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ORIGINAL ARTICLE

Proximity differences between forwards and defenders during goal scoring in soccer

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ABSTRACT

The role of a forward player in soccer is to score goals by destabilising defensive systems. The act of goal scoring in open play is fast paced with players requiring perceptual ability to navigate the environment. The purpose of this research study was to explore goal scorers' ability to perceive and adapt to the environmental threats to goal scoring at different competitive levels. All open play goals scored by forward players in the 2022/23 English Premier League, Championship, League 1, and League 2 divisions were analysed. Four observers recorded the proximity of defenders to the goal scorer at the moment of assist pass and moment of finish. Results showed significant differences existed between the proximity of defenders to the goal scorer between the assist pass and finish. When data was isolated to one touch finish goals within highly offensive zones, a reducing pattern of significant difference was found as league standard decreased. Findings offer an insight into the perceptual ability of forward players to destabilise defensive systems. Recommendations for practice design and talent identification are proposed.

Keywords: Performance analysis, Football, Perceptual ability, Scanning, Practice, Talent identification.

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INTRODUCTION

Successful actions in football require players to make rapid decisions within a complex and dynamic environment containing unpredictable movement patterns (Davids et al., 2013). Offensive players are tasked with creating space to destabilise defensive systems to provide shooting opportunities (Hewitt et al., 2016; Kempe & Memmert, 2018). Football is a low scoring sport and the analysis of goal scoring success is key to performance improvements (Rodenas et al., 2020). Thus, the capability of a team to maximise the creation of goal scoring opportunities is a vital aspect of winning (Harrop & Nevill, 2014; Holienka et al., 2020). Defensive destabilisation occurs through individual actions while in possession, such as dribbling, as well as out of possession reactive movements or tactical team patterns to counter defensive systems (Vilar et al., 2012). When research attention has been focused on the act of goal scoring, the spatial-temporal performance indicators that destabilise defensive systems include the type, accuracy, frequency and location of passes in the build-up to shooting, and the efficiency and location of the shot (Pratas et al., 2018). Underpinning all goal scoring performance indicators within the football environment is a player's perceptual ability, defined as the ability to "*locate, identify and process environmental information to integrate it with existing knowledge and current motor capabilities in order to select and execute appropriate actions*" (Schumacher et al., 2018).

Football players with greater perceptual ability are reported to exhibit superior adaptability to navigate the complex environment and create opportunities to score, such as demonstrating quicker response times to environmental cues (Williams, 2000). When attempting to create opportunities to score, footballers are required to make rapid movement decisions to disrupt defensive systems (Travassos et al., 2012). The enhanced perceptual ability of expert footballers is characterised by visual search behaviour that enables quicker decision making and greater response accuracy (Vaeyens, Lenoir, Williams & Philippaerts, 2007). Effective visual search behaviour is likely developed through experience and time engaged within the football environment, rather than merely a superior ability to recall information (Williams et al., 2012), which produces successful movements through decision making that is deep-rooted within environmental cues (Araujo et al., 2006). Potentially, therefore, footballers who have higher perceptual ability to innovate, improvise and respond to the affordances within the environment have a greater chance of scoring goals. For example, high perceptual ability players performing at higher competition levels may be able to evaluate defender locations, track the ball, and move themselves into spaces where defenders will not contest or block the ball during the action of shooting. Forward players in higher leagues should display greater perceptual ability.

Although a sought-after trait in expert footballers, perceptual ability has been grouped within generic task abilities rather than hold separate consideration within talent identification and development research (Sarmento et al., 2018); likely due to objective measurement difficulties (van Maarseveen et al., 2018). Observational recordings of visual perception in football has provided an objective measure, referred to as scanning, which records the frequency of attention shifting between different locations in the visual display (Jordet, 2005). Pokolm (2021) defined scanning as a "*self-initiated head movement in which the player's face was temporarily directed away from the ball, presumably to look for teammates, opponents, the referee, or space, relevant to the subsequent action with the ball*". Recent scanning research that records gaze behaviour within match situations (e.g., Aksum et al., 2021) or within simulated environments (e.g., Vu et al., 2022) recorded discrete actions (i.e., where the participant is applying fixed gaze at a specific moment in time) that does not measure the full perceptual range of an individual, which includes the faster processing of information extracted from peripheral vision (Vaeyens, Lenoir, Williams, Mazyn et al., 2007). Therefore, visual scanning is limited to fixed gaze location and cannot measure the important information gathered through peripheral vision that compares one's body position to other objects in the environment (Vater et al., 2022).

Jordet et al. (2020) reported scanning activity to be highest when players were not in possession of the ball or when under limited pressure from opposition players. Interestingly, Jordet and colleagues reported forward players undertook the least scanning when compared to other positions with forwards being less involved in total play and having to respond to less total environmental cues. Importantly, observations of scanning frequency only record the approximate location of gaze and not the location of attention through use of peripheral vision (Vater et al., 2019), which means observable scanning behaviour is incapable of measuring perceptual ability in footballers. Offensive players have been found to have greater ability than defensive players to peripherally observe unexpected relevant objects within attentional windows, such as unmarked players and defenders (Klatt & Nerb, 2021). The attentional resources applied to objects in the periphery results in less attention on gaze fixations (Kreitz et al., 2020). Consequently, forward players need to obtain less information from gaze fixations and more information from peripheral vision.

