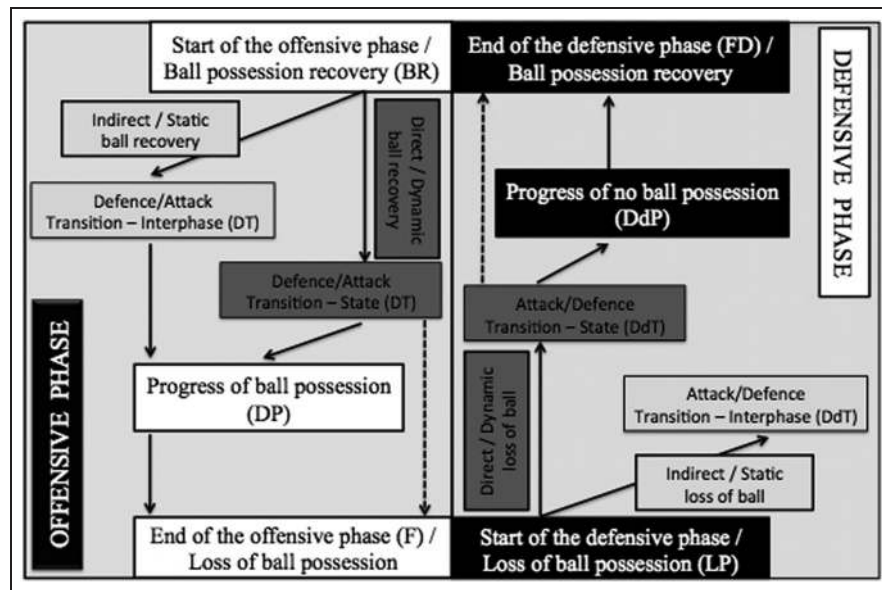


Figure 1. Updated version of the organizational model of soccer.^{26,27}

Table 1. Adapted version of SoccerEye observational instrument.^{32,33}

Criterion		Categories	Description
Start of the offensive phase/ball possession recovery (BR)	Direct ball recovery	BRi	Ball recovery by interception
		BRt	Ball recovery by tackle
		BRgk	Ball recovery by intervention of the goalkeeper in the defensive phase
	Indirect ball recovery	BRp	Ball recovery by a defensive behavior followed by a pass
		BRst	Start/restart of the offensive phase
		BRv	Ball recovery by opponent's violation of the laws of the game
		BRc	Ball recovery by corner kick
		BRgki	Ball recovery by goal kick
		BRdb	Ball recovery by dropped ball
		BRti	Ball recovery by throw-in
End of the offensive phase (F)	With efficacy	Fws	Wide shot
		Fst	Shot on target
		Fso	Shot stopped, with no maintenance of ball possession
		Fgl	Goal
	With no efficacy	Fed	Loss of ball possession by error of the ball carrier/defender's intervention (exception to the goalkeeper)
		Fgk	Loss of ball possession by the intervention of the opponent's goalkeeper
		Fo	Throwing the ball out of the pitch
		Fi	Violation of the laws of the game
Patterns of pitch space position		1	Zone 1: defensive sector/left strip
		2	Zone 2: defensive sector/central strip
		3	Zone 3: defensive sector/right strip
		4	Zone 4: mid-defensive sector/left strip
		5	Zone 5: mid-defensive sector/central strip
		6	Zone 6: mid-defensive sector/right strip
		7	Zone 7: mid-offensive sector/left strip
		8	Zone 8: mid-offensive sector/central strip
		9	Zone 9: mid-offensive sector/right strip
		10	Zone 10: offensive sector/left strip
		11	Zone 11: offensive sector/central strip
		12	Zone 12: offensive sector/right strip

software. For each attack, the observer records the match status, competition stage, match time, duration of the attack and any match events, regarding soccer

temporal and sequential structure, enabling to find and report the interactions concerning motor practices and dynamics of play.

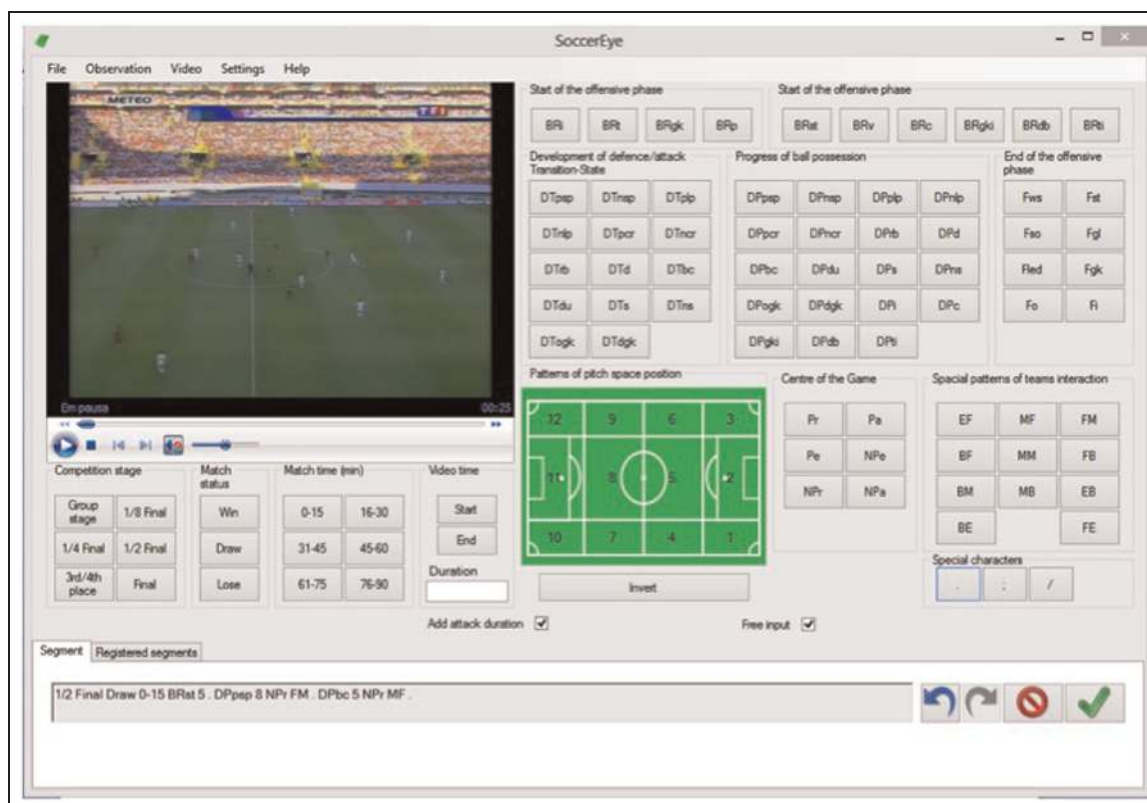


Figure 2. Soccer eye recording software (v3.0, October 2012).

