Journal of Physical Education and Sport ® (JPES), Vol. 21 (issue 6), Art 451, pp. 3319 - 3325, December 2021
online ISSN: 2247 - 806X; p-ISSN: 2247 – 8051; ISSN - L = 2247 - 8051 © JPES

Original Article

Euro 2020 goal analysis: an ecological dynamics approach for football shooting practice

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Published online: December 30, 2021
(Accepted for publication December 15, 2021)
DOI:10.7752/jpes.2021.06451

Abstract:
The development and practice of shooting skills in football often involves the use of stationary defenders and inanimate equipment. Previous research has focused on the biomechanical, physiological and psychological aspects of shooting, with less attention being applied to the ecology of shooting within the performance environment. The aim of this study was to identify and analyse Euro 2020 goal scorers' perception of defender proximity between the moment of the assist pass and the finish to offer guidance to coaches when designing shooting practice drills. Using an observation approach, goals scored by one- and two-touch finish (n=67) were analysed. Data collected were the proximity changes between goal scorer and defenders at the moment of the assist pass and finish. Proximity zones were based on the goal scorer's ability to take one, two, or three or more touches before shooting. Intra-rater and inter-rater reliability scores for the observation approach were high. 340 defender positions were analysed using dependent samples t-test and results revealed the proximity between goal scorer and defenders to significantly change between the moment of assist pass and finish if the defenders were within a closer proximity. Defender proximity changes outside of a two-touch zone for the goal scorer showed to have no significant impact. Data suggest that the use of stationary defender positions or inanimate equipment may not be effective when performing shooting practice drills due to the proximity changes the goal scorer will experience in the performance environment. Results showed all goals were scored from central pitch positions from assist passes in both central and wide areas. Practical implications are offered to guide coaches in practice drill design to create an ecologically dynamic environment where defenders change position between the moment of assist pass and finish.
Key Words*:* **- representative learning design, soccer, performance analysis, elite, professional**

Introduction

The UEFA European Football Championships (Euro) provide an arena for the best European footballers to compete against each other. In football, goal scoring is a vital and complex skill involving multiple players to determine match outcomes (Kubayi, 2020; Wang & Qin, 2020). The complex and unpredictable nature of open play goals (goals scored not from a dead ball situation), which is the most common route to goal scoring in football, has been studied in several recent major championships. In Euro 2016 there were a total of 108 goals scored with most open play goals being scored by a one-touch (54.63%) or two-touch (17.59%) finish (Tokul & Mülazimoglu, 2018). A similar pattern was observed in the 2018 football World Cup with one-touch (72.61%) and two-touch (15.28%) finishes providing the most likely routes to goal scoring (Çobanoglu, 2019). Due to the significant influence a goal scorer will have on match outcomes (Holienka, et al., 2020), an understanding of scoring patterns will have an impact on how coaches design and implement practice programmes and coordinate goal scoring tactics to enhance the chances of team success (Kubayi, 2020).

To enhance a team's ability to score more goals, physiological training programmes (Atabaş & Yapici, 2018; Rawat & Gangwar, 2019), goal target changes (Hidayat, 2018), gaze behaviour (Wood & Wilson, 2010), player physiology (Burhaein et al., 2020), football boot design (Kryger et al., 2020), and goal scoring patterns (Kubayi, 2020) have all recently been suggested to effect shooting ability and scoring success in football. A dynamic approach to analysing goal scoring has also been popular in recent years, which has led to the development of a goal expectancy measure to assess scoring performance using shooting positions and angles (Ruiz et al., 2015), network analysis that shows teams with a higher level of passing activity tend to score more goals, and machine learning algorithms that allow for the identification and comparison of teams' goal-scoring styles and formations in different game situations (Pratas et al., 2018). However, limited research attention has been applied towards analysing the proximal relationship between defenders and attackers at the final moment before a goal is scored, which is temporally pivotal in the execution of skills in a performance environment (Travassos et al., 2013).

