An analysis of goal scoring in English football
(Premier League to National League)

Jason Goodison

A dissertation submitted in part fulfilment of the requirement for the B.Sc. (Hons) Degree in Sports Coaching and Performance

April 2018

Waterford Institute of Technology
INSTITIÚID TEICNEOLAÍOCHTA PHORT LÁIRGE

Department of Sport and Exercise Sciences

School of Health Sciences

Waterford Institute of Technology

Statement of originality and ownership of work

Department of Sport and Exercise and Science

BSc in Sports Coaching and Performance

Name (block capitals)……..

I confirm that all the work submitted in this project is my own work, not copied from any other person's work (published or unpublished) and that it has not previously been submitted for assessment on any other course, in any other institution.

Signed……
Date…….…..

Student Number……
Address……..
……
……
……

Word processor word count……

Acknowledgements

Firstly, I would like to thank my supervisor, Richard Bolger. Richard has been an immense help - his creativity, knowledge and clarity of thought have been crucial over the course of this year.

I'd also like to thank Jean McArdle, Michael Hanlon and the rest of the staff in the Department of Sport and Exercise Science who facilitated a successful year for myself and my peers.

Thank you to my friends whose support and advice was key as we got through this year together.

Thank you Lauren for your input and also for encouraging me to take time away from my laptop screen when I needed it.

Thanks to Billy and my colleagues at Wexford FC, who allowed me time off when it was most necessary and also to the staff at Norwich City Academy, who planted the seed of this idea over a year ago.

Finally, a massive thank you to my parents for their many levels of support throughout my four years in Waterford Institute of Technology.

Table of Contents

1. Abstract.....1
2. Introduction & Literature Review.....1
2.1 Goal Location Trends.....1
2.2 Trends in Build-Up play.....4
2.3 The Effect of Scoreline and Time on Shot Location.....6
2.4 Comparing Variables across Leagues.....7
3. Summary and Rationale.....8
4. Research Questions.....9
5. Methodology.....9
6. Results.....12
7. Discussion.....25
7.1 Purpose of Study.....25
7.2 Summary of Results.....25
7.3 Goal Location.....25
7.4 Goal Method.....26
7.5 Assist and Pre-Assist Location.....28
7.6 Time and Scoreline.....29
7.7 Conclusion.....30
7.8 Limitations.....30
7.9 Practical Implications.....31
References.....32

List of Tables

Table 1: List of complete and partial goals accessed due to footage availability 12
Table 2: Average difference in number of goals per match 13
Table 3: Goal location by division 14
Table 4: Body part used in goal scoring by division.....15
Table 5: Number of touches in the goal scoring action by division 16
Table 6: Set-piece goals by division 16
Table 7: Assist Location by division.....18
Table 8: Pre-assist location by division 20
Table 9: Time of goal scoring by division 22
Table 10: The effect of time on goal location.....23
Table 11: The effect of scoreline on goal location 24

List of Figures

Figure 1: Wright et al. (2011, p. 441) analysis of goal scoring position 2
Figure 2: Rathke (2017, p. 518) division of the attacking half to examine shot location 3
Figure 3: Wright et al. (2011, p. 444) analysis of the starting point of attack.....4
Figure 4: The traditional division of the pitch (18 zones), followed by a more detailed breakdown of zone 14 and 17. 11
Figure 5: Goal location represented as a heat map 14
Figure 6: Set-piece goals by division 17
Figure 7: Assist location represented as a heat map 19
Figure 8: Pre-assist location represented by a heat map.....21
Figure 9: Time of goal scoring by division.....22
Figure 10: The effect of time on goal location 23
Figure 11: The effect of scoreline on goal location.....24

1. Abstract

Goal scoring is the ultimate measure of successful performance in soccer. The aim of this study was to investigate the act of goal scoring in English football, the most popular group of leagues in world football. Expanding on this, the study aimed to (a) examine trends in goal location and method across each division; (b) examine trends in build-up play across each division; (c) examine the impact time and scoreline may have on goal location. 60 matches from each league were randomly selected and footage was accessed using the social media accounts of each football club. Goals were analysed through notational analysis under a number of headings, including the characteristics of pre-assists, assists and the goal itself. All data was recorded and stored on excel. A number of differences were found between each analysed league. While goal location and method were similar throughout each division, analysis of assists and pre-assists presented much greater variability between divisions. Additionally, the time and scoreline of the match appeared to affect the location of goal scoring. In conclusion, differences do exist on a number of fronts when analysing goal location and its contributing factors, across England's top five divisions.