Research consistently reports goals to be scored most often with a one or two touch finish (e.g., Çobanoglu, 2019; Smith & Bedwell, 2021; Tokul & Mülazimoglu, 2018), indicating the goal scorer is out of possession in the short moments before scoring. Therefore, the goal scorer's ability to successfully perceive defensive player locations is paramount to goal scoring opportunity creation. Closer defender proximity to the goal scorer will decrease the chance of scoring (Lucey et al., 2015; Steiner et al., 2018), which suggests peripheral vision, auditory and physical contact information will also be used for decision making. Acar et al. (2008) showed goals to be mostly scored within attacks that lasted only a few seconds and involved a low number of passes. Therefore, it is doubtful that goal scorers will be able to undertake observable scans in the fast-paced final stages of goal scoring due to the complex actions within a multi-defender environment when fixed gaze attention is likely applied to the position of the ball (Pokolm et al., 2023). When goal scorers do make their final movement decisions to destabilise defensive systems, it has been shown to be done during the final assist pass (Duarte et al., 2012). It is also unclear if exploratory visual scanning before final decision making will provide enough information (McGuckian et al., 2019). Hence, there exists uncertainty that visual scanning observations will be an appropriate measure for perceptual ability of goal scorers.

The purpose of this research study was to explore goal scorers' ability to perceive and adapt to the environmental threats (i.e., defenders) to goal scoring at different competitive levels. Goal scoring success is often quantified by objective data based on probability models across many actions, such as expected goals or shooting frequency (Anzer & Bauer, 2021), with less focus on individual player ability (Mackenzie & Cushion, 2013). Individual player perceptual ability analysis is not a common area of research despite its suggested importance as a performance indicator within talent identification (Sarmento et al., 2018), probably due to difficulties quantifying information processed in peripheral vision. A recent analysis of international goal scorers reported defender proximities significantly changed between the moment of assist pass and moment of finish (Smith & Bedwell, 2021). Findings indicated the goal scorer was able to successfully navigate the environment and destabilise the defensive system to score without relying on discrete visual scans due to the speed of actions required in goal scoring (Travassos et al., 2012).

A goal scorer's location relative to defenders during the assist pass and successful conversion of a shot are likely performance indicators of perceptual ability as defensive destabilisation was achieved due to movements undertaken from environmental cues (Duarte et al., 2012). As higher-level goal scorers are predicted to have advanced perceptual ability (Williams et al., 2012), differences in goal scorer and defender proximities between the moment of assist pass and moment of finish should be seen between leagues (i.e., goal scorers with greater perceptual ability in higher leagues will create more space between defenders that allow them to score). The aim of this study was to identify the proximity differences between the goal scorer and defenders in the final stages of goal scoring across different league levels.

METHODS

Sample and procedure

Ethical approval was obtained from the first author's institutional review board. All goals scored in the 2022/23 English Premier League, Championship, League 1, and League 2 divisions were screened to meet inclusion criteria. The criteria represented goals scored where perceptual ability was required for success (i.e., goal scorers executing responses to defender locations during the fast-paced moments of goal scoring where information from peripheral vision is utilised). For goals to be included they had to be scored by a forward player (Centre Forward, Striker, Left Wing, Right Wing) with a role profile for goal scoring as identified by the techno-tactical position for forwards in Di Salvo et al. (2007), with player positions determined by OPTA Sports Data. Following the identification of goals scored by forward players, post-match public broadcast match videos were viewed. The final criteria for inclusion were goals scored from open play, goals scored from a purposeful and direct assist pass without deflection, and the goal scorer did not use technical skill to manoeuvre defender locations (i.e., dribble the ball). Goals that did not meet the criteria were excluded. Goals that met criteria but could not be fully observed, for example, goal scorer position not seen during assist pass due to camera angle, were excluded.

Goals that met all criteria for Premier League (n = 379), Championship (n = 310), League 1 (n = 373) and League 2 (n = 344) were subject to the observation analysis set out by Smith and Bedwell (2021). Observers recorded the frequency and proximity of defenders to the goal scorer at the moment of assist pass (MOAP) and moment of finish (MOF). Defender proximities were coded by location and the level of pressure the defender applied. Defender locations were coded into nine possible zones, as shown in Figure 1. First, locations were estimated within three circular zones 1.5m apart (1 = defender/s within 1.5m of the goal scorer; 2 = defender/s between 1.5-3m away from the goal scorer; 3 = defender/s between 3-4.5m away from the goal scorer), which were based on the defensive pressure definition stated in Tenga et al. (2010). Second, zone divisions were adapted from Lucey et al. (2015) and applied (A = defender/s between goal scorer and goal; B = defender/s in front of goal scorer but not in front of goal; C = defender/s behind goal scorer) to represent defender positions relative to the goal and the likelihood of scoring. An example of defender zone coding is shown in Figure 2. For each goal, the number of touches taken by the goal scorer and the location of the assist pass and finish (Figure 3) were recorded on a spatial analysis pitch map (González-Ródenas et al., 2019). Coding was undertaken independently by four researchers. The lead researcher, who was also a coder, provided training to the other three coders. Training was approximately 2-hours in duration. The lead researcher (trainer) fully explained the observation process and then undertook observations together with the trainee coder. Once the observation process was understood, the lead researcher and trainee coder performed separate observations and compared findings. Once similarity was established in the last 5 observations performed by the trainer and trainee coder, the training was completed. All coders had many years of experience within soccer practice and competition environments.