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The study of ecological dynamics in sport identifies the crucial role spatial-temporal cues play within skill acquisition and performance where there is continuous interplay between possibilities and actions (Araújo et al., 2020). A practice environment where activities are representative of the perceptual information experienced within the performance environment will allow individuals to develop adaptive behaviours and movements that will transfer to competition performance (Pinder et al., 2011). Therefore, breaking down and isolating the different elements of shooting during practice may create an unrepresentative environment and cause maladaptive learning (Woods et al., 2020). Schulze et al. (2018) identified shooting accuracy changes in relation to defender positions, which highlights the need to add contextual factors to goal scoring situations. Headrick et al., (2012) analysed the behaviour within attacker-defender dyads and reported behavioural changes to be influenced by the proximity to goal. Orth et al. (2014) studied the effect of defender pressure on crossing ability and reported running approach velocities to the ball to increase if the defender's location was nearer. Travassos et al. (2012), albeit within 5-a-side futsal, provided an analysis on match play and found that passing actions were influenced by spatial-temporal information.

Despite the advancement in performance analysis techniques and the attempts to implement ecological dynamics theory into football research to develop our understanding of why and how performance occurs (Travassos et al., 2013), there has been no research, to our knowledge, that has attempted to analyse attacker perceptions during elite competitive matches. Therefore, the need to investigate the spatial-temporal arrangements between players, especially the way in which attackers attempt to destabilise defensive systems, is fundamental to goal scoring and should be a coach's central focus during practice rather than working within predictable and isolated routines (Vilar et al., 2012). The purpose of this study was to i) identify the goal scorer's perception of defender proximity between the moment of assist and moment of finish, ii) evaluate the reliability of using a perceptual observation approach to identify player proximity, iii) offer guidance to coaches for shooting practice drills that are perceptually relevant to a competitive match environment.

Method

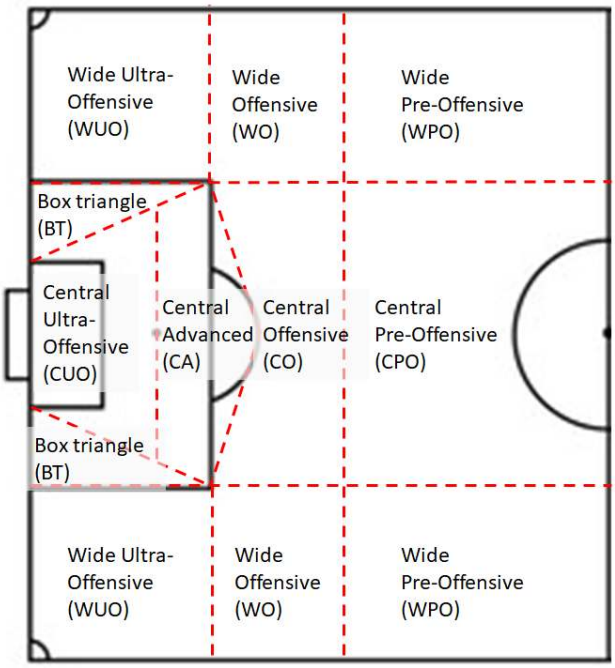
Sample and Variables

Goals scored by one or two touch finish from an assist in open play in Euro 2020 were analysed (n=67). The variables were the position of the goal scorer (GS) relative to opposition defensive players at the moment of assist (MOA) and moment of finish (MOF). A total of 340 defender positions were recorded and analysed. Defender positions relative to the GS were separated into three zones (see table 1). Defender positions were analysed through video footage rather than still images to enhance perceptual accuracy (i.e., the observer would use defender body position and previous momentum to aid in the identification of how many touches the GS perceived to have before the defender could engage). The area of the pitch where the MOA and MOF occurred was recorded using a spatial analysis pitch map (González-Ródenas et al., 2019) shown in figure 1. Data was analysed by the primary researcher who is a qualified Football Association coach with over a decade of coaching experience.