2. Introduction & Literature Review

2.1 Goal Location Trends

Goal scoring has been named as the ultimate measure of performance in soccer (Swarc, 2007). Several studies (Tenga, Holme, Ronglan & Bahr, 2010; Wright, Atkins, Polman, Jones & Sargeson, 2011; Durlik & Bieniek., 2014; Rathke, 2017) have explored goal scoring in professional football. While shooting more than the opposition has been linked to winning (Perin, Vuillemot & Fekete, 2013), the shot speed (Potthast, 2010), shot accuracy (Liu, Gomez, Lago-Penas & Sampaio, 2015) and shot location (Hughes & Franks, 2007) all influence the success of the shot attempt. However, few of these studies (Wright et al., 2011; Rathke, 2017) regarding shot location have offered specific zonal detail in relation to goal location and build-up play.

Scoring opportunities in the English Premier League were investigated by Wright et al. (2011). Data was collected after a group of coaches and analysts were consulted regarding the key behaviours in goal scoring. After a pilot test,

consisting of over 20 hours of coding was completed, definitions regarding these key behaviours were established. Wright et al. (2011) found that Position of Shot 4 (POS4), the area directly in front of the goal, was the best position to shoot from, boasting a 1:2.4 chance of scoring, while it also proved to be one of the most difficult areas to get into. Over half of all goals recorded came from Position of Shot 2 (POS2) and while the scoring ratio was far higher at 1:7.6, it was an easier position for teams to penetrate into. Shooting from outside the penalty area in central locations proved extremely ineffective, with just 1 in 37.7 shots resulting in a goal.

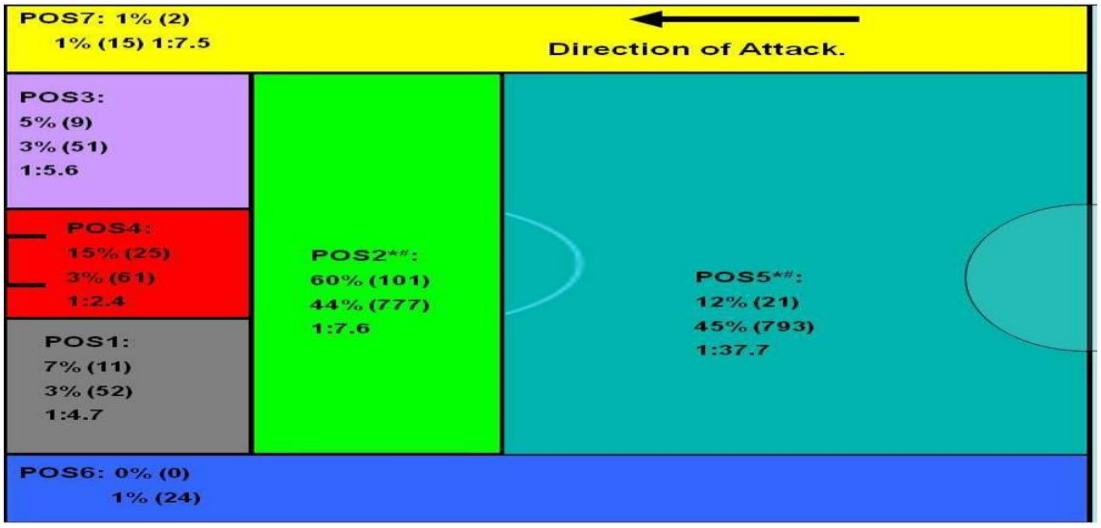

Figure 1: Wright et al. (2011, p. 441) analysis of goal scoring position.

Rathke (2017) study compliments the work of Wright et al. (2011) and provides further detail regarding shot locations in professional football. Rathke (2017) examined all the league games from the English Premier League and the Bundesliga for the 2012-2013 season. The data set used by Rathke (2017) was provided by Opta Sports, a private company committed to analysis of most European football leagues. Opta Sports data has been examined and verified as reliable by Liu, Hopkins, Gomez & Molinuevo (2013), who analysed a Spanish league match and showed kappa values of 0.92 and 0.94 across two groups of experienced analysts. Rathke (2017) expands on the work of Wright et al. (2011) with a more comprehensive analysis of goal and shot location, across both the Premier League and the Bundesliga. Figure 2 illustrates the adapted map used to categorise goal and shot location.

