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Quantifying the offensive sequences that result in goals in elite futsal matches

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ABSTRACT
The aim of this study was to quantify the type of offensive sequences that result in goals in elite futsal. Thirty competitive games in the Spanish Primera Division de Sala were analysed using computerised notation analysis for patterns of play that resulted in goals. More goals were scored in positional attack (42%) and from set pieces (27%) compared to other activities. The number of defence to offense “transitions” (n = 45) and the start of offensive plays due to the rules of the game (n = 45) were the most common type of sequences that resulted in goals compared to other patterns of play. The central offensive zonal areas were the most common for shots on goal, with 73% of all goals scored from these areas of the pitch compared to defensive and wide zones. The foot was the main part of the body involved in scoring (n = 114). T-pattern analysis of offensive sequences revealed regular patterns of play, which are common in goal scoring opportunities in futsal and are typical movement patterns in this sport. The data demonstrate common offensive sequences and movement patterns related to goals in elite futsal and this could provide important information for the development of physical and technical training drills that replicate important game situations.

1. Introduction
Futsal is the indoor 5-a-side equivalent of soccer and was developed in the 1930s (Barbero-Alvarez, Soto, Barbero-Alvarez, & Granda-Vera, 2008). More recently, Fédération Internationale de Football Association (FIFA) and Union of European Football Associations (UEFA) have standardised the rules of the game, thus allowing both domestic and international competitions to be popularised with an exponential increase in the number of participants involved in the game.

Despite its increasing popularity in the last 10 years, there is scant scientific evidence on the sport compared to other sporting codes (Duarte, Batalha, Folgado, & Sampiao, 2009). Some researchers have examined the physiological demands (Dittrich, Silva, Castagna, Lucas, & Guglielmo, 2011; Oliveira, Leicht, Bishop, Barbero-Alvarez, & Nakamura, 2013; Schultz de Arruda, De Freitas, De Moura, Aoki, & Moreira, 2013) and the physical characteristics of elite and sub-elite futsal players (Castagna, D’Ottavio, Granda Vera, & Barbero Alvarez, 2009; Dogramaci, Watsford, & Murphy, 2011). Although less work has been carried out on the match activities of futsal players, particularly the quantification of fundamental movement patterns of players during offensive sequences of the play (Jovanovic, Sporis, & Milanovic, 2011; Lapresa, Alvarez, Arana, Garzón, & Caballero, 2013; Travassos, Araújo, Vilar, & McGarry, 2011).

A recent systematic review of the literature pertaining to match analysis in the footballing codes identified that previous work has focused mainly on the description of physiological aspects of match-play (Sarmento et al., 2014). A current challenge in this area of research involves creating suitable movement sequences that can clearly identify and categorise individuals and behaviours over time. A valid predictor of sporting behaviour involves examining tactical strategies of individuals within a team, with the aim to identify common movement patterns during particular sequences (James, 2012).

Futsal is a game with a random intermittent nature, whereby critical elements of the game are sometimes determined by chance. Thus, the training process should aim to develop regular individual/team behaviour sequences. Attempting to predict future performance on the basis of previous performances is a challenging task yet important for match analysts (James, 2012). Typically, the basis for any prediction model is that performance is repeatable, to some degree. In other words, events that have previously occurred will occur again in some predictable manner. This type of prediction is based on the principle that any performance is a consequence of factors like prior learning, inherent skills and situational variables. Although this is a challenge given that movement patterns and technical performance indicators vary substantially from game to game in most footballing codes (Van Winckel et al., 2014).
Researchers in this area should adopt a multifactorial approach when employing statistical analyses, thus improving the ability to find associations between variables and the effect of different interactions (Sarmento et al., 2014). One promising area of research that has been recently employed at investigating common movement patterns in team sports is T-pattern analysis (Camerino, Chaverri, Anguera, & Jonsson, 2012; Lapresa, Álvarez, et al., 2013; Lapresa, Anguera, Alsasua, Arana, & Garzón, 2013; Sarmento et al., 2014). After studying the existing methods and software and running into their limitations regarding the analysis of naturally occurring behaviour as complex real-time processes, Magnusson (1978) set out to develop new structural concepts and tools and in particular for the discovery of hidden patterns of behaviour.