Table 1. Proximity of defenders to goal scorer

<table>
<tr><td rowspan="3">Zone 1
Defender has actual or very close physical contact with the GS so that only a 1-touch finish is possible.</td><td>Zone 1A
Defender position between GS and goal.</td></tr>
<tr><td>Zone 1B
Defender position in front of GS on 180-degree line parallel with 6- and 18-yard box but not between GS and goal.</td></tr>
<tr><td>Zone 1C
Defender position behind GS on 180-degree line parallel with 6- and 18-yard box.</td></tr>
<tr><td rowspan="3">Zone 2
Defender position is close enough to the GS that a 2-touch finish is possible.</td><td>Zone 2A
Defender position between GS and goal.</td></tr>
<tr><td>Zone 2B
Defender position in front of GS on 180-degree line parallel with 6- and 18-yard box but not between GS and goal.</td></tr>
<tr><td>Zone 2C
Defender position behind GS on 180-degree line parallel with 6- and 18-yard box.</td></tr>
<tr><td colspan="2">Zone 3
Defender position to GS will allow multiple touches and is between GS and goal.</td></tr>
</table>

Figure 1. Spatial analysis pitch map



Procedure

Match footage was obtained from open-source media. Each goal was screened and only those that met the criteria of being scored with a one or two touch finish from open play following an assist pass were analysed. An observation was undertaken of the GS's perception of defender proximity which involved the frequency and position (see table 1) of defenders during the MOA and the MOF.

The observer judged whether the defender/s position to the GS would cause the GS to take one, two, or three or more touches to finish (score). Data were entered into a computerised spreadsheet and took approximately 10 hours. Intra-rater reliability was conducted on 100% of the data six weeks after the first analysis was completed. Cohen's kappa revealed an extremely high level of agreement between all zones that ranged from k = 0.833 to k = 0.978.

Inter-rater Reliability Testing

A second qualified Football Association coach (Secondary Researcher) analysed 100% of the data. Cohen's kappa was used to assess interrater reliability due to the study's fully-crossed design with two coders (Hallgren, 2012). Inter-rater reliability was conducted on all zones (see table 2) with level of agreement predominantly between substantial and near perfect (Landis & Kock, 1977).

Table 2. Interrater reliability scores

Zone	k Score	Interpretation
MOA 1A	0.643	Substantial
MOA 1B	0.616	Substantial
MOA 1C	0.446	Moderate
MOA 2A	0.662	Substantial
MOA 2B	0.623	Substantial
MOA 2C	0.643	Substantial
MOA 3	0.934	Near Perfect
MOF 1A	0.857	Near Perfect
MOF 1B	0.784	Substantial
MOF 1C	0.833	Near Perfect
MOF 2A	0.824	Near Perfect
MOF 2B	0.713	Substantial
MOF 2C	0.760	Substantial
MOF 3	0.909	Near Perfect

Data Analysis

Descriptive statistics were generated to provide an overall illustration of all goals scored in the tournament. To assess the perceptual differences between MOA and MOF, data was analysed using the dependent samples t-test in the Statistical Package for Social Sciences (SPSS version 28) with significance set at $p > 0.05$.

Results

A total of 142 goals were scored at Euro 2020. Goals were scored from open play (114), penalty kick (9), own goal (9), corner set piece (6), freekick set piece (3), and direct freekick (1). Sixty-seven (58.77%) of the 114 open play goals were either a one (n=53) or two touch (n=14) finish. All the analysed goals were scored from central positions (CUO 79.1% (n=53), CA 16.4% (n=11), and CO 4.5% (n=3)) with positions of assist balanced between wide (49.3%) and central (50.7%) areas (see table 3).

Means for MOA and MOF zones can be seen in table 4, which also highlights how many defenders might be used in a representative training drill of 10 repetitions. There was a significant difference between zone 1 defender positions for MOA (M=0.37, SD= 0.57) and MOF (M=0.69, SD= 0.7) conditions; t(66)= -3.20, p= 0.002 and between zone 2 defender positions for MOA (M=2.04, SD= 1.39) and MOF (M=1.7, SD= 1.14) conditions; t(66)= 2.248, p= 0.028. No significant difference was found between zone 3 defender positions for MOA (M=0.16, SD= 0.45) and MOF (M=0.1, SD= 0.35) conditions; t(66)= 1.16, p= 0.251.

Further zone analysis revealed significant differences between defender positions in zone 1A MOA (M=0.06, SD= 0.24) and MOF (M=0.19, SD= 0.47) conditions; t(66)= -2.248, p= 0.028, zone 1C MOA (M=0.12, SD= 0.37) and MOF (M=0.27, SD= 0.51) conditions; t(66)= -2.307, p= 0.024, and zone 2B MOA (M=1.19, SD= 1.10) and MOF (M=0.69, SD= 0.80) conditions; t(66)= 4.130, p= 0.000. Defender positions at zone 1B, 2A and 2C showed no significant difference between MOA and MOF.