Reliability

Intra-observer and inter-observer reliability analysis were carried out to evaluate objectivity and reliability. At least 10% of all data (Cooper & Pulling, 2020; Pulling et al., 2018) were subject to both intra-observer (287 goals, 20.41%) and inter-observer (141 goals, 10.03%). Random intra-observer reliability was undertaken at least two weeks after the initial observation to minimise recollection of the event (O'Donoghue, 2014).

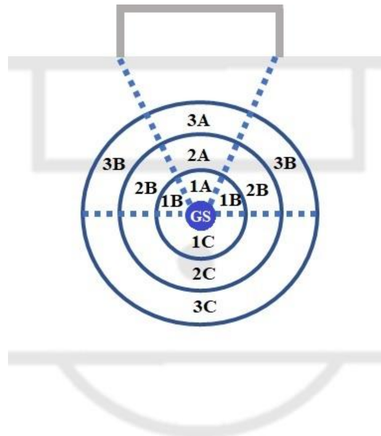

Figure 1. Proximity zones to record defender positions against the goal scorer.

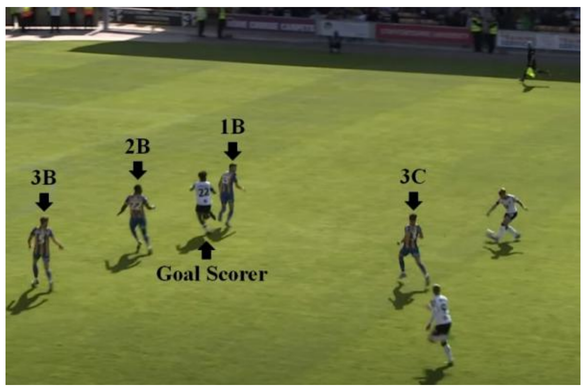

Figure 2. Example of defender proximity zone coding.

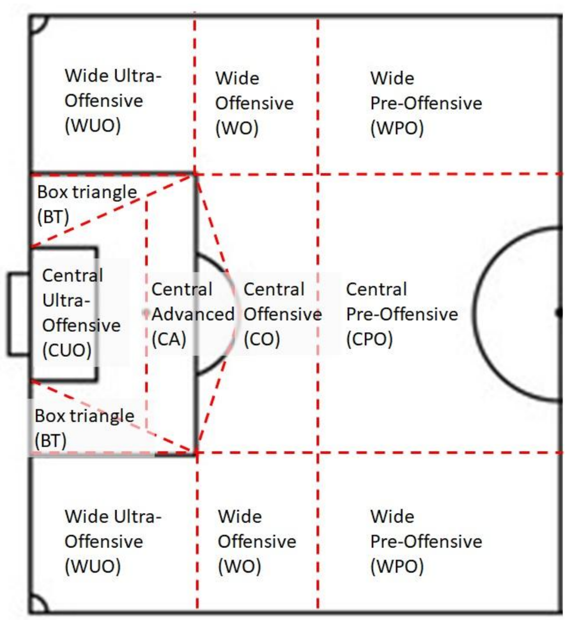

Figure 3. Spatial analysis pitch map.

For inter-observer reliability, all four researchers were requested to randomly code goals analysed by other coders to at least 10% of their total contribution. No processes of the observation were altered, and researchers were unable to view the previous coding undertaken. The Kappa statistic test was performed for all reliability testing. In accordance with Landis and Kock (1977), intra-observer tests revealed ‘almost perfect’ agreement and either ‘almost perfect’ or ‘substantial’ for inter-observer tests (Table 1).

Table 1. Kappa statistics for reliability tests.