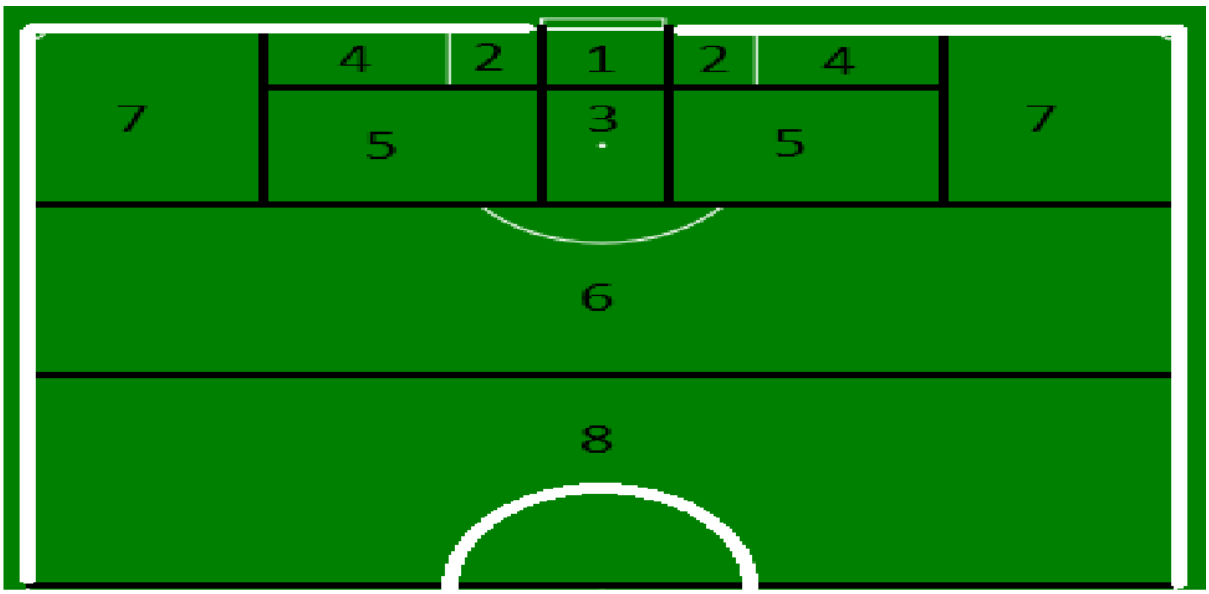

Figure 2: Rathke (2017, p. 518) division of the attacking half to examine shot location.

One key difference between the studies is the area identified as POS2 by Wright et al. (2011). Rather than examining one large zone, Rathke (2017) chooses to divide this zone in three, as represented by area 3 and 5 on Figure 2. The relevance of this division becomes clear when viewing the results. A shot from area 3 (15%) is more than twice as likely to result in a goal, than an attempt from area 5 (7%) in the English Premier League. Similarly in both studies, POS4 was the area which offered the greatest success rate of an attempt on goal. However, Rathke (2017) sub-division of this zone into area 1 and area 2 present further differences which show the importance of a thorough division of the penalty area, when examining goal and shot location. The success rate for a shot in area 1 is 34%, compared to just 10% from area 2.

Durlik and Bieniek (2014) also studied the location of goals and assists in depth. By analysing all goals from the 2008/2009 English Premier League, they once again found that most goals in the Premier League were scored from the central positions. However, in direct contrast to the work of Wright et al. (2011) more goals were scored from the area closer to the goal rather than from POS4. Durlik and Bieniek (2014) also found that 69% of goals came from a one touch finish and that only 17.9% come as a result of a dribble. Furthermore, 79.5% of goals were scored with feet and 17.7% with the players head. Yiannis (2014) and Charalampos, Yiannis, Michalis & Zisis (2013) showed very similar findings, with

between 67.3% and 75% coming from a shot with a players foot, while between 16.88% and 18.1% of goals scored were headers.

Rathke (2017) and Wright et al. (2011) showed the value of strategic shot location for football teams. Shooting from closer to the goal in central zones, including area 1 and 3 (Rathke, 2017), present a far greater chance of success than shooting from wide or from outside of the penalty area. First time finishes with either foot from these areas are the most common method of goal scoring (Durlik and Bieniek, 2014) while headers account for between 16.88% and 18.1% of goals (Charalampos et al., 2013; Yiannis, 2014).