The detection algorithm used in the software Theme allows the detection of repeated temporal and sequential structures in real-time behaviour records that cannot be fully detected through unaided observation or with the help of statistical methods (Borrie, Jonsson, & Magnusson, 2002). A temporal pattern is essentially a combination of events, which occur, in the same order with temporal distances between each other, which remain relatively invariant in relation to the null hypothesis that each component is independent and is distributed randomly in time (for review, see Casarrubea et al. (2014)). As stated by Magnusson (2000, p. 94), “that is, if A is an earlier and B a later component of the same recurring temporal pattern then after an occurrence of A at t, there is an interval [t+d1, t +d2] (d2≥d1≥d0) that tends to contain at least one occurrence of B more often than would be expected by chance”.

This software has been extensively used in several areas of knowledge both in animal (Feenders & Bateson, 2012; Nicol, Segonds-Pichon, & Magnusson, 2015) and human studies (Sandman, Kemp, Mabini, Pincus, & Magnusson, 2012; Woods, Yefimova, & Brecht, 2014).

Although no research exists that has examined T-pattern analysis of elite futsal match play during sequences that result in goals. Taking into account that goal scoring is the ultimate objective measure of offensive effectiveness in futsal match play, the aim of the present study was to quantify the type of offensive sequences that result in goals in elite futsal.

2. Methods

2.1. Players

Data were collected from a single Spanish team in the Primera División de Sala and consisted of 30 games and 17 individual players. The team qualified to the championship playoffs. Original data files included 126 goals scored. Ethical approval was granted from the appropriate institutional ethics committee.

2.2. Data coding system

The present study used an observational instrument that has a combination of a field format and a system of categories as criteria (Anguera, 2003; Anguera, Magnusson, & Jonsson, 2007); from a validated list of the most important futsal activities. This observational instrument enabled all notational events to be coded effectively. The finalised list of notational activities was selected based on an extensive review of futsal literature and by consulting a panel of experts in the area (coaches and researchers in the game). Based on the suggestions from the panel, the following observational instrument was developed (Table I). This instrument included the following categories that were used to code notational events: (1) start of the offensive process; (2) phases of the offensive process; (3) development of the offensive process; (4) spatial characterisation of the field (Figure 1); (5) body part that performed the shot on goal; (6) number of the player. The validated coding instrument mentioned above was used to code all futsal activities in each game and data were subsequently placed in Microsoft Excel. The reliability of the data collected was subjected to intra- and inter-observer agreement analysis using Cohen’s kappa (Cohen, 1960). Values >0.90 were achieved for all criteria.

2.3. Data analysis

Specialised software (THÈME V. 5.0) was used for the detection of temporal patterns of play during futsal matches. This algorithm is based on the assumption that the flow of complex human behaviour (e.g. sports performance) is based on the sequential structure as a function of time, and has a discrete nature that is not fully detectable without the use of standardised statistical and behavioural methods (Borrie et al., 2002).

The following criteria were used in order to detect the T-patterns during games: (1) a minimum frequency of three occurrences was set in each match dataset; (2) the level of significance was set at $P < 0.05$ and (3) the T-patterns detected were only accepted if the software detects them among all the additional randomly generated relationships. To reduce against this artefact, the software used well described algorithms to detect temporal patterns of importance (Magnusson, 1996, 2000, 2005, 2006).

Taking into account the variability of actions that characterise indoor soccer (like in football), the investigators in this research area (e.g. Camerino et al., 2012; Lapresa, Álvarez, et al., 2013; Lapresa, Anguera, et al. 2013; Sarmento et al., 2014) have considered that an action that is repeated three times, established a significance level <0.05, is relevant for being consider as a regular behaviour. Additionally, if the researchers failed to opt for the above criteria it could have increased the degree of difficulty in identifying completed T-patterns (i.e. behaviours that include the beginning, development and end of the offensive sequences). All actions in games were registered in a systematic manner taking into consideration the breakdown of successive actions. Despite this limitation, it was still possible for this software to quantify repetitive T-patterns of behaviour (Anguera, 2004, 2005). The most valuable contribution of T-patterns arises from the possibility of detecting particular types of temporal structures (Borrie et al., 2002). Given that patterns facilitate the detection of hidden structures, they are of significant importance in the analysis of a futsal game. This type of analysis allows the representation of a specific movement pattern which corresponds to the actions that occur in that specific order. Statistical Package

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for the Social Sciences (SPSS) 20.0 was used to calculate descriptive statistics.