Procedure

Data quality. In line with the procedure described in recent research,³⁶ data quality was ensured by assessing inter-observer reliability. Specifically, Cohen's kappa index³⁷ was calculated from the observations of the first half of the 2010 World Cup final (The Netherlands vs Spain). Application of SDIS-GSEQ software (v5.1)²⁸ yielded values of $0.92 \ll 0.98$, well above the value of ≥ 0.75 established as being indicative of high data quality.³⁸

Statistical analysis. In addition to descriptive statistics, one- and two-way analysis of variance (ANOVA) models were used to analyze differences in the ball recovery according to the stage of the competition, the four successful teams, the type of ball recovery and the respective pitch zones. Post hoc tests, namely Tukey's honestly significant difference (HSD) test and the Sidak correction, were also used to check for specific differences. Multinomial and binary logistic regression analyses were used to estimate the association between the patterns of ball recovery and the final attacking events. Statistical significance was set at 0.05. SPSS v19.0 was used for all analyses.

Results

Attacks performed by the successful teams in the 2010 FIFA World Cup

A total of 1619 attacks (67.5 ± 3.3) were registered in the 24 matches observed. During the group stage (GS),

there were 754 attacks (64.1 ± 20.5), while across the PO rounds, the four semi-finalists performed 865 attacks (72.5 ± 10.7). Spain—the winner of World Cup 2010—performed the majority of attacks ($n = 430$, 72.3 ± 21.5), while Germany performed the fewest number ($n = 357$, 59.2 ± 21.1). The other two semi-finalists, Dutch and Uruguayan national teams, completed 409 (70.1 ± 12.0) and 423 (71.0 ± 8.7) attacks, respectively. The analysis of the number of attacks performed revealed no significant differences when comparing the two stages of the competition ($p < 0.221$) or the four successful teams ($p < 0.509$) (Figure 3).

Ball recovery patterns in the 2010 FIFA World Cup

Direct ball recovery prevailed. Direct ball recovery revealed higher frequency than indirect ball recovery. Specifically, ball recovery by interception ($n = 380$, 16.0 ± 9.7) and by a defensive behavior followed by a pass ($n = 412$, 23.0 ± 8.7) were the ball recovery patterns most frequently observed, while ball recovery by corner kick and dropped ball did not occur in any of the 24 matches (Figure 4).

Competition stage influenced direct ball recovery patterns. Indirect ball recovery patterns did not differ according to the competition stage of the 2010 FIFA World Cup. However, there were significant differences between the group and PO stages regarding the types of direct ball recovery (Table 2). Interception ($23.0 \pm$

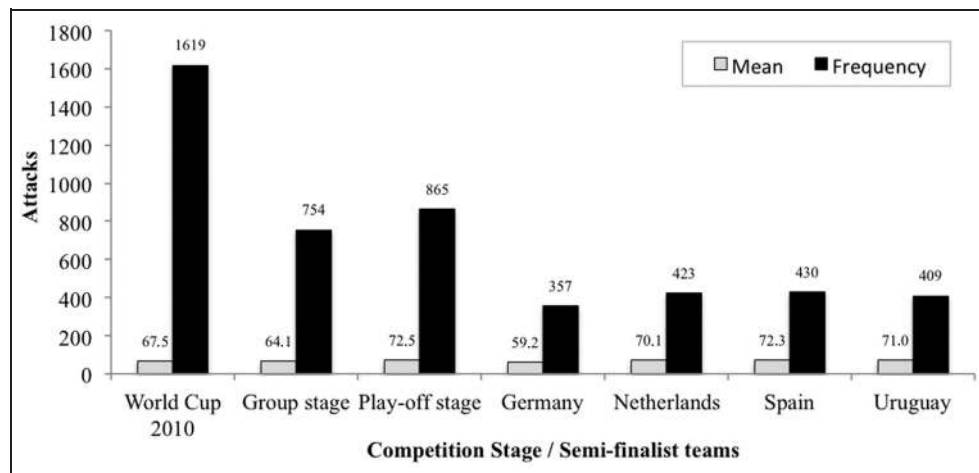


Figure 3. Frequency and mean number of attacks performed during the 2010 FIFA World Cup according to competition stage and the semi-finalists.

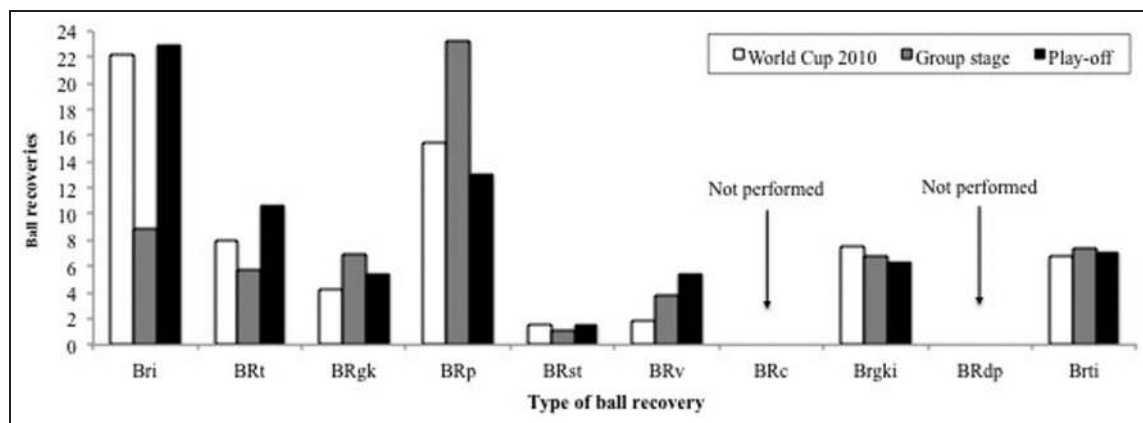


Figure 4. Mean frequency for the types of ball recovery and their relationship to the competition stages (group and play-off stages) of the 2010 FIFA World Cup.

BRi: ball recovery by interception; BRt: ball recovery by tackle; BRgk: ball recovery by intervention of the goalkeeper in the defensive phase; BRp: ball recovery by a defensive behavior followed by a pass; BRst: start/restart of the offensive phase; BRv: ball recovery by opponent's violation of the laws of the game; BRc: ball recovery by corner kick; BRgki: ball recovery by goal kick; BRdp: ball recovery by dropped ball; BRti: ball recovery by throw-in.