2.2 Trends in Build-Up play

The starting location of attacks which lead to goals was also studied by Wright at al. (2011). They found that attacks which begin in the opposition penalty area, as a result of a regain, are the most likely to result in a goal, while also being the least common starting point of attack. Starting Point of Attack 5 (SPA5), also described as zone 14 and zone 11 in a traditional pitch division, were the most common areas for an attack to begin. Attacks which started in the defensive half had a 1:7.8 chance of resulting in a goal.

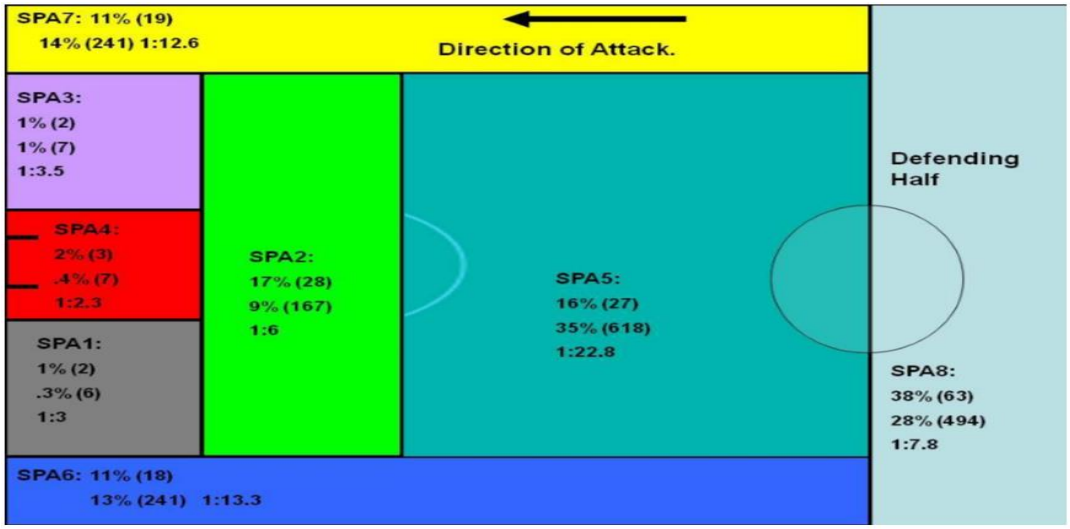

Figure 3: Wright et al. (2011, p. 444) analysis of the starting point of attack.

Tenga et al. (2010) also offered an insight into the starting location of attacks which lead to goals. Footage of each game was analysed by assigning a random

decimal number between 0-1 and then multiplying by 86 to assign an exact minute. From this point in the game, 20 consecutive team possessions were extracted for analysis. Tenga et al. (2010) study found that attacks which start in the attacking third (zone 13-18) had a 32.7% chance of leading to a goal, while attacks which started in the middle third and defensive third had only an 11.7% and 8.6% chance, respectively. This conflicts with the work of Wright et al., (2011) who reported that attacks beginning in the defensive half were significantly more likely to result in a goal than attacks from the midfield zone. Durlik and Bieniek (2014) showed value for attacking through the middle of the pitch with zone 14C, the central zone in front of the penalty area, being a favourable area for an assist to occur in the English Premier League. Durlik and Bieniek (2014) also emphasised the wings, zone 16 and zone 18, as the most prominent area for an assist.

When analysing the type of attacks that lead to goals, Tenga et al. (2010) found that 43% of goals are scored during counter attacks and that long possessions are almost twice as likely to produce a goal as short possessions of the ball. This backed up findings made by Hughes and Franks (2007) that possessions of 5-8 passes, rather than 0-4, are more likely to produce a shot on goal. Contrastingly, Smith, Callaway & Broomfield (2013) found that 73.1% of first team goals were scored using 4 or less actions (pass or dribble). However, Smith et al. (2013) only studied goal scoring in one team, and while the analysed team were part of the National League at the time of examination, the sample size does not allow for assumptions to be made about the attacking styles of other teams in the National League. Complementing the work of Tenga et al. (2010) and Hughes and Franks (2007), Charalampos et al. (2013) analysed the length of the pass in the assist action. The findings reinforce the value of short passing attacking styles of play rather that direct tactics, with 25% of goals being assisted by a short pass, of under 10 metres in length. Conversely, long passes (over 10 meters) only account for 8.44% of all assists. This is supported by Durlik and Bieniek (2014) who report that 51% of assists were passes of under 15 metres in length. While, individual dribble's were the pre-cursor for 12.8% of goals.