	Intra-Observer		**Inter-Observer**	
Variable	Kappa Value	Strength of Agreement	Kappa Value	Strength of Agreement
MOAP1A	1.00	Almost Perfect	0.91	Almost Perfect
MOAP1B	0.99	Almost Perfect	0.87	Almost Perfect
MOAP1C	0.94	Almost Perfect	0.96	Almost Perfect
MOAP2A	0.97	Almost Perfect	0.86	Almost Perfect
MOAP2B	0.97	Almost Perfect	0.77	Substantial
MOAP2C	0.96	Almost Perfect	0.88	Almost Perfect
MOAP3A	0.98	Almost Perfect	0.85	Almost Perfect
MOAP3B	0.94	Almost Perfect	0.77	Substantial
MOAP3C	0.92	Almost Perfect	0.82	Almost Perfect
MOF1A	0.96	Almost Perfect	0.95	Almost Perfect
MOF1B	0.95	Almost Perfect	0.88	Almost Perfect
MOF1C	0.97	Almost Perfect	0.90	Almost Perfect
MOF2A	0.96	Almost Perfect	0.93	Almost Perfect
MOF2B	0.94	Almost Perfect	0.84	Almost Perfect
MOF2C	0.96	Almost Perfect	0.92	Almost Perfect
MOF3A	0.97	Almost Perfect	0.90	Almost Perfect
MOF3B	0.97	Almost Perfect	0.80	Substantial
MOF3C	0.94	Almost Perfect	0.86	Almost Perfect

Data analysis

Absolute frequency and percentage were calculated for location at MOAP and MOF, and frequency of touches per goal were recorded. The mean of each proximity zone was calculated at MOAP and MOF. Prior to inferential statistical analysis, proximity zone data were checked for normality. The skewness and kurtosis scores were calculated to examine the distribution of the data. Repeated measures t-tests were conducted if the data were parametric. If the data were non-parametric, a Wilcoxon signed-rank test was applied. A comparison between the frequency of defenders within each proximity zone at the MOAP and MOF were separately analysed using IBM Statistical Package for Social Sciences (SPSS version 28) with significance set at $p \leq .05$.

RESULTS

Locations for MOAP and MOF for each league are displayed in Table 2. The MOF was similar for all leagues with central ultra offensive (CUO) being the most common location (70-77%), followed by central advanced (CA) (19-23%) and central offensive (2-5%), with central locations covering between 98-99% of all MOF locations. Box triangle was the most common location for the MOAP (19-23%) across all data. However, the ranked order of MOAP locations were varied across leagues. Table 3 shows the touches taken by goal scorers across league. Table 4 displays means and inferential analysis for each zone with three different conceptual data selections. The first analysis was undertaken on all goals (AG), the second on all goals with one touch finish (1T), and the third represented one touch finish goals within highly offensive locations (1TOL), which were MOF in CUO and MOAP in WUO, BT, CUO and CA. Analysis on all goals showed that defensive locations significantly changed in zone 1 for all leagues. The Championship was the only league where all zone 2 locations significantly changed. Other zones across all leagues were varied. One touch finish analysis found significant difference in all components of zone 1 locations for Premier League and League One. Similar to all goals, the Championship was the only league with defender numbers significantly changing in all zone 2 location components. As with all goal analysis, other zones were varied apart from League Two having recorded significant differences within all components of zone 3 locations.

One touch finish goals within highly offensive zones provided the greatest differences across leagues. The Premier League was the only league that continued to have significant differences in defender number in all components of zone 1 between MOAP and MOF. Zone 2 and 3 analysis revealed mixed results across leagues, although League 2 presented with no significant difference in any components of the zone 2 locations. Overall, the Premier League had the highest frequency of zone differences (6) compared to the other leagues (Championship = 4, League 1 = 3, League 2 = 3) when one touch finish goals within highly offensive zones was analysed. Figure 4 provides a visual representation of mean change with significant difference between MOAP and MOF for one touch finish goals within highly offensive zones across each league and in combination. A zone with an arrow represents a significant difference was found and the arrow direction indicates the change in mean score between MOAP and MOF. For example, if the arrow points up, the mean increased from MOAP to MOF. Finally, all significant differences across all data in all leagues provided the same mean direction change, which is shown in Figure 4.

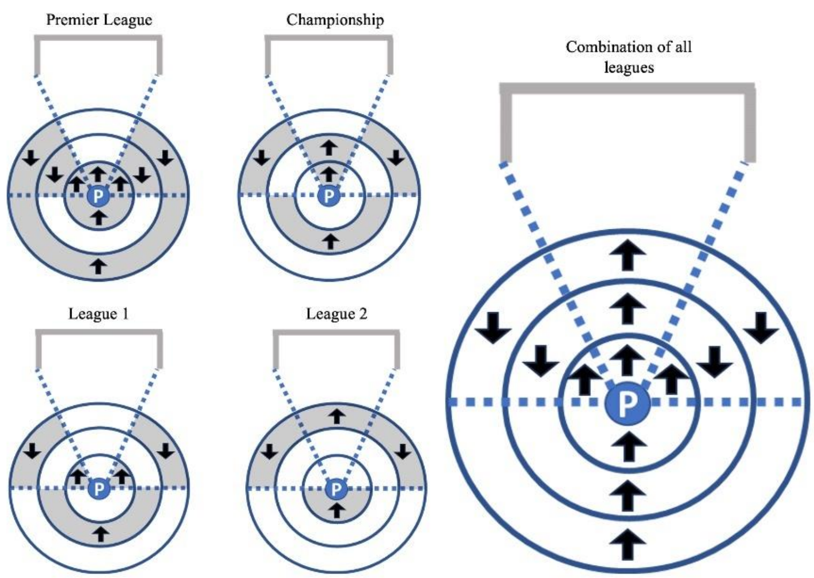

Figure 4. Visual representation of mean change in each zone with significant difference between MOAP and MOF.