8.7, $p = 0.000$) and tackle (10.6 ± 4.5 , $p < 0.006$) were more frequent in PO matches than during the group stage of the tournament (GS, BRi: 8.9 ± 3.4 ; BRt: 5.8 ± 3.3) (Figure 4). By contrast, ball recovery by defensive behavior followed by a pass was more frequently observed in group stage matches (GS: 23.3 ± 10.2 vs PO: 13.0 ± 5.8 ; $p < 0.006$). In relation to ball recovery due to intervention of the goalkeeper, a similar rate of occurrence was observed in both stages of the competition and for both indirect (BRgki: GS: 6.8 ± 3.5 , PO: 6.3 ± 2.6) and direct (BRgk: GS: 7.0 ± 4.2 , PO: 5.4 ± 2.6) ball recoveries (Figure 4).

Ball recovery by throw-in differentiated Germany and Spain. The results in Table 2 show that the German national team performed less ($p < 0.323$) use of interceptions (12.5 ± 7.5), defensive behavior followed by a pass (16.7 ± 10.2), violation of the laws of the game

(1.6 ± 0.7) and throw-in (3.7 ± 1.5) to recover the ball than did The Netherlands (BRi: 13.7 ± 7.0 ; BRp: 20.0 ± 12.7 ; BRv: 3.7 ± 1.5 ; BRti: 8.3 ± 2.1), Spain (BRi: 15.5 ± 5.7 ; BRp: 20.5 ± 6.3 ; BRv: 4.2 ± 1.7 ; BRti: 10.2 ± 2.1) and Uruguay (BRi: 16.0 ± 9.7 ; BRp: 18.2 ± 9.7 ; BRv: 4.6 ± 3.2 ; BRti: 7.3 ± 3.8). The opposite occurred regarding ball recovery by tackle; Germany (9.7 ± 7.2) employed more often ($p < 0.843$) than did the teams from The Netherlands (7.5 ± 2.9), Spain (7.5 ± 3.1) and Uruguay (8.2 ± 4.6) (Figure 5). Overall, however, all semi-finalists in the 2010 FIFA World Cup showed similar patterns of ball recovery, with the exception of ball recovery by throw-in ($p < 0.012$), for which there was a significant difference ($p < 0.009$) between Germany (3.67 ± 1.5) and Spain (10.2 ± 2.1) (Figure 5).

Ball recovery occurred mainly in defensive and mid-defensive central zones of the field. The defensive and mid-defensive

Table 2. Types of ball recovery during the 2010 FIFA World Cup according to competition stage and the semi-finalist team.

		WC2010	Group stage	Play-off	Germany	The Netherlands	Spain	Uruguay
Direct BR	BRi ^a	22.2 ± 15.0	8.9 ± 3.4	23.0 ± 8.7	12.5 ± 7.5	13.7 ± 7.0	15.5 ± 5.7	16.0 ± 9.7
	BRt ^a	8.0 ± 4.7	5.8 ± 3.3	10.6 ± 4.5	9.7 ± 7.2	7.5 ± 2.9	7.5 ± 3.1	8.2 ± 4.6
	BRgk	4.3 ± 2.6	7.0 ± 4.2	5.4 ± 2.6	6.8 ± 3.8	7.5 ± 4.2	6.2 ± 3.4	6.2 ± 3.5
	BRp ^a	15.5 ± 10.2	23.3 ± 10.2	13.0 ± 5.8	16.7 ± 10.2	20.0 ± 12.7	20.5 ± 6.3	18.2 ± 9.7
Indirect BR	BRst	1.5 ± 1.2	1.1 ± 0.5	1.6 ± 1.0	1.5 ± 0.8	1.2 ± 0.8	1.2 ± 0.4	1.3 ± 0.8
	BRv	1.8 ± 0.8	3.8 ± 3.5	5.5 ± 2.8	1.6 ± 0.7	3.7 ± 1.5	4.2 ± 1.7	4.6 ± 3.2
	BRc ^b	—	—	—	—	—	—	—
	BRgki	7.5 ± 4.2	6.8 ± 3.5	6.3 ± 2.6	6.0 ± 1.7	7.5 ± 2.6	5.3 ± 3.1	6.6 ± 3.0
	BRdb ^b	—	—	—	—	—	—	—
	BRti ^c	6.8 ± 2.3	7.4 ± 3.2	7.1 ± 4.4	3.7 ± 1.5 ^d	8.3 ± 2.1	10.2 ± 2.1 ^d	7.3 ± 3.8

Values are mean ± SD.

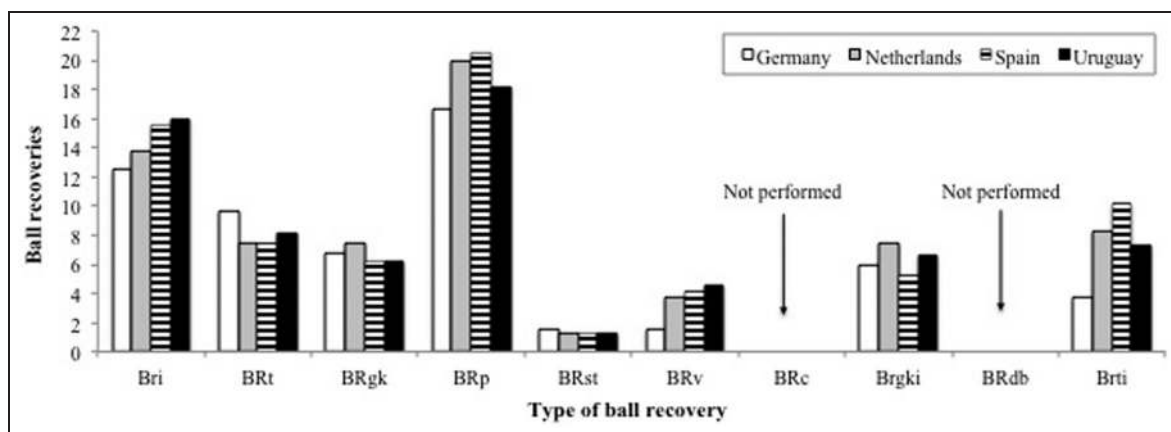
WC2010: FIFA World Cup 2010; BR: ball recovery; BRi: ball recovery by interception; BRt: ball recovery by tackle; BRgk: ball recovery by intervention of the goalkeeper in the defensive phase; BRp: ball recovery by a defensive behavior followed by a pass; BRst: start/restart of the offensive phase; BRv: ball recovery by opponent's violation of the laws of the game; BRc: ball recovery by corner kick; BRgki: ball recovery by goal kick; BRdb: ball recovery by dropped ball; BRti: ball recovery by throw-in; SD: standard deviation; ANOVA: analysis of variance.

^aSignificant difference between the group and play-off stages of WC2010; $p \leq 0.05$ according to one-way ANOVA.

^bType of ball recovery not performed during WC2010.

^cSignificant difference when comparing the four successful teams in WC2010; $p \leq 0.05$ according to one-way ANOVA.

^dSignificant difference between Germany and Spain ($p < 0.009$) in WC2010; $p \leq 0.05$ according to Tukey's HSD test.

