ORIGINAL ARTICLE

Analysis of the goals scored in the 2016 and 2017 CONMEBOL Libertadores Cups

Análise de gols marcados nas Copas Conmebol Libertadores 2016 e 2017

Análisis de los goles marcados en las Copas Conmebol Libertadores 2016 y 2017

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ABSTRACT

This study aimed to describe regularities in soccer goal-ending sequences in the 2016 and 2017 CONMEBOL Libertadores Cups. Observational methodology was used. The sample comprised 699 attack sequences that ended in goal from 250 games played in 2016 and 2017. An *ad hoc* observational instrument was designed. Data analysis was performed in three complementary ways: sequential, graph theory, and polar coordinates. Two sequences were highlighted: Pass with the head-Shot-Goal and Rebound-Rebound-Shot-Goal. The foot pass action is the most common prior to a shot. In addition, dribbling and conducting were excitatory and inhibitory actions, respectively, to score a goal. In conclusion, the use of open game was relevant to score goals and different patterns were observed.

RESUMO

O objetivo foi descrever regularidades nas sequências terminadas em gol nas Copas CONMEBOL Libertadores 2016 e 2017. Foi escolhida a metodologia observacional. A amostra compreendeu 699 sequências de ataques terminadas em gol de 250 jogos disputados em 2016 e 2017. Elaborou-se um instrumento de observação ad hoc. A análise dos dados foi realizada de três maneiras complementares: análise sequencial; teoria dos grafos; e coordenadas polares. Duas sequências foram destacadas: Passe com a cabeça–Chute–Gol e Rebote-Rebote-Chute-Gol. A ação passe com o pé foi a mais comum antes de um tiro. Além disso, dribbling foi uma ação excitatória de marcar um gol e a condução o inibiu. Conclui-se que o uso do jogo aberto foi relevante para marcar gols e diferentes padrões foram observados.

RESUMEN

El objetivo fue describir regularidades en las secuencias terminadas en gol en las Copas Libertadores de fútbol 2016 y 2017. Se utilizó la metodología observacional. La muestra comprendió 699 secuencias de ataque que terminaron en gol de 250 partidos jugados en 2016 y 2017. Se diseñó un instrumento de observación ad hoc. El análisis de datos se realizó a través de tres maneras complementarias: análisis secuencial; teoría de grafos y coordenadas polares. Se destacaron dos secuencias: Pase con la cabeza-Remate-Gol y Rebote-Rebote-Remate-Gol. La acción Pase con el pie fue la más común antes de un tiro. Además, el regate fue una acción excitatoria de marcar un gol y la conducción lo inhibió. En conclusión, la utilización del juego abierto fue relevante para marcar goles y se observaron diferentes patrones.

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INTRODUCTION

The analysis of soccer game sequences has been the object of study of a large number of investigations (Barbosa et al., 2014; Barreira et al., 2014a; Castelão et al., 2015; Castellano and Hernández Mendo, 2000; Machado et al., 2013). In this case, only the sequences ending in goal have been considered (Castañer et al., 2016, 2017), as in the collective games such as soccer, the objective to reach victory is to score more goals than the opponent. Considering their low occurrence, as only 1% of offensive sequences end in goals (Lago et al., 2003; Tenga et al., 2010; Vivés, 2012), it seems relevant to understanding how goals are scored, their frequency and context. To sum up, a way to introduce a new discussion is to address the object of analysis from different approaches.

Sequence is defined as the successive occurrence of conducts (Anguera et al., 2011). In soccer, these conducts include technical-tactical actions performed before a goal: passes, shots, conducting, dribbling, and rebounds. Passes and shots with right foot were the most used actions to reach and conclude the finalization phase, followed by individual actions such as conducting and dribbling (Armatas & Yiannakos, 2010; Barreira et al., 2014a; Michailidis, 2014, Santos et al., 2016; Vivés, 2012). Scoring a goal through a combination of actions, such as passes, is a present tendency, as opposed to the use of individual actions in the recent past (Barreira et al., 2014a; Camerino et al., 2012). However, according to Aguado-Méndez et al. (2020), Barreira et al. (2014b), and Castellano & Hernández Mendo (2000), the types of recovery and the short offensive combinations have been the most effective sequences to defeat the opponent's defense and score a goal.