3. Results

3.1. Temporal and zonal analysis

The greatest number of goals was scored in attacking positions (42%), from set pieces (27%) and fast counterattacks (27%) compared to other activities such as offensive (4%) and defensive (2%) play in a “4 vs 5” situation. The central offensive zonal areas were the most common for shots on goal (n = 92) compared to other areas, with 73% of all goals scored from these areas of the pitch compared to defensive and wide zones. When breaking down the goals into zonal areas it seems that only 2 goals were scored from the defensive zone, 14 goals from the midfielder zone, 47 from the offensive zone and 52 goals from the ultra-offensive zone. It is noteworthy that 44 goals were scored inside the penalty area with the offensive and ultra-offensive zones accounted for a total of 37 and 44 goals, respectively. From the points 1 (Z1) and 2 (Z2) were performed 11 goals. Finally, 18 goals were scored from the side corridors (left and right)

3.2. T-pattern analysis

The data analysis revealed the existence of 345 different T-patterns, ranging from 1 to 5 levels and including 2–8...
Data were selected that included complete T-patterns \((n = 5)\), which comprised of the offensive sequence from start to its finish. T-patterns that were associated with goals scored on at least three separate occasions were analysed in greater detail in the software and subsequently represented in Figures 3–7.

Figure 3 represents the first complete T-pattern which was repeated five times during sequences that ended in a goal. This figure presents a graphical representation of the offensive sequence that results in a goal, and the Theme output of the detected pattern, composed of three boxes: (1) the box in the top left corner of the screen highlights the hierarchical construction of the pattern using a dendrogram. The right-hand edge details the technical action taking place within the pattern. The left-hand side details the structure of the pattern and how a combination of simple patterns combines to form a more complex pattern; (2) the upper right hand box contains information about the frequency and real-time distribution of event types in the pattern. The dots represent event occurrences and the zig-zag lines connecting the dots represent pattern occurrences. Thus, the number of lines illustrates how often the pattern occurs; (3) the bottom box contains information about the real-time structure of the offensive pattern. It shows lines displaying the connections between events, the times at which they take place, and how much time passes between event occurrences and pattern occurrences.

This comprised of a positional attack pattern and included six events: (1) the pattern was initiated by a player transitioning in the left midfield zone (ZME); (2) followed by a through pass (DPOp) from the left midfield zone (ZME), to another
player; (3) that player then controls the ball (DPOrc) in the right midfield zone (ZMD); (4) this player keeps moving forward into a more offensive position and then makes a through pass (DPOp) from the right midfield zone (ZMD) in the direction of another player; (5) this player follows the same direction of the ball (DPOcb) from the same zone (ZMD) and (6) this sequence is finished with a shot from the right central zone (ZOCD) that results in a goal (DPOgol).

Figure 4 represents the second complete T-pattern which was repeated five times during sequences that ended in a goal. This comprised of a second type of positional attack pattern and included four events: (1) players start by transitioning (IPOt) in the right midfield zone (ZMD); (2) a pass is produced (DPOp) from the right midfield zone (ZMD) to a second player; (3) followed by a through pass (DPOcb) from the left midfield zone (ZME) in the direction of the opponent goal and (4) this sequence is finished with a shot from the right central offensive zone (ZOCD), which results in a goal (DPOgol).

Figure 5 represents the third complete T-pattern, which was repeated five times during sequences that ended in a goal. This comprised of a third type of positional attack pattern that included four events: (1) players start by transitioning (IPOt) in the right midfield zone (ZMD); (2) a pass is produced (DPOp) from the right midfield zone (ZMD) to a second player; (3) ball is moved (DPOcb) in the direction towards the opponent goal from the right midfield zone (ZMD) and (4) this sequence is finished with a shot from the right central offensive zone (ZOCD), which results in a goal (DPOgol).

Figure 6 represents the fourth complete T-pattern, which was repeated five times during sequences that ended in a goal. This comprised of a fourth type of positional attack pattern that included three events: (1) players start by transitioning (IPOt) into the left midfield zone (ZME); (2) a pass is produced (DPOp) from the midfield zone (ZME) and (3) this sequence is finished with a shot from the ultra-offensive central zone (ZUOCD), which results in a goal (DPOgol).

Figure 7 represents the final complete T-pattern, which was repeated five times during sequences that ended in a goal. This comprised of an offensive sequence from a set-piece that included two events: (1) an infringement has occurred and the team in possession have a free kick 10 m from goal (IPOj) and (2) a shot from the free kick (Z2) results in a goal (DPOgol).

4. Discussion

The aim of this study was to quantify the type of offensive sequences that result in goals in elite futsal. The T-patterns that were detected in this study and subsequently analysed represent 21% of all goals scored. These
included basic movement patterns in the game such as pivot combinations, parallels and diagonals along with set-pieces. These data demonstrate common offensive sequences and movement patterns related to goals in elite futsal and this could provide important information for the development of physical and technical training drills that replicate important game situations for all levels and ages.