**Figure 5.** Relationship between the types of ball recovery and successful teams in the 2010 FIFA World Cup.

BRi: ball recovery by interception; BRt: ball recovery by tackle; BRgk: ball recovery by intervention of the goalkeeper in the defensive phase; BRp: ball recovery by a defensive behavior followed by a pass; BRst: start/restart of the offensive phase; BRv: ball recovery by opponent's violation of the laws of the game; BRc: ball recovery by corner kick; BRgki: ball recovery by goal kick; BRdb: ball recovery by dropped ball; BRti: ball recovery by throw-in. Values are means.

sectors, both categorized as the defensive midfield (Table 1), were the pitch zones, in which the ball was most often recovered by the semi-finalists in the 2010 FIFA World Cup. A trend for recovering the ball in central zones was observed (zone 2: 18.5 ± 1.1 ; zone 5: 18.9 ± 1.6), with results showing significant differences between zones 2 and 5 and all the other pitch zones ($p \leq 0.001$) (Table 3); still, no differences were observed between zones 2 and 5 ($p = 1.000$), corroborating the tendency for ball recovery to occur primarily near the teams' own goals.

When considering each pitch sector separately (defensive, mid-defensive, mid-offensive and offensive), a slight tendency was detected for the ball to be similarly recovered in the opposing lateral zones ($p = 1.000$) (e.g. zone 4 vs zone 6, both in the mid-defensive sector). Similarly, the central mid-offensive zone (zone

8: 4.1 ± 0.6) was the zone of the pitch most widely used for recovering the ball in the mid-offensive and offensive sectors, which confirms the tendency for using the central strip observed for the defensive midfield. However, zone 8 showed no significant differences with respect to its corresponding lateral zones, that is, zone 7 (2.8 ± 0.5 , $p < 0.993$) and zone 9 (2.9 ± 0.3 , $p < 0.998$). On sporadic occasions, only the ball was recovered in offensive sector zones (zone 10: 0.2 ± 0.1 ; zone 11: 0.1 ± 0.1 ; zone 12: 0.1 ± 0.1), which produced significant less ball recovery situations than the overall pitch zones ($p < 0.005$). This indicates that teams rarely recovered the ball near the opponent's goal.

Patterns of ball recovery used by semi-finalists were similar and independent of the competition stage. Overall, there were

Table 3. Zones of ball recovery (from 1 to 12, see Table 1) during the 2010 FIFA World Cup (WC2010) according to competition stage and each of the successful teams.

Pitch zone	Germany			Netherlands			Spain			Uruguay		
	WC2010 ^a	Group stage	Play-off stage	WC2010 ^a	Group stage	Play-off stage	WC2010 ^a	Group stage	Play-off stage	WC2010 ^a	Group stage	Play-off stage
1	2.2 ± 0.3	1.9 ± 0.5	2.4 ± 0.5	2.5 ± 0.7	3.0 ± 1.0	2.0 ± 1.0	1.8 ± 0.7	0.7 ± 1.0	3.0 ± 1.0	1.5 ± 0.7	1.0 ± 1.0	2.0 ± 1.0
2	18.5 ± 1.1	18.8 ± 1.6	18.3 ± 1.6	16.5 ± 2.2	21.3 ± 3.1	11.7 ± 3.1	18.3 ± 2.2	20.7 ± 3.1	16.0 ± 3.1	19.5 ± 2.2	15.0 ± 3.1	24.0 ± 3.1
3	2.9 ± 0.4	3.4 ± 0.6	2.3 ± 0.6	3.2 ± 0.8	4.7 ± 1.1	1.7 ± 1.1	2.3 ± 0.8	3.7 ± 1.1	1.0 ± 1.1	2.8 ± 0.8	1.3 ± 1.1	4.3 ± 1.1
4	7.6 ± 0.9	9.7 ± 1.3	5.5 ± 1.3	6.0 ± 1.8	8.3 ± 2.6	3.7 ± 2.6	8.5 ± 1.9	10.7 ± 2.6	6.3 ± 2.6	8.7 ± 1.9	9.3 ± 2.6	8.0 ± 2.6
5	18.9 ± 1.6	18.5 ± 2.3	19.3 ± 2.3	18.2 ± 3.3	20.7 ± 4.7	15.7 ± 4.7	17.8 ± 3.3	18.3 ± 4.7	17.3 ± 4.7	21.2 ± 3.2	21.6 ± 4.7	20.7 ± 4.7
6	7.3 ± 0.9	10.0 ± 1.2	4.5 ± 1.2	5.5 ± 1.8	7.7 ± 2.5	3.3 ± 2.5	8.7 ± 1.8	12.3 ± 2.5	5.0 ± 2.5	7.0 ± 1.8	10.3 ± 2.5	3.7 ± 2.5
7	2.8 ± 0.5	2.8 ± 0.7	2.9 ± 0.7	1.5 ± 0.9	1.0 ± 1.3	2.0 ± 1.3	3.0 ± 0.9	2.3 ± 1.3	3.7 ± 1.3	2.8 ± 0.9	4.0 ± 1.3	1.7 ± 1.3
8	4.1 ± 0.6	4.9 ± 0.8	3.3 ± 0.8	2.8 ± 1.1	3.3 ± 1.6	2.3 ± 1.6	5.2 ± 1.2	4.7 ± 1.6	5.7 ± 1.6	4.7 ± 1.2	6.7 ± 1.6	2.7 ± 1.6
9	2.9 ± 0.3	3.4 ± 0.5	2.3 ± 0.5	1.8 ± 0.6	2.7 ± 0.9	1.0 ± 0.9	4.0 ± 0.64	5.0 ± 0.9	3.0 ± 0.9	2.5 ± 0.6	3.0 ± 0.9	2.0 ± 0.9
10	0.2 ± 0.1	0.2 ± 0.2	0.3 ± 0.2	0.2 ± 0.2	0.3 ± 0.3	0.0 ± 0.3	0.3 ± 0.2	0.0 ± 0.3	0.7 ± 0.3	0.0 ± 0.2	0.0 ± 0.3	0.0 ± 0.3
11	0.1 ± 0.1	0.3 ± 0.1	0.0 ± 0.1	0.0 ± 0.1	0.0 ± 0.2	0.0 ± 0.2	0.5 ± 0.1	1.0 ± 0.2	0.0 ± 0.2	0.0 ± 0.1	0.0 ± 0.2	0.0 ± 0.2
12	0.1 ± 0.1	0.1 ± 0.1	0.2 ± 0.1	0.0 ± 0.1	0.0 ± 0.2	0.0 ± 0.2	0.2 ± 0.1	0.3 ± 0.2	0.0 ± 0.2	0.2 ± 0.1	0.3 ± 0.2	0.0 ± 0.2
	–	6.2 ± 0.4 ^b	5.1 ± 0.4 ^b	–	5.9 ± 0.7 ^c	3.6 ± 0.7 ^c	–	6.6 ± 0.7 ^c	5.1 ± 0.7 ^c	–	6.0 ± 0.7 ^c	5.8 ± 0.7 ^c

WC2010: FIFA World Cup 2010; SD: standard deviation.