Moreover, the paths to reach the goal are another important element, represented by the areas of the field where the technical-tactical actions occur. The field zones are one of the performance indicators in soccer (Maneiro et al., 2020). The patterns used in the soccer field zones vary, for example, according to the team and its tactical intention (Sarmento et al., 2014). According to Amatria et al. (2019) and de Andrade et al. (2015), the central and left lanes are the most used zones to score a goal or reach the sequence finalization; this tendency was observed in away teams in the Italian Serie A as well. According to some research, the right and left lanes are the paths to reach the goal or end the offensive sequences, as well as the recoveries in the defensive zone central lane (Barreira et al., 2014b; Vivés et al., 2018). Also, the Italian Serie A home teams use the lateral lanes to carry out the offensive sequences (Diana et al., 2017).

Whereas few studies carried out in the South American context analyze the actions occurring in soccer games (De Pablo et al., 2019; de Andrade et al., 2015), many studies addressing this aspect have been performed with European national championships and World Cups (Barreira et al., 2014a; Casal et al. 2015; Castelão et al., 2015; Robles & Castellano, 2012). At the same time, many studies have been carried out exclusively with World Cups, as those conducted by Armatas y Yiannakos (2010), Barreira et al. (2014b), Castellano & Hernández Mendo (2002), and Michailidis (2014). Also, some studies have been performed exclusively with European national championships, such as the Euro Cup 2012 (Amatria et al. 2019; Maneiro et al., 2020). Other researchers have studied European teams, such as Barcelona (Camerino et al., 2012), Manchester United and Internazionale (Sarmento et al., 2014), Betis (Aguado-Méndez et al., 2020), Espanyol (Vivés, 2012; Vivés et al., 2018), Italian Serie A teams 2012-2013 (Diana et al., 2017), and the Portuguese, Spanish, English and German leagues (Santos et al., 2016)

Considering the relevance of technical-tactical inputs to the planning of training sessions (Abad et al., 2013), the results of this research will provide professionals linked to South American soccer with relevant information.

From the sequence of actions and the field zones where they occur, this investigation aimed to describe regularities in soccer goal-ending sequences in the 2016 and 2017 CONMEBOL Libertadores Cups. It was hypothesized that there are different patterns of goal-ending sequence actions in this competition.

MATERIALS AND METHODS

Observational methodology guidelines were followed. The observational design was ideographic, punctual, and multidimensional (Anguera and Hernández Mendo, 2013).

SAMPLE

The study sample comprised 699 attack sequences that ended in goal in 250 men´s soccer games of a total of 264 games played in the 2016 and 2017 CONMEBOL Libertadores Cups. Fourteen games were not analyzed because it was impossible to access their video recordings or observe the sequence actions.

OBSERVATIONAL INSTRUMENT

An *ad hoc* observational instrument (Table 1) was designed taking as a reference the Soccer Observational System of Zones and Actions (ZASOF) (Vivés, 2012). This instrument is a combination of a field format and category systems. The category systems are nested within the field format and meet the criteria of exhaustiveness and mutual exclusiveness (Anguera and Hernández Mendo, 2013). It is composed of five criteria and 44 categories. Validation of this instrument was performed through the authority criterion (De Pablo et al., 2019).

The starting actions refer to possession of the ball at the beginning of the sequence analysis. Thus, "continuity" supposes that the studied team were playing the ball previously. However, "recovery" was considered when the team were defending and executed a steal of the ball.

Table 1. Observational instrument.

Criteria	Categories
Result	Ties (TIES); Winning by difference of 1 (WIN1); Winning by difference of 2 or more (WIN2); Losing by difference of 1 (LOS1); Loosing by difference of 2 or more (LOS2).
Staring actions	Throwing in (THRO); Foul kick (FKIC); Corner kick (CKIC); Recovery (RECV); Continuity (CNTN); Penalty (PNTY).
Field zone	Field zones where the analyzed actions are carried out: Goal (GOL), left corner (ZCA), left goal area (ZCB), right goal area (ZCC), right corner (ZCD), left third offensive quarter (ZCE), left penalty area (ZCF), right penalty area (ZCG), right third offensive quarter (ZCH), second offensive quarter from left to right (ZCI, ZCJ, ZCK, ZCL), first offensive quarter from left to right (ZCM, ZCN, ZCO, ZCP), last defensive quarter (ZCQ, ZCR, ZCS, ZCT), first, second and third defensive quarter (ZCU), and penalty point (PENAL).
Progress and ending actions	Pass with the foot (PASS); Pass with head and other parts of the body (PWH); Conducting (COND); Dribbling (DRB); Rebound (RBD); Shot with the foot (SHF); Shot with head and other parts of the body (SHH); Goal (GOL).
Sequential	Continuity (.) and Ending (/) of the sequence.