The optimum location for an assist, the actions prior to a goal and the starting point of attacks which lead to goals remain unclear and warrants further study. While some research (Tenga et al., 2010; Durlik & Bieniek, 2014) shows a greater

effectiveness for attacks starting in the midfield zone, Wright et al. (2011) suggests that attacks beginning in the defensive zone offer a greater likelihood of goals being scored. All identify the attacking zone as the most effective location to begin an attack. Shorter passing styles appear to be more effective in goal creation than direct play (Hughes & Franks, 2007; Durlik & Bieniek, 2014).

2.3 The Effect of Scoreline and Time on Shot Location

Numerous studies (Redwood-Brown, 2008; Lago-Ballesteros, Lago-Penas & Rey 2012; Ruiz-Ruiz, Fradua, Fernandez-Garcia & Zubillaga, 2013; Lago-Penas & Gomez-Lopez, 2014) have investigated the effect of scoreline on goal scoring in professional football. Lago-Ballesteros et al. (2012) investigated the effects of situational variables on penalty area entries in Spanish professional football. This study suggests that when a team is winning or drawing a match, the probability of recording a penalty area entry decreases by 43% and 53%, respectively, compared to when losing. Lago-Penas and Gomez-Lopez (2014) also studied the effect of the scoreline on match performance, in the 2012-2013 English Premier League. Similar to Lago-Ballesteros et al. (2012), final third entries were greater when a team was one goal behind, while shots on goal also increase when trailing. This reinforces Ruiz-Ruiz et al. (2013) who inferred that teams who were winning conceded more penalty area entries. This suggests that after a team takes the lead in a match they become more defensive and their need to retain possession of the ball decreases. Indeed, Lago and Martin (2007) reported that possession statistics decrease when a team goes ahead in a match. This is further supported by Redwood-Brown (2008) who identified that both passing rate and accuracy decrease after a goal is scored. These findings indicate that the team which is behind in the game is most likely to score the next goal, as more successful teams tend to be those who shoot more often (Araya & Larkin, 2013; Perin et al., 2013).

Common trends in the timing of goal scoring have also been explored in professional football. Both Yiannis (2014) and Armatas, Yiannakos & Sileloglou (2007) identified that 57%-60% of goals were scored in the second half of games in various World Cup competitions. Expanding further on this, Yiannis (2014) demonstrated that 43% of goals were scored in the final 30 minutes, with the middle third of the half (61-75 minute) exhibiting the most goals scored. Durlik

and Bieniek (2014) reported contrasting findings in their study of the English Premier League. While 42.5% of goals were scored in the first half, a massive spike occurs in the final 15 minutes of the match, where 25% of all goals are scored. Furthermore, the number of goals scored in second half injury time far exceed standard levels. Yiannis (2014) identified that more goals were scored in additional time at the end of the second half (approx. 3-5 minutes), than in the entire extra 30 minutes of games that enter extra-time. Gurkan, Ertetik & Muniroglu (2017) also demonstrated that over twice as many goals were scored in second half injury time when compared to first half injury time. This is supported by van Ours and van Tuijl (2011), who suggested that goal intensity, the frequency with which goals are scored, is over double in additional time in the second half than at any other time in the match.

Lago-Penas and Gomez-Lopez (2014) assessed the effect of the scoreline on certain key performance indicators such as ball possession, final third entries and shots on goal. However, shot location was not examined among those key performance indicators. While, there is an abundance of research on both goal location and build-up play (Tenga et al., 2010; Wright et al., 2011; Durlik & Bieniek., 2014; Rathke, 2017) and the effect of scoreline on team tactics and general play (Redwood-Brown, 2008; Lago-Ballesteros et al., 2012; Ruiz-Ruiz et al., 2013; Lago-Penas & Gomez-Lopez, 2014), few studies have examined how shot location and build-up play are influenced by the scoreline. Similarly, while multiple studies have identified trends in the timing of goal scoring (Armatas et al., 2007; Durlik & Bieniek, 2014; Yiannis, 2014) few have correlated this information to examine the affect time plays on goal location.