Table 3. Position of the football at MOA and MOF

Area of Pitch	Moment of Assist	Moment of Finish
Wide Ultra-Offensive (WUO)	9	0
Box Triangle (BT)	12	0
Central Ultra-Offensive (CUO)	11	53
Central Advanced (CA)	8	11
Wide Offensive (WO)	8	0
Central Offensive (CO)	13	3
Wide Pre-Offensive (WPO)	4	0
Central Pre-Offensive (CPO)	2	0

Table 4. Analysis of MOA and MOF zone data

Zone	MOA	MOA Defenders for Representative Training Drill (per 10 reps)	MOF	MOF Defenders for Representative Training Drill (per 10 reps)
1A	M = 0.06, SD = 0.24	1	M = 0.19, SD = 0.47	2
1B	M = 0.19, SD = 0.43	2	M = 0.22, SD = 0.45	2
1C	M = 0.12, SD = 0.37	1	M = 0.27, SD = 0.51	3
Total Zone 1	**M = 0.37, SD = 0.57**	**4**	**M = 0.69, SD = 0.70**	**7**
2A	M = 0.16, SD = 0.45	2	M = 0.27, SD = 0.57	3
2B	M = 1.19, SD = 1.10	10	M = 0.69, SD = 0.80	7
2C	M = 0.69, SD = 0.82	7	M = 0.75, SD = 0.88	8
Total Zone 2	**M = 2.04, SD = 1.39**	**10**	**M = 1.70, SD = 1.14**	**10**
3	M = 0.16, SD = 0.45	2	M = 0.10, SD = 0.35	1

Discussion

The purpose of this study was to i) identify the goal scorer's perception of defender proximity between the moment of assist and moment of finish, ii) evaluate the reliability of using a perceptual observation approach to identify player proximity, iii) offer guidance to coaches for shooting practice drills that are perceptually relevant to a competitive match environment. This study identified perceptual differences between the MOA and MOF in many of the analysed zones. The results suggest that when attempting to score a goal in elite football, the environment is highly dynamic with the proximity between attacker and defenders changeable in the short moment between the assist pass and shooting.

Data suggested that defender proximity to the GS became closer at the MOF in zone 1, which is similar to the results from Headrick et al. (2012) who reported defender proximity to be closer to the attacker when the chances of scoring increased (e.g., attacker got nearer to the goal). Data also suggested that multiple defenders were likely to be present in zone 2 during both MOA and MOF. The changing of defender proximity to the GS within the short time period between the MOA and MOF reinforces the need for attacking players to be adaptable to proximity changes when they execute shots (Schulze et al., 2018).

In line with ecological dynamics, the current study indicates that isolated technical skill training, such as predictable shooting drills with stationary defenders or equipment (e.g., poles and mannequins), will not serve to develop the performance skills required in goal scoring (Orth et al., 2014). However, it is unclear from results whether the GS actively changed their proximity to defenders to create a goal scoring opportunity or whether the GS had to adapt to changing defender positions. Comparisons between MOA and MOF zone 3 data would suggest that defenders with a proximity of more than 3 touches away from the GS would not affect them and, therefore, should not be factored into training routines. Further analysis of zone data showed significance differences within zones 1A, 1C, and 2B and no significant difference within zones 1B, 2A, and 2C. These findings may indicate that zone 1 is a more dynamic space that has a greater perceptual impact on attacking players. Study results state the pitch location where the assist pass was made to be evenly balanced between central and wide positions and offensive and ultra-offensive positions (see figure 1 and table 3), which differs somewhat to the findings of González-Ródenas et al. (2019) who identified ultra-offensive wide positions as producing the most frequent assist position in elite European football. The reasons behind this are unknown but could be the result of evolving tactics in elite football (Bush et al., 2015).

This was the first study known to the authors to use an observational approach to gaining perceptual information within the competitive football performance environment. The need to identify player perception within a dynamically evolving environment is required to understand and develop skills (Woods et al., 2020), with the approach used in this study offering acceptable reliability. The intra-rater ($k = 0.833$ to $k = 0.978$) reliability scores were near perfect and very similar to those reported by Kubayi (2020) ($k = 0.81$-1.00). Interrater reliability was found to range from substantial to near perfect (Landis & Kock, 1977) with only MOA zone 1C returning a moderate score (see table 2).