Field zones are shown in Figure 2.

Finally, "throwing in" (lateral line), "foul kick", "corner kick", and "penalty" are different types of set pieces.

In regards to progress and ending actions, all types of passes were grouped into two categories, "pass with the foot" and "pass with the head and other parts of the body". The latter refers to "pass with the head", but includes other possibilities of passing with very low frequencies. This argument is used to distinguish between "shot with the foot" and "shot with head and other parts of the body". On the other hand, when a player translated the ball from one side of the field to another using two or more touches, this was considered "conducting". In this case, a "conducting" action was registered each time the player changed the field zone or advanced extensively in the same area. Otherwise, "dribbling" means that a player overcomes the defender while retaining possession of the ball. Finally, "rebound" is applied when a shot impacted a defender or the ball was uncontrolled, and there were other actions after that.

PROCEDURE

Three trained observers registered the last five actions before a goal. All observations were made from videos previously broadcasted on TV; therefore, it was not necessary to have the informed consent from the athletes. This study was approved by the University Ethic Committee.

DATA QUALITY

The observers were previously trained by analyzing a set of games of similar level. To assess the quality of the data, the inter- and intra-observer concordance was calculated using the Kappa coefficient with values >0.70 in all criteria and standard error <0.05, and these values were considered as of good concordance.

STATISTICAL ANALYSIS

Statistical analysis was performed in three complementary ways: sequential, graph theory, and polar coordinates.

First, a sequential analysis from five lags before the goal was scored (Hernández Mendo and Anguera, 1999; Castellano and Hernández Mendo, 2002; Chaverri et al., 2010). The relationships are established between a triggering behavior and its possibilities of matching with the rest in the different lags. Thus, when the value of the adjusted residual is ≥1.96 (significance level of 95%), the matching of the different behaviors occurs with greater probability than expected due to the simple random effect, there being an excitatory or positive dependence, whereas if the adjusted residual is >-1.96, the dependence is inhibitory or negative. On the other hand, the use of five lags is a common convention in this type of study due to the low probability of associations between the goal and other previously conducted actions (Castelão et al. 2015).

Second, graph theory was used for graphic analysis, which through a set of nodes and vectors allows modelling the motor communication network, generating the graph of a sports game whose nodes represent the zones and whose vectors symbolize the motor communication allowed by the rules of the game.

Finally, polar coordinate analysis is a double data reduction strategy that provides a vector representation of the complex network of interrelations among the different categories (or configurations of field formats) that comprise an *ad hoc* system produced to record the behavioral flow deriving from any activity or situation (Bakeman and Quera, 1995). As an example, a few studies have analyzed data through polar coordinate analysis (Castellano and Hernández Mendo, 2000; Castañer et al., 2016, 2017). This analysis tool shows an interaction between different categories integrating the prospective and retrospective perspectives. For each focal category (FC), the adjusted residuals from five lags were calculated, determining the prospective Z_{sum}, the retrospective Z_{sum}, and the quadrant assignation for the other matching categories (MC). When the resulting vector has a radius >1.96, it is statistically significant at 5% (Hernández Mendo and Anguera, 1999). Thus, the

interpretation of the four possible quadrants is as follows (Figure 1):

- Quadrant I [+,+]: FC and MC are mutually excitatory;
- Quadrant II [-,+]: FC is inhibitory and MC is excitatory;
- Quadrant III [-,-]: FC and MC are mutually inhibitory;
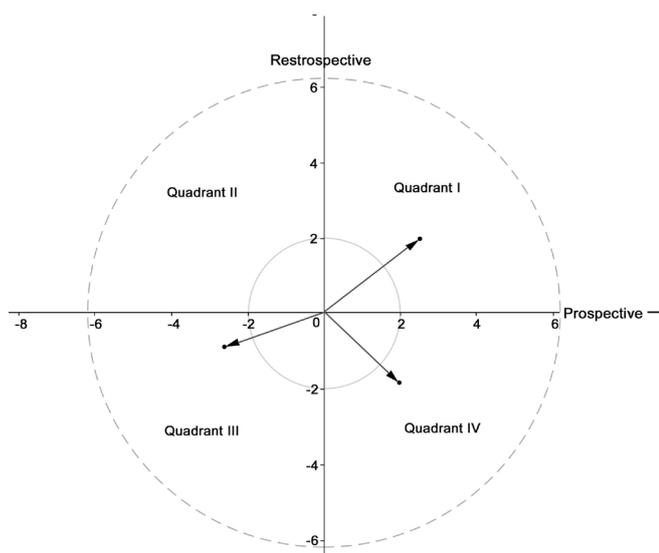- Quadrant IV [+,-]: FC is excitatory and MC is inhibitory.