2.4 Comparing Variables across Leagues

Araya and Larkin (2013) studied the key performance indicators of teams in the top 10 and bottom 10 of the English Premier League in the 2012/13 season with the objective of identifying the key performance indicators most related to success and failure. They found clear differences in shot location between teams located in the top and bottom half of the league. Teams in the top 10 tended to take more shots from inside the penalty area, while teams in the bottom half of the league took more shots from outside the area. This suggests that shooting from inside the penalty area increases the chances of success and supports the

work of Wright et al. (2011). Araya and Larkin (2013) also identify that successful teams played almost 100 more short passes per game than teams in the bottom 10, which as Charalampos et al. (2013) highlighted, short passes are more likely to be an assist to a goal. There was no significant ($p = 0.22$) differences between successful and unsuccessful teams frequency of crossing, which may indicate that crosses are not an effective method of assisting goals, which is supported by Yiannis (2014). Furthermore, they found that a much higher percentage (41.2%) of goals were scored from open play by teams in the top half, than from open play by teams in the bottom ten (24.7%). While the study was carried out only in the Premier League, its findings are likely to be representative on a broader scale. The key performance indicators of successful teams may represent those in higher divisions, while the performance of the bottom 10 may be representative of teams competing in lower divisions, such as the English League 2 or the English National League.

The influence of a clubs budget on in-game key performance indicators was investigated by Lago-Penas and Gomez-Lopez (2014). There were no significant ($P > 0.05$) differences between high and low budget clubs when comparing their final third entries and shots on goal. While Lago-Penas and Gomez-Lopez (2014) studied the effect club budget had on the likelihood of goal-scoring, it did not offer any insight as to whether goal location or build-up varies between clubs with a large or small budget, or in this case with their division of competition. There is a need to examine each of England's top five divisions in greater detail. To date, the majority of research has been carried out in the Premier League (Wright et al., 2011; Araya & Larkin, 2013; Rathke, 2017), while far less is present in the lower English divisions (Smith et al., 2013).

3. Summary and Rationale

Goal scoring, the climax of, and the target to any attack, is one of the most important variables in the game of football (Yiannakos & Armatas, 2006). Goal scoring is the one statistic in football which determines winning and losing, success and failure. Therefore, analysis of the goal itself, and the actions immediately prior to the goal are extremely valuable to coaches and researchers (Reilly, Bangsbo & Hughes, 1995). Numerous studies (Tenga et al., 2010; Wright

et al., 2011; Durlik & Bieniek., 2014; Rathke, 2017) have investigated trends in goal scoring in football. Wright et al. (2011) and Rathke (2017) highlighted the relevance of shot location and the importance of shooting in the closest proximity to the goal. Araya and Larkin (2013) discussed similar findings and linked optimum shot locations to successful performance outcomes. Tenga et al. (2010) analysed build up play in greater detail. They identified that goals were most likely to occur from long possessions and from attacks which start in the attacking third (zone 13-18). Lago-Penas and Gomez-Lopez (2014) demonstrated that goal scoring key performance indicators increase in frequency when a team is losing the game. There are numerous gaps in research pertaining to goal scoring in football. The level of detail in such studies as Wright et al. (2011) and Rathke (2017) is rare and therefore needs further support. Additionally, few studies to date have analysed goal scoring in England's lower divisions or attempted to make comparisons between goal scoring locations and build-up play across all of these divisions. Little is known about the effect of scoreline and timing on shot location. Furthermore, clarity is sought on the premium location for assists and build-up to occur.

4. Research Questions

To focus the analysis of this study, three research questions were developed. They are:

a) Do trends exist in the location of goal scoring across England's top five divisions?

b) Do trends exist in build-up method (assist and pre-assist) across England's top five divisions?

c) Does the time of goal and scoreline influence other variables such as shot location?

5. Methodology

The primary research aim was to investigate the gap in the research surrounding goal-scoring trends in English league football. This study's analysis is descriptive in nature and cross-sectional. The analysis of goal scoring was achieved through

observation and notational analysis. Goal scoring was analysed in the top five divisions in the English football system. They are: Barclays Premier League, Sky Bet Championship, Sky Bet League 1, Sky Bet League 2, Vanarama National League. All teams competing in these leagues were subject to analysis and were grouped with teams in the same division.

Footage is widely available online in the form of highlight reels and was accessed using clubs official highlight databases found on club websites and social media platforms. In addition to each club supplying highlights from matches on their own media platforms, game footage was also supplied by the leagues themselves. This method of footage collection was sufficient for this study's needs and did not require any further manipulation.