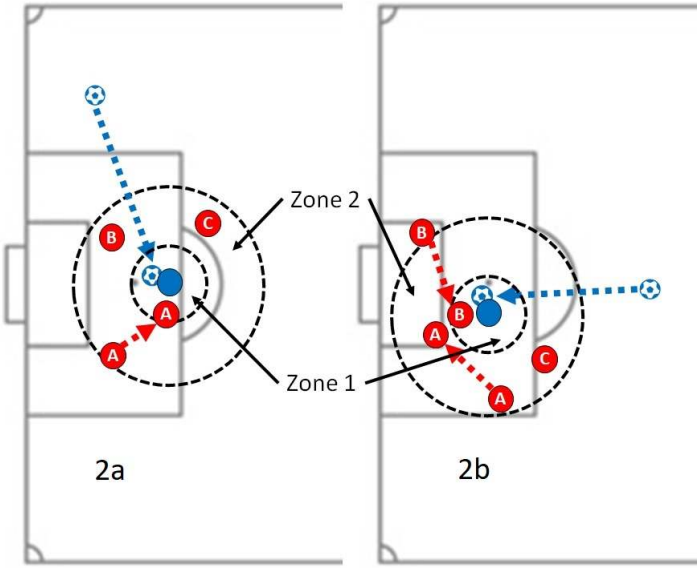
The results suggest this observational approach is reliable, but far more data collection is required before it should be considered as a practical method to analyse goal scoring situations. Future research may wish to consider applying this approach to talent identification and scouting through the use of a proximity profile (e.g., if the proximity profile of goal scorers at an elite level is known, players from lower competition levels may be identified who match the elite level profile). Finally, this study collected data from elite level football and further research should be conducted at lower levels to identify any perceptual pattern changes.

Practical Implications

To best develop goal scoring in footballers, coaches should ensure training drills are dynamic with defenders changing position from the MOA to the MOF. The following practical implications could be applied to the technical action of shooting with one or two touches, which can be added to further pre-shooting movements undertaken by the attacker and defenders. Table 4 suggests the defender positions per 10 repetitions of a shooting drill. For example, within all drills there should be a single defender or multiple defenders within zone 2 for both the MOA and MOF. Defenders in zone 1 can vary from zero to one but should increase at the MOF. The position of the attacker and defenders will differ depending on the area of the assist, but all shots should be from a central position.

The use of flat disc markers is recommended to identify starting positions for defenders from which they can create a changing situation. Coaches will need to focus most of their attention and time coordinating the defensive positions and ensuring they are constantly changing. Figure 2 gives an example of a routine based on the data from this study (Figure 2a: wide assist pass with defender A moving from zone 2 (MOA) to zone 1 (MOF) with defender B and C maintaining their positions. Figure 2b: central assist pass with defender A moving within zone 2 (between MOA and MOF), defender B moving from zone 2 (MOA) to zone 1 (MOF) and defender C maintaining their position in zone 2).

Figure 2. Example of a shooting practice routine



Conclusions

The findings from this study suggest the proximity between goal scorer and defenders will change between the moment of the assist pass and when the final shot is taken. This study has reported results that are in line with previous ecological dynamics research and highlights the need for football coaches to understand and implement the perceptions of players in the competition environment when devising training routines. Practising the skill of goal scoring without the perceptual cues found in competitive football may cause maladaptive learning behaviours. Coaches will benefit from the knowledge produced in this study when designing and implementing practice shooting drills, with particular focus being given to the defensive system (e.g., frequency, location and movement of defenders) that an attacker has to destabilise to create a shooting opportunity. Shooting practice routines should be highly dynamic with defenders moving constantly between one and two touch zones to represent the competitive performance environment. Data analysis also revealed that goal scorers scored within central areas from both central and wide assist passes, which should also be factored into shooting drill design. The observational method used in this study to gather attacker perceptions of the performance environment was shown to offer high reliability. Overall, this study is of benefit to coaches to enhance individual goal scoring skills.

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