DISCUSSION

The findings from this study revealed significant differences existed between the proximity of defenders to the goal scorer in the final stages of goal scoring, with differences between leagues (see Table 4 and Figure 4).

Table 2. Location of MOAP and MOF across leagues.

	Premier League						Championship						League 1						League 2					
	MOAP			MOF			MOAP			MOF			MOAP			MOF			MOAP			MOF		
Location	*f*	*%*	*Rank*	*f*	*%*	*Rank*	*f*	*%*	*Rank*	*f*	*%*	*Rank*	*f*	*%*	*Rank*	*f*	*%*	*Rank*	*f*	*%*	*Rank*	*f*	*%*	*Rank*
WUO	47	12	5	2	1	=4	47	15	3	2	1	5	73	20	2	0	0	=5	66	19	1	0	0	=5
BT	85	22	1	2	1	=4	72	23	1	4	1	4	82	22	1	6	2	=3	65	19	2	2	1	4
CUO	51	13	4	270	71	1	29	9	6	218	70	1	49	13	3	289	77	1	46	13	4	261	76	1
CA	67	18	2	86	23	2	46	15	4	71	23	2	46	12	4	72	19	2	36	10	=5	70	20	2
WO	18	5	7	0	0	=6	38	12	5	1	0	6	23	6	7	0	0	=5	29	8	7	0	0	=5
CO	66	17	3	19	5	3	50	16	2	14	5	3	43	12	5	6	2	=3	54	16	3	11	3	3
WPO	6	2	8	0	0	=6	12	4	8	0	0	=7	20	5	8	0	0	=5	12	3	8	0	0	=5
CPO	39	10	6	0	0	=6	16	5	7	0	0	=7	37	10	6	0	0	=5	36	10	=5	0	0	=5
TOTAL	379			379			310			310			373			373			344			344		

Table 3. Touches taken by goal scorer across leagues.

	Premier League		Championship		League 1		League 2		Total	
1 Touch Finish	270	71%	251	81%	300	80%	264	77%	1085	77%
2 Touch Finish	77	20%	47	15%	61	16%	66	19%	251	18%
3+ Touch Finish	32	8%	12	4%	12	3%	14	4%	70	5%
Total	379	100%	310	100%	373	100%	344	100%	1406	100%

Table 4. Means and inferential analysis for each proximity zone.