All 'match-days' which were completed by the 31st of March 2018, dating back to the beginning of the season were selected and inserted into a random number generator. The program randomly selected six of these 'match-days' from the Premier League and five 'match-days' from the Championship, League 1, League 2 and National League for analysis. During this analysis, every accessible match from these 'match-days' in each of England's top five divisions was analysed. This ensured that the study analysed 60 matches from each English division. Smith et al. (2013) suggested that the average first team match contains 3.43 goals, therefore estimating that this study gathered evidence from approximately 206 goals from each division. This is a similar sample size to that of Wright et al. (2011).

The football pitch is traditionally broken into 18 different zones, as demonstrated by Rahnama, Reilly & Lees (2002). Figure 4 displays each zone in relation to their position on the pitch. Additionally, to add to the level of detail generated on each goal, zones 14 and 17 have been broken into sub-zones. Zone 14 is now divided into zone 14 left (Z14L), zone 14 centre (Z14C) and zone 14 right (Z14R). While zone 17, also known as the penalty area, is divided into 5 zones. It is also sectioned in thirds but with the centre third divided vertically. The sub-zones of zone 17 are visible on Figure 4 and will therefore be called: 'zone 17 left (Z17L)', 'zone 17 right (Z17R)', 'zone 17 goal area (Z17G)', 'zone 17 centre (Z17C)' and 'zone 17 edge (Z17E)'. All other zones were formatted so that the word zone is represented by the letter 'Z'. The specific zone is then referred to as 'Z' followed by its corresponding number, for example 'Z11' represented zone 11.

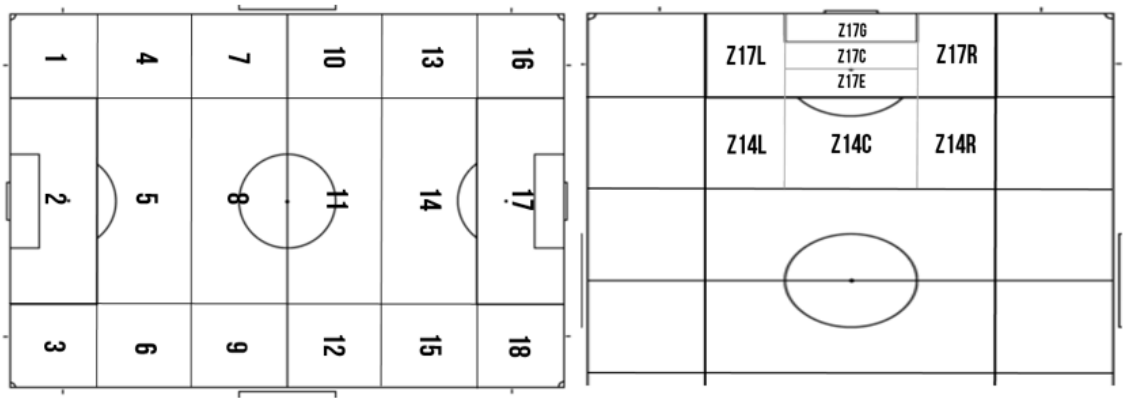

Figure 4: The traditional division of the pitch (18 zones), followed by a more detailed breakdown of zone 14 and 17.

The position of each goal, assist and pre-assist was logged based on method, time, scoreline and division of the competing teams into a Microsoft Office Excel spreadsheet for further statistical analysis. The analysis focused on carrying out an extensive frequency count of all actions in this goal scoring process. A pilot test was carried out using the same methods as the study, but with a smaller sample size to allow for the procedures and methodology to be tested prior to the commencement of the study. As proposed by Wright et al. (2011) a gold standard approach to this method of notational analysis is to use an independent researcher to verify any difficulties which may arise. Therefore, any actions which were contentious were discussed with a second, independent observer, with the footage in ‘freeze frame’, before a decision was made on the nature of the action or outcome.

This study produced descriptive statistics to analyse goal scoring data from each English division. How goals are scored, the methods used in goal creation and the impact of time and scoreline on goal scoring across each league was examined in detail. To evaluate these aspects, this study analysed the quantitative data extracted from the notational analysis of matches to discover the frequency of actions during goal scoring. Important finding’s were those based around the most common areas of pre-assist and assist, and those describing common shot locations. The frequency of goals, assists and pre-assists from each zone will be determined and compared.

6. Results

In total there were 771 goals scored in the 300 matches analysed. Of these 771 goals, adequate footage, which at a minimum contained the goal action, was found for 753 goals. Only for 50 goals in total, of which the majority were scored in the National League, was the available footage incomplete when analysing each goal in relation to the pre-assist, assist and goal actions. Table 1 displays the breakdown of all analysed goals and shows the leagues in which some footage could not be accessed. Many goals in each division did not contain assist or pre-assist actions purely because of the nature of the goal, for instance a penalty kick, direct free kick or regain may have no preceding action and therefore no assist or pre-assist.