Results are shown by stage and for the competition as a whole. Values are mean ± SD.

^aSix observations, corresponding to the sum of the group and play-off stages matches in WC2010 for each team per zone.^bBall recovery occurrence in relation to pitch zones per stage of the competition; $p \leq 0.05$, using Sidak's post-hoc correction.^cBall recovery occurrence in relation to pitch zones per team in each stage of the competition: team × stage interaction, $p \leq 0.05$, using Sidak's post-hoc correction.

no significant differences ($p < 0.053$) between the group and PO stages with regard to the zones in which the ball was recovered. Although the mean number of ball recoveries was lower in the PO stage (PO: 5.1 ± 0.4 ; GS: 6.2 ± 0.4 , Table 3), the results for zones 1 and 5 did not follow this trend. More ball recoveries were observed during the PO matches (zone 1: 2.4 ± 0.5 ; zone 5: 19.3 ± 2.3) than during the group stage (zone 1: 1.9 ± 0.5 ; zone 5: 18.5 ± 2.3) (Table 3).

When considering each of the four semi-finalists separately, the results showed no influence of competition stage for any of the pitch zones in which the ball was recovered ($p < 0.968$). Additionally, there were no differences between the German, Dutch, Spanish and Uruguayan national teams ($p < 0.386$). The analysis therefore revealed no interaction ($p < 0.229$) between competition stage and teams ($p < 0.630$ for all comparisons between teams).

Ball recovery by tackle induced goal scoring. Analyzing the association between the patterns of ball recovery and the final attacking events, we found that recovering the ball by tackle induced goal scoring ($p = 0.050$) (Table 4). Also, ball recovery by a defensive behavior followed by a pass increased the occurrence of shots on target ($p < 0.017$) (Table 4).

In addition, the results showed that defensive behavior followed by a pass was positively associated with the efficacy of the attack ($p < 0.004$) (Table 5). In opposition, no significant association was found between indirect patterns of ball recovery and the final attacking events with efficacy ($p < 0.403$) (Table 5).

Discussion

The main purpose of this investigation was to examine the patterns of ball recovery and attacking play according to competition stages, successful teams and pitch zones during the 2010 FIFA World Cup. Indeed, this study provided an overview of the patterns of ball recovery as a performance indicator with potential to predict efficacy of the subsequent attack in elite soccer.

In the 2010 FIFA World Cup, a mean number of 67.5 attacks per team were performed, as compared with 54.0 attacks in the 2008 Euro Cup held in Switzerland and Austria.³² In an analysis of attacks that finished close to goal 26.3 attacks per match per team in the 2002 FIFA World Cup in Korea and Japan were observed;³⁹ similar results were found in the 1998 FIFA World Cup⁴⁰ and in UEFA Euro 2000.⁴¹ Using identical methods to the current study, investigation⁴² added that in the PO rounds of the 2010 World Cup, South American teams performed fewer attacks per match ($n = 59$) than did European ones ($n = 83$). It is worth noting, however, that some European teams, such as France, The Netherlands and Spain, have nowadays blended the two styles of play into a more

Table 4. Association between patterns of ball recovery and the final attacking events.

Patterns of BR	Final attacking events	Odds ratio	95% CI	p
BRi	Shot wide	1.068	0.624–1.827	0.811
	Shot on target	1.577	0.673–3.694	0.294
	Shot stopped, with no maintenance of ball possession	0.657	0.163–2.647	0.555
	Goal	1.752	0.602–5.099	0.303
BRt	Shot wide	1.376	0.744–2.543	0.309
	Shot on target	1.036	0.320–3.347	0.953
	Shot stopped, with no maintenance of ball possession	0.863	0.172–4.319	0.858
	Goal ^a	3.021	1.001–9.119	0.050
BRgk	Shot wide	0.956	0.445–2.055	0.908
	Shot on target	1.020	0.276–3.760	0.977
	Shot stopped, with no maintenance of ball possession	0.566	0.068–4.748	0.600
	Goal	2.266	0.630–8.152	0.211
BRp	Shot wide	1.524	0.932–2.490	0.093
	Shot on target ^b	2.566	1.186–5.555	0.017
	Shot stopped, with no maintenance of ball possession	1.283	0.410–4.014	0.668
	Goal	1.925	0.678–5.460	0.218

BR: ball recovery; BRi: ball recovery by interception; BRt: ball recovery by tackle; BRgk: ball recovery by intervention of the goalkeeper in the defensive phase; BRp: ball recovery by a defensive behavior followed by a pass; CI: confidence interval.

^aSignificant association between ball recovery by tackle and goal scoring event; $p \leq 0.05$, according to multinomial logistic regression.

^bSignificant association between ball recovery by a defensive behavior followed by a pass and shot on target event; $p \leq 0.05$ according to multinomial logistic regression.

Table 5. Association between patterns of ball recovery and the efficacy of the attack.

Patterns of ball recovery	Attack with efficacy		
	Odds ratio	95% CI	p
BRi ^a	1	–	–
BRt	1.455	0.983–2.154	0.061
BRgk	0.897	0.498–1.616	0.718
BRp ^b	2.788	1.055–4.100	0.004
IndBR	0.839	0.555–1.266	0.403

BRi: ball recovery by interception; BRt: ball recovery by tackle; BRgk: ball recovery by intervention of the goalkeeper in the defensive phase; BRp: ball recovery by a defensive behavior followed by a pass; IndBR: indirect ball recovery; CI: confidence interval.

^aReference category.

^bSignificant association between ball recovery by tackle and attack with efficacy; $p \leq 0.05$ according to binomial logistic regression.

attacking or modern European style, with both being equally efficient in World Cup tournaments.⁴³

In other words, top South American and European national teams, according to FIFA ranking, were characterized by performing different styles of play, that is, long ball possessions with predominance to occurrence of short passes, with greater relevance to goal scoring in South American teams and, contrarily, shorter duration possessions with direct long passes and counter-attack patterns of play to European teams.⁴³ However, playing styles found in the analysis of France and Brazil do not corroborate this idea, with both teams performing multiple sequences of possession, hence identical and elaborate patterns of play.⁴⁴ These findings were confirmed by 1990 World Cup analysis results, in which Europeans and South Americans completed an extent number of passes, runs and dribbles

within the midfield and attacking areas, reducing the chance of losing possession, that is, both styles were blended into a patient passing strategy named as possession football style.⁴⁵ Furthermore, a 2002 FIFA World Cup study found that Europeans performed significantly more dribbling sequences in the midfield third and more possession techniques in offensive areas than South Americans, who carried out direct attacks in midfield areas and possession techniques in advanced offensive areas.⁴⁶ Although, probably due to Europe has become the most successful venue for professional soccer players,⁴⁷ the European style in general became hang back less on defense and attack more on offense,⁴³ with both styles—European and South American—revealing nowadays effective similarities. Also, comparing both halves of the 2010 World Cup matches, a study³³ found that teams performed more attacks during the first half (485 vs 471 in the second half), although this difference was not significant.