Figure 1. Vector map of the polar coordinates.

Table 2. Distribution of sequences ending in goal according to their origin.

Type of sequences origin	Absolute frequency	Relative frequency
Penalty	56	8.0%
Continuity	457	65.3%
Recovery	21	3.0%
Throwing in	18	2.6%
Corner kick	55	7.9%
Foul kick	92	13.2%
Total	699	100.0%

RESULTS

The total of goals scored from open game and set plays were 68.4 and 31.6%, respectively, considering the total percentage of goals scored. The open game is represented by plays initiated in Continuities (CNTN) and Recoveries (RECV) (Table 2).

In the sequential analysis of lags (Table 3), Pass with the head and other parts of the body (PWH) was an excitatory action to score a goal in lag minus four ($p<0.05$). Also, Shot with the foot (SHF) ($p<0.01$) and with the head and other parts of the body (SHH) were excitatory actions to score a goal ($p<0.01$) in lags minus three and one. In addition, Rebound (RBD) and Scoring a goal had an excitatory relation in lag minus three ($p<0.05$) and two ($p<0.01$), whereas Conducting (COND) was found as an inhibitory action in lags minus one, two, and three ($p<0.01$).

From the study of the graphs (Figure 2), the connections between the nodes on the right side presented a high frequency compared with those on the left side. In reference to Shot with the foot to goal (SHF), a greater frequency was found from left zone inside the goal area (ZCB) as well as from the right zone inside the penalty area (ZCG), with non-statistically significant differences. At the same time, Shot with the head and other parts of the body (SHH) presented higher frequency on the left side (ZCF) than on the right side of the penalty area. Conducting (COND) was registered in a larger number in the right lane than in the left lane inside the central creation zones, and Passes with the foot (PASS) were similar on both sides, with more connections to goal scoring on the right side (ZCK) compared with the left side (ZCJ).

As for the polar coordinates, two maps of shots as focal conduct were presented because of their relevance to scoring a goal. Firstly, the focal category was Shot with the foot (SHF), which presented statistically significant association with Goal (GOL) and Rebound (RBD) in quadrant I (Figure 3).

Secondly, in Figure 4, Shot with the head and other parts of the body (SHH) was the focal category. In this case, Shot with the head and other parts of the body (SHH) showed statistically significant association with

Table 3. Sequential analysis of lags from continuity and recovery sequences.

Lag-5	Lag-4		Lag-3		Lag-2		Lag-1		Lag-0
	PWH	2.2*	SHF	5.7*	RBD	6.1*	SHF	37.1*	
			SHH	2.8*			SHH	14.8*	
			RBD	2.0*			PASS	-19.6†	GOL
							PWH	-3.2†	
			COND	-3.8†	COND	-3.2†	COND	-12.3†	
					SHF	-4.2†	DRB	-7.2†	
							RBD	-5.5†	