League	Data Selected	1A		1B		1C		2A		2B		2C		3A		3B		3C	
Premier League	AG (n = 379)	Z = -4.73, p<.001		Z = -4.31, p<.001		Z = -5.42, p<.001		Z = -3.07, p = .002		t(378) = 2.80, p = .005		Z = -1.80, p = .071		Z = -1.39, p = .164		Z = -6.41, p<.001		Z = -2.21, p = .027	
	M	*MOAP*	*MOF*	*MOAP*	*MOF*	*MOAP*	*MOF*	*MOAP*	*MOF*	*MOAP*	*MOF*	*MOAP*	*MOF*	*MOAP*	*MOF*	*MOAP*	*MOF*	*MOAP*	*MOF*
		0.042	*0.137*	*0.074*	*0.179*	*0.055*	*0.177*	*0.082*	*0.153*	*0.441*	*0.327*	*0.253*	*0.311*	*0.082*	*0.111*	*0.554*	*0.272*	*0.515*	*0.617*
	1T (n = 270)	Z = -3.73, p<.001		Z = -3.36, p<.001		Z = -4.43, p<.001		Z = -1.62, p = .106		t(269) = 3.31, p<.001		t(269) = -1.58, p = .116		Z = -1.01, p = .313		Z = -5.92, p<.001		Z = -2.36, p = .018	
	M	*MOAP*	*MOF*	*MOAP*	*MOF*	*MOAP*	*MOF*	*MOAP*	*MOF*	*MOAP*	*MOF*	*MOAP*	*MOF*	*MOAP*	*MOF*	*MOAP*	*MOF*	*MOAP*	*MOF*
		0.059	*0.152*	*0.078*	*0.174*	*0.063*	*0.178*	*0.096*	*0.141*	*0.470*	*0.311*	*0.274*	*0.337*	*0.081*	*0.107*	*0.548*	*0.248*	*0.500*	*0.630*
	1TOL (n = 190)	Z = -3.45, p<.001		Z = -3.28, p<.001		Z = -4.11, p<.001		Z = -0.46, p = .647		t(189) = 3.07, p = .002		t(189) = -0.43, p = .671		Z = -0.38, p = .705		Z = -4.77, p<.001		Z = -2.18, p = .029	
	M	*MOAP*	*MOF*	*MOAP*	*MOF*	*MOAP*	*MOF*	*MOAP*	*MOF*	*MOAP*	*MOF*	*MOAP*	*MOF*	*MOAP*	*MOF*	*MOAP*	*MOF*	*MOAP*	*MOF*
		0.068	*0.179*	*0.068*	*0.179*	*0.074*	*0.205*	*0.132*	*0.147*	*0.474*	*0.300*	*0.305*	*0.326*	*0.089*	*0.100*	*0.547*	*0.263*	*0.532*	*0.679*
Championship	AG (n = 310)	Z = -4.73, p<.001		Z = -2.15, p = .031		Z = -4.36, p<.001		Z = -2.94, p = .003		Z = -3.13, p = .002		Z = -3.38, p = .001		Z = -0.42, p = .673		t(309) = 7.542, p<.001		t(309) = -1.32, p = .188	
	M	*MOAP*	*MOF*	*MOAP*	*MOF*	*MOAP*	*MOF*	*MOAP*	*MOF*	*MOAP*	*MOF*	*MOAP*	*MOF*	*MOAP*	*MOF*	*MOAP*	*MOF*	*MOAP*	*MOF*
		0.058	0.174	0.123	0.181	0.090	0.213	0.074	0.142	0.352	0.223	0.287	0.432	0.155	0.145	0.752	0.403	0.790	0.868
	1T (n = 251)	Z = -3.96, p<.001		Z = -1.63, p = .102		Z = -3.64, p<.001		Z = -2.24, p = .025		Z = -2.50, p = .012		Z = -3.44, p = .001		Z = -1.24, p = .217		t(250) = 5.94, p<.001		t(250) = -0.63, p = .530	
	M	*MOAP*	*MOF*	*MOAP*	*MOF*	*MOAP*	*MOF*	*MOAP*	*MOF*	*MOAP*	*MOF*	*MOAP*	*MOF*	*MOAP*	*MOF*	*MOAP*	*MOF*	*MOAP*	*MOF*
		0.072	0.183	0.124	0.171	0.096	0.203	0.092	0.151	0.339	0.227	0.295	0.462	0.175	0.143	0.725	0.418	0.813	0.853
	1TOL (n = 157)	Z = -2.75, p = .006		Z = -.51, p = .612		Z = -1.67, p = .095		Z = -2.87, p = .004		Z = -1.22, p = .222		Z = -2.64, p = .008		Z = -1.79, p = .074		Z = -4.98, p<.001		t(156) = -0.43, p = .668	
	M	*MOAP*	*MOF*	*MOAP*	*MOF*	*MOAP*	*MOF*	*MOAP*	*MOF*	*MOAP*	*MOF*	*MOAP*	*MOF*	*MOAP*	*MOF*	*MOAP*	*MOF*	*MOAP*	*MOF*
		0.070	0.159	0.140	0.159	0.134	0.191	0.089	0.197	0.299	0.236	0.299	0.465	0.166	0.115	0.688	0.363	0.866	0.898
League One	AG (n = 373)	Z = -2.59, p = .010		Z = -4.85, p<.001		Z = -3.30, p = .001		Z = -2.33, p = .020		Z = -1.64, p = .100		Z = -4.95, p<.001		Z = -1.22, p = .222		Z = -4.46, p<.001		t(372) = -2.13, p = .034	
	M	*MOAP*	*MOF*	*MOAP*	*MOF*	*MOAP*	*MOF*	*MOAP*	*MOF*	*MOAP*	*MOF*	*MOAP*	*MOF*	*MOAP*	*MOF*	*MOAP*	*MOF*	*MOAP*	*MOF*
		0.075	0.121	0.110	0.217	0.072	0.142	0.091	0.145	0.330	0.271	0.193	0.351	0.099	0.123	0.584	0.413	0.466	0.552
	1T (n = 296)	Z = -2.14, p = .033		Z = -3.57, p<.001		Z = -2.83, p = .005		Z = -1.32, p = .187		t(295) = 1.09, p = .278		Z = -4.17, p<.001		Z = -0.88, p = .380		Z = -3.63, p<.001		t(295) = -1.65, p = .100	
	M	*MOAP*	*MOF*	*MOAP*	*MOF*	*MOAP*	*MOF*	*MOAP*	*MOF*	*MOAP*	*MOF*	*MOAP*	*MOF*	*MOAP*	*MOF*	*MOAP*	*MOF*	*MOAP*	*MOF*
		0.088	0.132	0.125	0.209	0.078	0.145	0.101	0.135	0.328	0.284	0.199	0.345	0.111	0.132	0.591	0.443	0.480	0.551
	1TOL (n = 200)	Z = -1.89, p = .059		Z = -3.40, p = .001		Z = -1.86, p = .063		Z = -0.77, p = .444		Z = -0.88, p = .379		Z = -3.10, p = .002		Z = 0.00, p = 1.000		Z = -2.62, p = .009		t(199) = -1.62, p = .106	
	M	*MOAP*	*MOF*	*MOAP*	*MOF*	*MOAP*	*MOF*	*MOAP*	*MOF*	*MOAP*	*MOF*	*MOAP*	*MOF*	*MOAP*	*MOF*	*MOAP*	*MOF*	*MOAP*	*MOF*
		0.115	0.165	0.110	0.200	0.105	0.160	0.135	0.160	0.335	0.290	0.245	0.380	0.125	0.125	0.580	0.455	0.495	0.575
League Two	AG (n = 344)	Z = -2.34, p = .020		Z = -2.53, p =0.012		Z = -4.02, p<.001		Z = -1.98, p = .047		t(343) = -1.03, p = .303		Z = -3.79, p<.001		Z = -3.59, p<.001		t(343) = 4.52, p<.001		Z = -1.79, p = .074	
	M	*MOAP*	*MOF*	*MOAP*	*MOF*	*MOAP*	*MOF*	*MOAP*	*MOF*	*MOAP*	*MOF*	*MOAP*	*MOF*	*MOAP*	*MOF*	*MOAP*	*MOF*	*MOAP*	*MOF*
		0.055	0.093	0.172	0.233	0.064	0.128	0.073	0.110	0.317	0.355	0.160	0.267	0.044	0.113	0.619	0.433	0.488	0.561
	1T (n = 262)	Z = -1.73, p = .083		t(261) = -1.76, p = .08		Z = -3.80, p<.001		Z = -0.87, p = .384		t(261) = -1.34, p = .182		Z = -3.20, p = .001		Z = -3.00, p = .003		t(261) = 4.67, p<.001		Z = -2.72, p = .006	
	M	*MOAP*	*MOF*	*MOAP*	*MOF*	*MOAP*	*MOF*	*MOAP*	*MOF*	*MOAP*	*MOF*	*MOAP*	*MOF*	*MOAP*	*MOF*	*MOAP*	*MOF*	*MOAP*	*MOF*
		0.069	0.103	0.202	0.252	0.069	0.141	0.088	0.107	0.313	0.366	0.160	0.256	0.038	0.099	0.656	0.439	0.477	0.595
	1TOL (n = 160)	Z = -1.09, p = .275		t(159) = -1.73, p = .086		Z = -3.15, p = .002		Z = -0.43, p = .670		t(159) = -1.37, p = .173		Z = -1.57, p = .117		Z = -2.07, p = .039		Z = -4.80, p<.001		Z = -1.82, p = .070	
	M	*MOAP*	*MOF*	*MOAP*	*MOF*	*MOAP*	*MOF*	*MOAP*	*MOF*	*MOAP*	*MOF*	*MOAP*	*MOF*	*MOAP*	*MOF*	*MOAP*	*MOF*	*MOAP*	*MOF*
		0.075	0.106	0.206	0.269	0.094	0.175	0.113	0.125	0.325	0.394	0.194	0.250	0.044	0.106	0.675	0.400	0.519	0.619