In the current study, no significant differences were found when comparing the two stages of the 2010 World Cup and the semi-finalist teams with regard to the number of attacks performed per match and in the whole competition. This suggests that successful teams maintain an attacking rate independent of their playing style and competition stage, which probably is likely to be a feature of success, even though it does not predict the ultimate winner of the competition. Contrarily, in the 2006 FIFA World Cup, it was found that competition stage variable predicted the winner across the group stage matches; however, performance of winners was worse than the losers during PO rounds.⁶ This is justified by the characteristics of PO stage, namely, the knock-out system and the lower distance in FIFA

ranking between the opposing teams. The overall conclusion to be drawn from our results is that the number of attacks is independent of the competition stage and the considered teams.

Also, our analysis showed a predominance of direct ball recovery during the 2010 FIFA World Cup (direct ball recovery: 77.3% vs indirect ball recovery: 22.3%; Table 3), corroborating the 2002 World Cup findings.⁴⁸ Thus, open play predominated over set-plays, and consequently, the flow of the game was generally preserved. Moreover, categorizing the types of ball recovery into (a) interception or tackle, (b) set-plays and (c) error by the opponent was found that 54% of ball recoveries occurred due to a wrong pass or poor ball control by the opponent,⁴⁹ while other study found that 33% of attacks ending with a shot were preceded by an error on the part of the opponent.³⁴

Regarding indirect ball recoveries (i.e. set-plays), it was found that goalkeeper intervention (BRgki: 7.5 ± 4.2) and throw-ins (BRti: 6.8 ± 2.3) were the most commonly used behaviors (Table 2). The least frequent kinds of indirect ball recovery were the dropped ball and the corner kick, neither of which occurred during the 24 matches. Specifically, we observed an average of 4.3 goalkeeper interventions per match, which is more than that reported in a study of the 1998 World Cup (only one ball possession starting with the goalkeeper).⁵⁰ However, on English Premier League 2007–2008, goalkeepers intervened more times per match (13.4) due to attack distribution tasks.⁵¹ Thus, results confirmed that ball possession by goalkeepers has increased over the years, as shown in outcomes of the analysis of the 1953, 1974, 1998 and 2002 World Cups,⁵² and that goalkeeper role also varies according to the level of competition.⁵³ In this sense, due to goalkeeper's dependence on what and where attackers perform,⁵⁴ teams' attacking style of play needs to be considered to understand the goalkeeper's intervention during the matches. In this sense, the literature^{11,55,56} shows that the number of passes per attack and the maintenance of ball for longer durations—considered as indicators of success—have increased in the last years, probably enhancing the goalkeeper participation.

Our findings also corroborate the results of the 1990⁸ and 2002⁵⁷ World Cup studies, with both sets of authors stating that in elite soccer approximately one-third of attacks start from a set-play. Additionally, it was found that a similar number of goals were scored from direct or indirect set-plays,⁸ concluding that open play showed greater efficacy accounting for most of the goals scored in the 1998 World Cup,⁵⁸ in which goals recorded from set-plays (i.e. free kicks, corner kicks and long throw-ins) represented 25% of all goals scored.

A study of the 1998 World Cup⁵⁰ concluded that the most common way of regaining possession was controlling a free ball (29%), followed by a restart (19%), tackle (11%), throw-in (11%) and an interception (10%), with the respective relationship to the goals scored being 38%, 18%, 18%, 0% and 18%. Also, it

was concluded that the interruption of an attack by means of a defensive foul enhances rather than disrupts the probability of conceding a goal.⁵⁸

In the present study of the 2010 FIFA World Cup, indirect ball recovery patterns were not influenced by the change in competition stage. However, ball recovery by interceptions and tackles was more common in PO matches than during the group stage (Figure 4). The single exception to this was the case of ball recovery by a defensive behavior followed by a pass, which was more frequent during group stage matches, while ball recovery by intervention of the goalkeeper was similarly present in both stages of the competition (Figure 4). In general, our findings confirm studies^{59,60} that show relevant differences concerning direct or indirect ball possession recovering¹⁹ and confirm the influence of competition stages in teams' performance.⁶

Overall, the four successful teams in the 2010 World Cup showed similar patterns of ball recovery, excepting for regaining of possession by throw-in, which was achieved significantly more often by Spain than by Germany (Figure 5).

The results regarding ball recovery according to pitch zones were similar to those reported to 2008 Euro Cup.³² Thus, teams tended to regain possession directly in the central strip of the first and second quarters of the pitch (defensive midfield) and less often in mid-offensive pitch zones (third quarter). The attacking quarter was not used to recover the ball. Our results corroborate the findings of the study of Norwegian men's professional league during one competitive season,¹⁸ showing only 2% of the attacks starting on the final third of the pitch and a balance between the first and middle thirds (53% and 45%, respectively). In the same line, the analysis of the 708 attacks considered from the Spanish *La Liga* 2009–2010, excluding possessions starting with a set-play, showed that 34%, 43%, 22% and 1% started from defensive, mid-defensive, mid-offensive and offensive pitch zones, respectively.¹⁷ Furthermore, in a study among top-level European teams, it was found that attacks started on the midfield central zone were the most widely used to regain possession,²¹ probably because these attacks can be done while maintaining an ideal defensive formation.³⁴

During the 2010 FIFA World Cup, semi-finalist teams mostly used the direct ball recovery, with tackle and pass after defensive behavior inducing attacking play efficacy. Regarding the dynamic nature of the soccer game, after direct ball recovery and inversely after ball lost—state-transition moments²⁷—the opposing teams compete to get advantage in time and space, developing individual and collective behaviors to improve their own organization levels and to benefit from the opponent's unbalance. Transition moments evidence chaotic behaviors, with no organization; nevertheless, the literature uncovers the importance of guiding the training process to improve the attitude-changing moments of performance and, consequently, the efficacy of the subsequent attacking play. Thus,

according to our results, it seems essential to keep up the collective defensive balance in mid-defensive zones, increasing pressure in opponent players in the central strip, to warrant resourceful ball recovering and attacking efficacy.

Conclusion

This study shows that the type and the zone of ball recovering seem to affect attacking efficacy in elite soccer. Also, it was emphasized that the competition stage and the team should be taken into consideration. Consequently, pertinent data for coaches were provided to better organize the training process and improve performance. In the 2010 World Cup, Spain was the team that carried out the highest number of attacks, while no significant differences were detected between the four successful teams during the tournament.