Conducting (COND); Dribbling (DRB); Rebound (RBD); Shot with the foot (SHF); Shot with head and other parts of the body (SHH); Goal (GOL). Excitatory (*) and (†) inhibitory relations with goal.
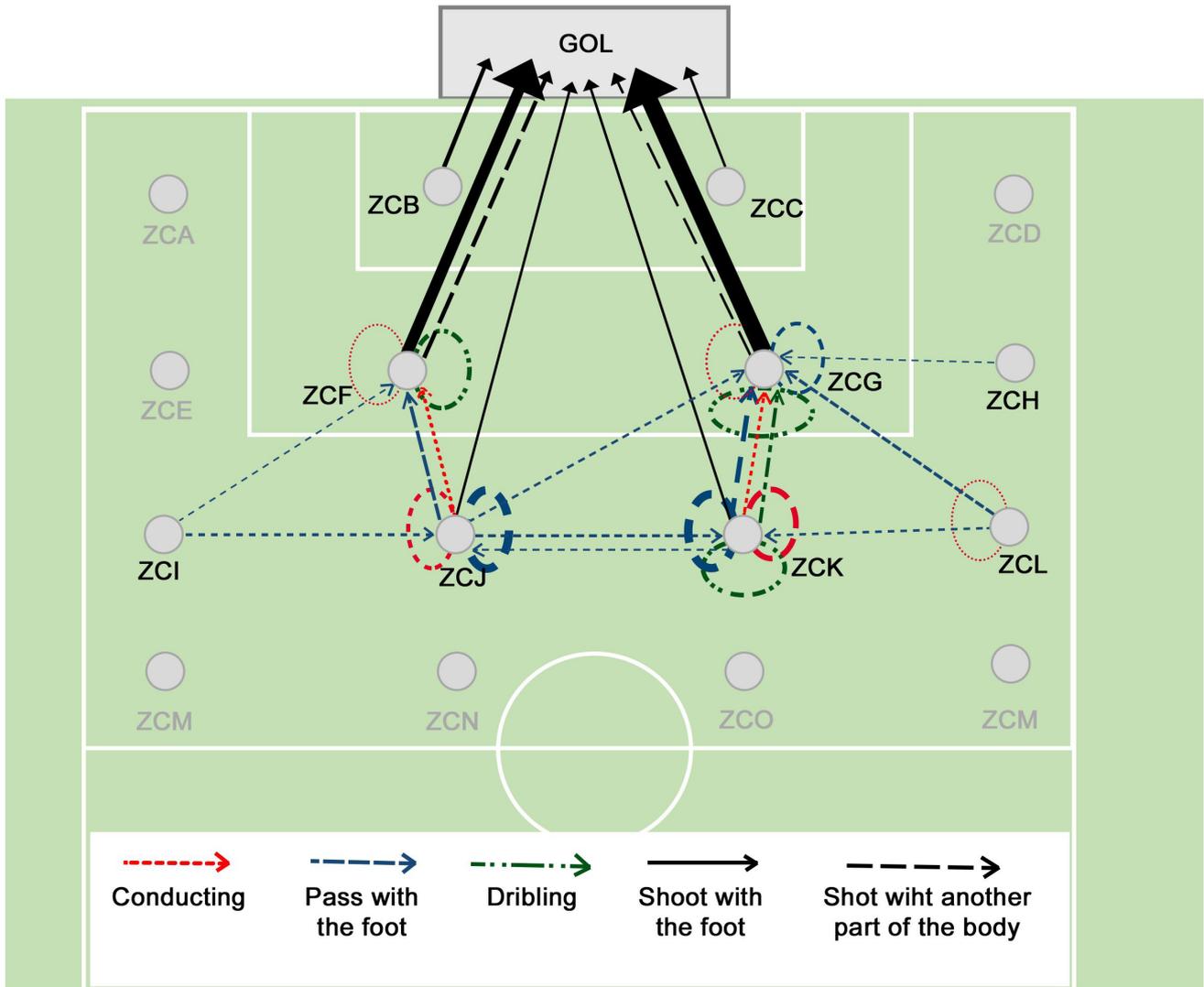
Figure 2. Graph of actions carried out in five lags prior to goal.

Pass with the foot (PASS) in quadrant II, whereas the focal category was associated with Conducting (COND), Shot with the foot (SHF), and Dribbling (DRB) in quadrant III.

DISCUSSION

This study aimed to analyze the soccer goal-ending sequences in the 2016 and 2017 CONMEBOL Libertadores Cups. It seems relevant to highlight the use of open game to score goals in this tournament (Table 2). In any case, these numbers are within normality, because they are comparable to those registered at an international level (Casal et al., 2015) considering all offensive sequences that do not belong to the category of set plays as open game. However, in regard to the South American context, the use of open game was grater in the CONMEBOL Libertadores Cup than in the Uruguayan Soccer Championship (De Pablo et al., 2019).