The first four patterns start in the midfield offensive zone (right and left), through transitions that are developed by positional attacks. In the first pattern, the offensive sequence is developed through a pass to the pivot player (in futsal this field position is characterised by the most offensive central zone). Normally, the pivots are characterised by their capacity to receive and control the ball and by their decision-making capabilities (Braz, 2006). In this situation, the pivot received the ball in the ZME and performed a pass to the ZMD, where another player finished and scored. In the second pattern, the pivot player receives a pass but in this case, through the conduction of the ball without the ball in the direction of the opposition goal, a player from the defensive sector of the team (Voser, 2001). They then receive and move the ball into the ZOCD where a shot occurs that results in a goal. Another basic movement pattern within futsal is the diagonal. In this case, a player from the defensive sector of the team, moves into the offensive half of the pitch through a diagonal run (Voser, 2001) until the ZUOCD is reached and a shot occurs.

The final pattern found displayed very different characteristics to the other patterns since all seven goals were scored from a free kick 10 m away from the opposition goal. This type of set piece usually occurs due to an accumulation of fouls by the opposition team. For each foul committed by the opponent, a 10 m free kick is awarded to any outfield player (Lozano, 1995). Thus this should be considered a fundamental strategic situation that is only found in futsal and not in other

Figure 5. Graphical representation of T-pattern 3.
sports. Professional coaches advocate the use of systematic set pieces training as part of the modern game and our data therefore support that assertion (Lozano, 1995; Sarmento et al., 2014; Voser, 2001).

Additionally to the T-pattern analysis, the frequency analysis of the data also suggest that the teams frequently start offensive sequences that result in a goal, through the transitional play and set plays. Therefore, the set pieces, positional attack and the capacity to maintain ball possession are strengths that characterise the style of play of this team. The central offensive zonal areas were the most common for shots on goal compared to other areas, with 64% of all goals scored from these ZUOCE, ZUOCD, ZOCE and ZOCD zones of the pitch compared to defensive and wide zones. This finding is similar to the previous work by Álvarez, Manero, Manonelles, and Puente (2004), which concludes that 90% of the 1771 analysed goals in the Spanish Futsal League were scored from a similar area. Similarly, Martin (2009), Alves (2010) and Lapresa, Álvarez, et al. (2013) confirmed this zonal trend in futsal, while Yiannakos and Armatas (2006) found a similar tendency in football. These data, in addition to the detected regular structures of behaviour (T-patterns), are even more important given that the analysed team can be characterised as a successful team as it has qualified to the championship playoffs, thus these tendencies of the game can help the coach and team achieve success.

The present findings concerning the area of the body used to score goals are in line with previous research (Álvarez et al., 2004). Players typically scored more goals with the inside edge of the foot (54%), followed by the instep (27%). However, Lapresa, Álvarez, et al. (2013) demonstrated that the Spanish National team in the 2010 UEFA Futsal Championship scored more goals with the instep (55%), and the inside edge of the foot (22%). These results are consistent with the current literature (Castelo, 2009) that state that using the inside edge of the
foot increases ball precision and placement, with the instep of the foot allowing players to take shots from any area of the field while influencing the ball speed (Lapresa, Álvarez, et al., 2013).

Determining which style of play is the most effective has long been disputed in football performance (Hughes & Franks, 2005; Tenga, Holme, Ronglan, & Bahr, 2010a, 2010b). Although the present study suggests that positional attack was the most efficient. We emphasise that this situation is the result of the complex interaction of different factors such as the philosophy of the playing style, the tradition, identity and history of the club, the quality of the players, as well as the specific environment that characterises the game (e.g. the quality of opposition, match status) (Sarmento, Barbosa, Campaniço, Anguera, & Leitão, 2011).

5. Conclusions
Futsal tactical analysis should not only include the action of the players but also the sequences of game play resulting from these actions, particular the patterns that result in goals. Despite the importance attributed to tactical–technical factors to the success of futsal teams, this element of the game is not well understood. The complexity of the T-patterns observed in this study highlight the intricate nature of futsal performance and a greater understanding of this area is needed to optimise the performance in the game. Our data demonstrate that the greatest number of goals were scored in attacking positions and from set pieces and are scored from central offensive zonal areas by using the inside edge and instep of the foot. T-pattern analysis of offensive sequences revealed regular patterns of play that are common in goal scoring opportunities in futsal and are typical movement patterns in the sport. This information could help develop physical and technical training drills that replicate important game situations.

Disclosure statement
No potential conflict of interest was reported by the authors.

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