Overall, direct ball recovery was more widely used than indirect ball recovery. Patterns of indirect ball recovery did not seem to be influenced by changing of competition stage. Interceptions and tackles were the most frequent defensive behaviors in PO matches, while ball recovery by a defensive behavior followed by a pass was the most common during the group stage.

The most successful teams showed similar patterns of ball recovery, with the exception of throw-ins that differentiated Germany from Spain. Ball recovery behaviors were not regularly performed in the defensive lateral wings or in the offensive sector of the pitch, indicating that successful teams normally recover the ball in the central strip of the defensive and mid-defensive sectors. Patterns of direct ball recovery increase attacking play efficacy, namely through ball recover by tackle and by a defensive behavior followed by a pass related to goal scoring and shots on target, respectively. The zones and the way the ball is recovered in elite soccer are important tactical determinants that coaches should consider when preparing the training process. It seems fundamental to train specifically the collective defensive organization and simultaneously the state-transition moments, rather than the set-plays.

Declaration of conflicting interests

The authors declare that there is no conflict of interest.

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References

1. Lago C. The influence of match location, quality of opposition, and match status on possession strategies in professional association football. *J Sport Sci* 2009; 27: 1463–1469.
2. Ruiz-Ruiz C, Fradua L, Fernandez-Garcia A, et al. Analysis of entries into the penalty area as a performance indicator in soccer. *Eur J Sport Sci* 2011; 1–8. DOI: 10.1080/17461391.2011.606834
3. Lago C and Lago-Ballesteros J. Game location and team quality effects on performance profiles in professional soccer. *J Sport Sci Med* 2011; 10: 465–471.
4. Taylor J, Mellalieu S, James N, et al. The influence of match location, quality of opposition, and match status on technical performance in professional association football. *J Sport Sci* 2008; 26: 885–895.
5. Fradua L, Zubillaga A, Caro O, et al. Designing small-sided games for training tactical aspects in soccer: extrapolating pitch sizes from full-size professional matches. *J Sport Sci* 2012; 1–9. DOI: 10.1080/02640414.2012.746722
6. Lago C. Are winners different from losers? Performance and chance in the FIFA World Cup Germany 2006. *Int J Perform Anal Sport* 2007; 7: 36–47.
7. Hughes M and Bartlett R. The use of performance indicators in performance analysis. *J Sport Sci* 2002; 20: 739–754.
8. Jinshan X, Xiakone C, Yakamaka K, et al. Analysis of the goals in the 14th World Cup. In: Reilly T, Clarys J and Stibbe A (eds) *Science and football II*. Eindhoven: E & FN Spon, 1993, pp.203–205.
9. Ali A, Williams C, Hulse M, et al. Reliability and validity of two tests of soccer skill. *J Sport Sci* 2007; 25: 1461–1470.
10. Hughes M and Franks I. Analysis of passing sequences, shots and goals in soccer. *J Sport Sci* 2005; 23: 509–514.
11. Lago C, Lago-Ballesteros J, Dellal A, et al. Game-related statistics that discriminated winning, drawing and losing teams from the Spanish soccer league. *J Sport Sci Med* 2010; 9: 288–293.
12. Jones P, James N and Mellalieu S. Possession as a performance indicator in soccer. *Int J Perform Anal Sport* 2004; 4: 98–102.
13. Brillinger D. A potential function approach to the flow of play in Soccer. *J Quant Anal Sports* 2007; 3: 1–19 (article 3).
14. Garganta J, Marques A and Maia J. Modelação táctica do jogo de Futebol: estudo da organização da fase ofensiva em equipas de alto rendimento. In: Garganta J, Suarez A and Lago C (eds) *A Investigação em Futebol: Estudos Ibéricos*. Porto: Faculdade de Ciências do Desporto e de Educação Física, 2002, pp.51–66.
15. Bayer C. *L'Enseignement des jeux sportifs collectifs*. Paris: Vigot, 1986.
16. Franks I and Miller G. Training coaches to observe and remember. *J Sport Sci* 1991; 9: 285–297.
17. Lago-Ballesteros J, Lago C and Rey E. The effect of playing tactics and situational variables on achieving score-box possessions in a professional soccer team. *J Sport Sci* 2012; 30: 1455–1461.
18. Tenga A, Holme I, Ronglan LT, et al. Effect of playing tactics on achieving score-box possessions in a random