In regard to the technical-tactical sequence actions performed before a goal, the importance of the sequences Pass with the head and other parts of the body-Shot-Goal and Rebound-Rebound-Shot-Goal is noticeable (Table 3). From the sequence Pass with the head and other parts of the body-Shot-Goal, Pass with the head and other parts of the body showed a low use frequency, but presented statistically significant association with ending in goal; this could be explained by the high technical quality of the players, probably the best ones of the continent. In this case, Pass with the head and other parts of the body is a specific motor skill that requires high quality of execution, which is highlighted in outstanding players, as in the ball control observed in a research carried out to study Lionel Messi and Cristiano Ronaldo mastery to score goals (Castañer et al., 2016, 2017).

The other noticeable sequences refer to Rebound, which is excitatory in itself, and Shot with the foot and
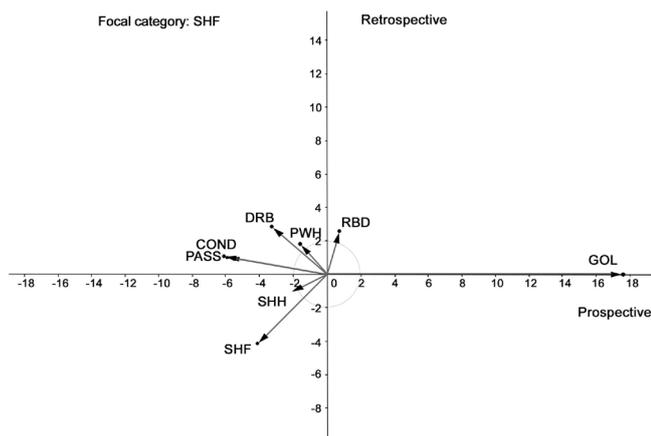
Figure 3. Polar coordinates for "shot with the foot" as focal category.
Pass with the foot (PASS); Pass with head and other parts of the body (PWH); Conducting (COND); Dribbling (DRB); Rebound (RBD); Shot with the foot (SHF); Shot with head and other parts of the body (SHH); Goal (GOL).

Figure 4. Polar coordinates for "Shot with the head and other parts of the body" as focal category.
Pass with the foot (PASS); Pass with head and other parts of the body (PWH); Conducting (COND); Dribbling (DRB); Rebound (RBD); Shot with the foot (SHF); Shot with head and other parts of the body (SHH); Goal (GOL).
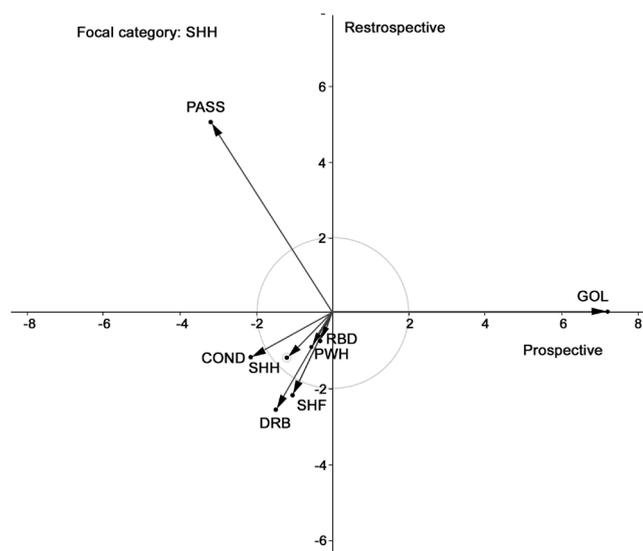
the head and other parts of the body. The occurrence of rebounds presents a great chance to the randomness of scoring goals (Diana et al., 2017), coinciding with the results observed in the 2010 World Cup (Machado et al., 2013), in which the shots of Spanish players were preceded by goalkeeper actions.

In the polar coordinate analysis, Pass is followed by Shot with the head and other parts of the body and the foot, mainly by the first one, as reported by Machado et al. (2013). In addition, Shot with the foot is preceded by Dribbling (Graph 3), and this result was

different from that found in the sequential analysis, where it does not appear saliently (Table 3). This result, where Dribbling preceded Shot with the foot, is similar to the behaviors observed in Messi and Ronaldo, and it is comparable to the results obtained from the 2010 World Cup semi-finalists (Machado et al., 2013; Castañer et al., 2016, 2017). In this context, it is possible that players with outstanding individual technical-tactical actions present greater possibilities to perform the shot with the foot than the players with a more collective action. This may highlight the well-known South American "skilled players". To sum up, the current trends underline the utilization of the collective game through pass in the creation phase (Barreira et al., 2014a; Michailidis, 2014; Castelão et al., 2015; de Andrade et al., 2015; Santos et al., 2016; Vivés et al., 2018), as it was found in the general results obtained in this investigation.