Analysis of all goals and all one touch finish goals were comparable across leagues. However, when the data were isolated to a one touch finish within offensive locations for both MOAP and MOF (1TOL), which represents a need for quicker decision making with less time and opportunity to score (Acar et al., 2008), a reducing pattern of significant difference was found as league standard decreased (i.e., as league level decreased, frequencies of zones with significant difference decreased). Therefore, as recognised by Williams (2000), findings suggest goal scorers at higher levels possess greater perceptual ability to destabilise defensive systems and create opportunities to score. The majority of all goals in each league (70-77%) were scored from a central offensive position (Table 2) where higher densities of defenders exist during goal scoring attempts (Wallace & Norton, 2014), which further strengthens the requirement for goal scorers to process information extracted from peripheral vision (Vaeyens, Lenoir, Williams, Mazyn et al., 2007).

Interestingly, when data across all leagues were combined (Figure 4), the means always moved in the same direction. Means that increased from MOAP to MOF represent goal scorers who had previously created space, with out of position defenders attempting to restabilise a defensive system at MOF by moving closer to the goal scorer or into a shot blocking position (Lucey et al., 2015). Means that decreased show where the defenders were coming from to restabilise the defensive system to apply pressure to the goal scorer at MOF. As reported in Smith and Bedwell (2021), the common movement patterns between the goal scorer and defenders found in the current study provide recommendations for goal scoring practice design. For example, during MOAP the goal scorer should move to decrease defenders in very close proximity (zones 1A, 1B and 1C), decrease defenders who block the goal (zones 2A and 3A) and decrease defenders behind them (2C and 3C). During the MOF, defenders should move from zone 2B and 2C to reoccupy the aforementioned zones to put the goal scorer under pressure.

The movement pattern found in the current study is comparable to that described by Duarte et al. (2012) where defensive stability and centrality between offensive and defensive units is held until the assist pass is made, with the goal scorer moving away or moving past defenders to create a clear line of sight to goal (Schulze et al., 2022). Current study findings provide further evidence for the spatial-temporal importance of the final assist pass and final shot as an indicator of goal scorer perceptual ability. The visual representation of all data combined shown in Figure 4 highlights the need for the goal scorer to move away from a central line of defenders before attempting to shoot, which is why zones 2B and 2C have higher frequencies of defenders at the MOAP. Essentially, successful goal scorers adapt to defender locations at the last possible moment and move to position defenders outside of their direct line of sight to the goal.