- series of team possessions from Norwegian professional soccer matches. *J Sport Sci* 2010; 28: 245–255.
19. Pollard R and Reep C. Measuring the effectiveness of playing strategies at soccer. *Statistician* 1997; 46: 541–550.
 20. Castelo J. *Futebol: a organização do jogo. Como entender a organização dinâmica de uma equipa de futebol e a partir desta compreensão como melhorar o rendimento e a direcção dos jogadores e da equipa*. Lisboa: Edição do autor, 1996.
 21. Garganta J, Maia J and Basto F. Analysis of goal-scoring patterns among top-level European soccer teams. *J Sport Sci* 1995; 13: 513–514.
 22. Reina E, Abad P and Losa J. La velocidad en el juego de ataque: análisis táctico de los goles de la Eurocopa 96 de Fútbol. *Fútbol: Cuadernos Técnicos* 1997; 8: 36–43.
 23. Gréhaigine J. *La organización del juego en el fútbol*. Barcelona: INDE, 2001.
 24. Carling C, Williams M and Reilly T. *Handbook of soccer match analysis*. London: Routledge, 2005.
 25. Gréhaigine J, Marchall D and Duprat E. Regaining possession of the ball in the defensive area in soccer. In: Spinks W, Reilly T and Murphy A (eds) *Science and football IV*. London: Routledge, 2002, pp.112–120.
 26. Barreira D. *Transição defesa-ataque em Futebol. Análise Sequencial de padrões de jogo relativos ao Campeonato Português 2004/05. Tese de Licenciatura*. Porto: Faculdade de Desporto da Universidade do Porto, 2006, p.231.
 27. Barreira D and Garganta J. Padrão sequencial da transição defesa-ataque em jogos de Futebol do Campeonato Português 2004/2005. In: *1º Congresso Internacional de Jogos Desportivos* (eds F Tavares, A Graça and J Garganta), 2007. Porto: Faculdade de Desporto da Universidade do Porto (in CD-ROM) Porto 12–14th July 2007.
 28. Bakeman R and Quera V. *Analyzing interaction: sequential analysis with SDIS and GSEQ*. Cambridge: Cambridge University Press, 1995.
 29. Gutiérrez-Santiago A, Prieto I, Camerino O, et al. Sequences of errors in the judo throw Morote Seoi Nage and their relationship to the learning process. *Proc IMechE, Part P: J Sports Engineering and Technology* 2011; 227: 57–63.
 30. Anguera MT, Blanco A, Hernández-Mendo A, et al. Diseños observacionales: ajuste y aplicación en psicología del deporte. *Cuadernos de Psicología del Deporte* 2011; 11: 63–76.
 31. Hughes M, Robertson K and Nicholson A. Comparison of patterns of play of successful and unsuccessful teams in the 1986 World Cup for soccer. In: Reilly T, Lees A, Davids K, et al. (eds) *Science and football*. Liverpool: E & FN Spon, 1988, pp.363–367.
 32. Barreira D, Garganta J and Anguera MT. In search of nexus between attacking game-patterns, match status and type of ball recovery in European Soccer Championship. In: *Research methods and performance analysis 5th international Christmas sport scientific conference: qualitative and quantitative research in sport science* (eds M Hughes, H Dancs, K Nagyvárad, et al.), Szombathely, Hungary, 2011, pp.226–237 Published by University of West-Hungary, Institute of Sport Science, Szombathely 12nd–14th December 2010.
 33. Barreira D, Garganta J, Pinto T, et al. Do attacking game patterns differ between first and second halves of soccer matches in the 2010 FIFA World Cup? In: Nunome H, Drust B and Dawson B (eds) *Science and football VII: the proceedings of the seventh world congress on science and football*. London and New York: Routledge, 2013, pp.193–198.
 34. Garganta J. *Modelação táctica do jogo de Futebol. Estudo da organização da fase ofensiva em equipas de alto rendimento* [Tactical modelling of Soccer game]. Porto: Faculdade de Ciências do Desporto e de Educação Física, Universidade do Porto, 1997.
 35. Castellano J. *Observación y análisis de la acción de juego en el fútbol*. Vitoria-Gasteiz: Departamento de Teoría e Historia de la Educación, Universidad del País Vasco, 2000, p.680 + 7 anexos.
 36. Perea A, Castellano J, Hernández-Mendo A, et al. *Pautas para el análisis de la calidad del dato en la observación de los deportes colectivos: una aplicación en el fútbol. I Congreso virtual de investigación en la actividad física y el deporte*. Vitoria-Gasteiz, 2005.
 37. Cohen J. A coefficient of agreement for nominal scales. *Educ Psychol Meas* 1960; 20: 37–46.
 38. Bakeman R and Gottman JM. *Observing interaction: an introduction to sequential analysis*. 2nd ed. Cambridge: Cambridge University Press, 1997.
 39. De Baranda P, Ortega E and Palao J. Analysis of goalkeepers' defence in the World Cup in Korea and Japan in 2002. *Eur J Sport Sci* 2008; 8: 127–134.
 40. Ruiz D and Sáinz P. Análisis del portero de fútbol en el mundial de Francia-98. *Training Fútbol: Revista técnica profesional*, 2000, pp. 24–41 November, 2000.
 41. De Baranda P and Ortega E. Estudio comparativo de las acciones realizadas por los porteros de fútbol participantes en el Mundial de Francia 98 versus Eurocopa del 2000. *Lecturas: Educación Física y Deportes* 2002; 8. Lecturas: Educación Física y Deportes. Revista Digital, 24 de Agosto. <http://www.efdeportes.com/efd49/francia.htm>. (accessed on August 10, 2012)
 42. Barreira D, Garganta J, Guimarães P, et al. Attacking game-patterns differences between South American and European national Soccer teams in the World Cup 2010. In: *7th world congress on science & football 2011 & 9th annual conference of Japanese Society of Science and Football 2011*, 2011, p.259. Nagoya, Japan: Japanese Society of Science and Football. Nagoya, Japan May 26–30 2011.
 43. Skirka N. Finding meaning in the World Cup's results. *Soccer J* 2010; 55: 63–64.
 44. Pollard R, Reep C and Hartley S. The quantitative comparison of playing styles in soccer. In: Reilly T, Lees A, Davids K, et al. (eds) *Science and football*. Liverpool: E & FN Spon, 1988, pp.309–315.
 45. Yamanaka K, Hughes M and Lott M. An analysis of playing patterns in the 1990 World Cup for association football. In: Reilly T, Clarys J and Stibbe A (eds) *Science and football II*. Eindhoven: E & FN Spon, 1993, pp.206–214.
 46. Brown S and Hughes M. The attacking playing patterns in offensive areas of European, South American, African and Asian teams in the 2002 World Cup for association football. In: O'Donoghue P and Hughes M (eds) *Performance analysis of sport VI*. Cardiff: Centre for Performance Analysis, 2004, pp.99–102.
 47. Goldblatt D. *The ball is round: a global history of soccer*. New York: Riverhead Books, 2006.
 48. Silva A, Sánchez-Bañuelos F, Garganta J, et al. Patrones de juego en el fútbol de alto rendimiento. Análisis secuencial del

- proceso ofensivo en el campeonato del mundo Corea-Japón 2002. *Cultura, Ciencia y Deporte* 2005; 1: 65–72.
49. Joaquim T. *Características da posse de bola e do processo ofensivo nos Escalões de Formação em Futebol*. Porto: Faculdade de Desporto da Universidade do Porto, 2009.
 50. Kirkendall D, Dowd WW and DiCicco T. Patterns of successful attacks: a comparison of men's and women's games in World Cups. *Int J Soccer Sci* 2002; 1: 29–36.
 51. Oberstone J. Comparing English premier league goalkeepers: identifying the pitch actions that differentiate the best from the rest. *J Quant Anal Sports* 2010; 6 pp. 1–17.
 52. Kuhn T. Changes in professional soccer: a qualitative and quantitative study. In: Reilly T, Cabri J and Araújo D (eds) *Science and football V*. London: E & FN Spon, 2005, pp.179–193.
 53. Seaton M and Campos J. Distribution competence of a football clubs goalkeepers. *Int J Perform Anal Sport* 2011; 11: 314–324.
 54. Bode G. World Cup 2010: giving away the goals. *Success Soccer* 2011; 14: 6–10.
 55. James N, Jones P and Mellalieu S. Possession as a performance indicator in soccer as a function of successful and unsuccessful teams. *J Sport Sci* 2004; 22: 507–508.
 56. Hook C and Hughes M. Patterns of play leading to shots in Euro 2000. In: CPA (ed.) *Passcom*. Cardiff: UWIC, 2001, pp.295–302.
 57. Yiannakos A and Armatas V. Evaluation of the goal scoring patterns in European Championship in Portugal 2004. *Int J Perform Anal Sport* 2006; 6: 178–188.
 58. Grant A, Williams M, Reilly T, et al. Analysis of the successful and unsuccessful teams in the 1998 World Cup. *Insight (FA Coaches)* 1998; 2: 21–24.
 59. Castellano J, Masach J and Zubillaga A. Cuantificación del esfuerzo físico del jugador de fútbol en competición. *Training Fútbol: Revista técnica profesional*, 1996, vol. 7, pp.27–42 September 1996.
 60. Castellano J and Zubillaga A. Análisis de los goles Mundial USA'94 (2ª parte). *El Entrenador Español* 1995; 65: 46–58.