The relationship between the technical-tactical actions and the field zones where they were carried out presented some peculiarities (Figure 2). The passes with the foot had more motor connections in the right lane than in the left lane inside the central creation zones. These results were similar to different research findings, which analyzed the 2010 World Cup, European teams such as Manchester United, and Brazilian and Uruguayan teams (Barreira et al., 2014b; Sarmento et al., 2014; de Andrade et al., 2015; De Pablo et al., 2019). However, creation of the game on the sides through passes prevailed in other investigations carried out with Spanish teams, such as Espanyol and Real Madrid, in several World Cups, and in the best European soccer leagues (Barbosa et al., 2014; Barreira et al., 2014a; Sarmento et al., 2014; Santos et al., 2016; Diana et al., 2017; Vivés et al., 2018). Conducting was more frequent in the right lane than in the left lane inside the central creation area of the soccer field (Figure 2). The last results are indeed comparable to those reported in studies carried out with Espanyol (Vivés, 2012) and Real Madrid (Barbosa et al., 2014), although in these cases Conducting was used with greater frequency on the field sides inside the creation area.

In general, a larger number of connections with passes and conductions were observed in the right zone of the filed, with the use of depth in the right lane using pass actions, especially with passes to the penalty area, as an evident fact. This could be due to the larger number of right leg dominant attackers and the smaller number of left leg dominant defenders. Despite this, in this research, the frequency of utilization is similar in both lanes inside the central creation area of the field. Consequently, the use of both legs to carry out technical-tactical actions would exhibit the better motor skills of the best South American players compared with second-level players such as those who play in domestic soccer leagues (De Pablo et al., 2019). Furthermore, Rebound, whose occurrence is evident in the sequential analysis (Table 3), could be excited by offensive sequences carried out in the central lane of the field. These results are similar to those

registered in an elite team such as Manchester United and in the Spanish national team in the 2010 World Cup (Machado et al., 2013; Sarmento et al., 2014).

Obviously, shots prevailed in the finalization phase (Michailidis, 2014; Castelão et al., 2015; Vivés et al., 2018). In regard to Shot with the foot to score goals, the use of the left zone inside the goal area and the right zone inside the penalty area was particularly noticeable, with non-statistically significant differences and predominance of the first case (Figure2). In addition, Shot with the head and other parts of the body was most frequently used on the front side than on the right side of the penalty area. These results were similar to those observed in different World Cups, the best European leagues, the Brazilian league, and the Uruguayan championship, whose values highlight the use of shots from inside the penalty area to score goals (Armatas and Yiannakos, 2010; Michailidis, 2014; de Andrade et al., 2015; Santos et al., 2016; De Pablo et al., 2019).

In conclusion, the use of open game to score goals in the 2016 and 2017 CONMEBOL Libertadores Cups was relevant. Two sequences were outlined: the first highlights Pass with the head and other parts of the body, which could be a result of the high technical quality of the players; the second evidences the occurrence of Rebounds providing a greater chance of scoring goals randomly, as observed in other international championships. This conduct appears mainly from offensive sequences carried out in the central lane of the soccer field. On the other hand, the use of collective game through passes in the creation phase was the most frequent action before performing a shot to score a goal. However, Shot with the foot was also preceded by Dribbling, which may be a consequence of the performance of the well-known South American "skilled players".

The main limitation to this study is that it did not estimate the intensity of defense, that is, the technical-tactical actions executed for the defenders to accomplish the objective of avoiding goals or steal the ball. This may be the major limitation to the observational methodology, as it is very difficult establish an objective criterion to determine this variable.

PRACTICAL APPLICATIONS

Due to the wide and variable range of situations in soccer, practical applications could be considered from offensive or defensive perspectives. To train offensive sequences, coaches could present situations where players should carry out Pass with the head and other parts of the body or Pass with the foot and Shots in the soccer field zones highlighted in the research, as well as train Rebound anticipation to increase goal scoring efficacy. In contrast, coaches could design tasks where defenders must occupy the most used game spaces and execute defensive actions to avoid the most frequent offensive actions and their sequence occurrence, as well as train ball trajectory anticipation from Rebounds to avoid goals.

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CONFLICTS OF INTEREST

Conflicts of interest declaration not received.

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