The Premier League was the only league that presented significant differences in all the separate components of zone 1 within 1TOL. Lower defender density (Wallace & Norton, 2014) and proximity (Lucey et al., 2015) allowing for successful pass completion (Steiner et al., 2018), have been defined as determinates of successful goal scoring, which suggests why significant differences across all zone 1 components was only observed in the Premier League. The zone 1 Premier League analysis is similar to the zone 1 results reported by Smith and Bedwell (2021) at the 2020 UEFA European Championships, suggesting zone 1 to be a performance indicator for the highest perceptual ability in goal scoring. As the league level reduced, goal scorers decreased their ability to change zone 1 defensive systems within 1TOL. Championship goal scorers were only able to match the Premier League in zone 1A, which could be considered as the most likely to stop a goal scoring opportunity (Lucey et al., 2015). In League 1, goal scorers were not able to significantly reduce the number of defenders in zone 1A between MOAP and MOF but were able to position defenders away from zone 1B. League 2 players were only able to impact defensive positions directly behind them (zone 1C). The zone 1 analysis also suggests that higher level goal scorers have superior technical ability to finish under pressure with defenders in goal blocking positions.

During the MOAP within 1TOL, goal scorers move so that more defensive players are in zones 2B and 3B and away from central blocking positions. However, only Premier League goal scorers were able to significantly change the number of defenders in both zones 2B and 2C at MOAP to MOF. No other league was able to replicate the Premier League goal scorers in zone 2B, but all leagues had higher defensive numbers in zone 3B during MOAP, suggesting the relationship between goal scorer and defending players is too far apart at zone 3B to have an impact (Laakso et al., 2019) and shouldn't be considered as a performance indicator. Interestingly, league 2 data within 1TOL showed no significant differences in any zone 1 and zone 2 component, except for zone 1C, suggesting lower ability players do not have the capability to obtain defender location information from peripheral vision and execute successful actions compared to higher level players (Klatt & Nerb, 2021).

Practical implications

The results from this research study impact both practice design and talent identification. As previously reported by Smith and Bedwell (2021), this study shows the environment in which goals are scored is dynamic and indicates shooting practice design should contain defenders that move position between the assist pass and shot. The changes in movement location shown in Figure 4 from combined league data creates a pattern that might be useful for coaches to adopt in practice design. Physical and technical ability may well be beneficial for enhanced goal scoring success (Atabaş & Yapıcı, 2018), but learning designs without the perceptual cues of the environment may weaken skill acquisition (Davids et al., 2012). For example, goal scorers should practice increasing the distance from defenders and creating a clear line of sight towards the goal at the moment of the assist pass, with defenders moving closer to the goal scorer with blocking attempts as they shoot. For talent identification, this study showed that the perceptual ability of goal scorers and league standard held a positive linear relationship and can be considered as a much-needed performance indicator for perceptual ability in goal scorers (Sarmento et al., 2018). Therefore, the movement differences within zones between leagues from MOAP and MOF (Figure 4) could be used for player profiling in talent identification, especially in all the components of zones 1 and 2. For instance, if a goal scorer outside the Premier League is able to significantly change all zone 1 components from the MOAP to the MOF within 1TOL conditions they may be able to score goals in the Premier League.

Limitations

The current study used the fast-paced movements before goal scoring as a mechanism to detect perceptual ability differences in goal scorers across league levels. However, forward players could also be processing key environmental information and executing key movements before the final assist pass. Further, physical advantages may exist in higher level league players that may enhance the execution phase of perceptual ability (Kelly et al., 2021). As perceptual-cognitive abilities can alter per position in football (Klatt & Nerb, 2021; Schumacher et al., 2018), differences in defending in each league may have impacted results. Despite strong observer reliability results, digital player positioning technology (Buchheit et al., 2014) and Artificial Intelligence technology (Purtak et al., 2023) may provide more accurate proximity distances between players.

CONCLUSION

The results from this study indicate forward players locate, identify and process information to execute actions that destabilise defensive systems in the final stages of goal scoring. Forward players destabilise defensive systems by increasing the distance to defenders and decreasing defenders in blocking positions in the final stages before scoring. Goal scorers in higher ability leagues have greater perceptual ability when the assist pass and moment of finish are in offensive locations and a one touch finish is required to score. As league standards decrease, forward players are less able to create space to score in situations that require higher perceptual ability. Recommendations for practice design are offered as well as perceptual ability performance indicators for talent identification.

AUTHOR CONTRIBUTIONS

SS led this project, undertook observations, and wrote the manuscript. JB assisted with concept, planning, and undertook observations. DE and CP were consulted on the performance analysis aspects of the study. KC and GL undertook observations.

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DISCLOSURE STATEMENT

No potential conflict of interest was reported by the authors.

DATA AVAILABILITY

The data that support the findings of this study are available from the corresponding author, [SS], upon reasonable request.

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