Table 1: List of complete and partial goals accessed due to footage availability.

Division	Goals Analysed	Assists Analysed	Pre-Assists Analysed
Premier League	171 (100%)	150 (87.7%) 21 - no assist	110 (64.3%) 55 - no pre-assist 6 - no footage
Championship	164 (100%)	135 (82.3%) 28 - no assist 1 - no footage	103 (62.8%) 58 - no pre-assist 3 - no footage
League 1	122 (100%)	104 (85.2%) 17 - no assist 1 - no footage	75 (61.5%) 44 - no pre-assist 3 - no footage
League 2	182 (100%)	154 (84.6%) 25 - no assist 3 - no footage	95 (52.1%) 72 - no pre-assist 15 - no footage
National League	114 (86.4%)	105 (79.5%) 9 - no assist	70 (53.0%) 39 - no pre-assist
	18 – no footage	18 - no footage	23 - no footage

The average goals scored per game fluctuated highly between each league. Table 2 shows that League 2 contained the highest amount of goals, with an average of 3.03 goals scored per match across the 60 matches. League 1 subsequently had the lowest, with only 2.03 goals being scored per match. There was a significant difference between the average number of goals scored per game in League 2 when compared with League 1 and the National League. There was also a significant difference between goals scored per game in the Premier League and League 1. Difference was identified using a One-Way ANOVA and usage of Tukey's test for Honest Significant Difference (HSD). HSD was equal to 0.806.

Table 2: Average difference in number of goals per match.

	Premier League	Championship	League 1	League 2	National League
Goals per match	2.85*	2.73	2.03	3.03**	2.20

* denotes significant difference to League 1. ** denotes significant difference to League 1 and National League.

The total number and percentage of goals relating to the zones in which they are scored and the league which they are scored in is visible on Table 3. Figure 5 presents a visual representation of the data collected on Table 3. In Figure 5, the percentage of goals in each area is accompanied by a colour. Area's shaded in red are consistent with higher frequencies while areas in green represent a lower frequency of goals scored in this zone. Each individual zone on the map is separated by thick black lines and each zone contains five different frequencies which are representative of the five leagues being analysed. The first frequency in each zone represents the Premier League, while the second represents the Championship, third represents League 1, fourth represents League 2 and the fifth percentage represents the National League. As no goals were scored in Z1-12 in data collection, only the attacking third of the pitch (Z13-18) is pictured.

Table 3: Goal location by division

	Premier League	Championship	League 1	League 2	National League	Average
Z17G	45 (26.3%)	48 (29.2%)	33 (27.0%)	50 (27.4%)	34 (29.8%)	27.9%
Z17C	60 (35.1%)	52 (31.7%)	30 (24.6%)	53 (29.1%)	31 (27.2%)	30.0%
Z17E	18 (10.6%)	15 (9.1%)	13 (10.6%)	24 (13.1%)	11 (9.6%)	10.8%
Z17L	12 (7%)	3 (1.8%)	10 (8.1%)	9 (4.9%)	9 (7.9%)	5.7%
Z17R	6 (3.5%)	5 (3.0%)	6 (4.9%)	8 (4.4%)	8 (7%)	4.4%
Z16	0 (0%)	1 (0.6%)	2 (1.6%)	0 (0%)	0 (0%)	0.0%
Z18	0 (0%)	1 (0.6%)	0 (0%)	0 (0%)	0 (0%)	0.0%
Z14C	17 (9.9%)	18 (11%)	14 (11.4%)	22 (12%)	11 (9.6%)	10.9%
Z14L	3 (1.7%)	5 (3.0%)	3 (2.5%)	1 (.05%)	3 (2.6%)	2.0%
Z14R	2 (1.2%)	5 (3.0%)	4 (3.8%)	6 (3.2%)	2 (1.7%)	2.5%
Z13	0 (0%)	0 (0%)	1 (0.8%)	0 (0%)	0 (0%)	0.0%
Z15	0 (0%)	0 (0%)	0 (0%)	1 (0.5%)	0 (0%)	0.0%
Penalty Spot	8 (4.7%)	11 (6.7%)	6 (4.9%)	8 (4.4%)	5 (4.4%)	5.0%

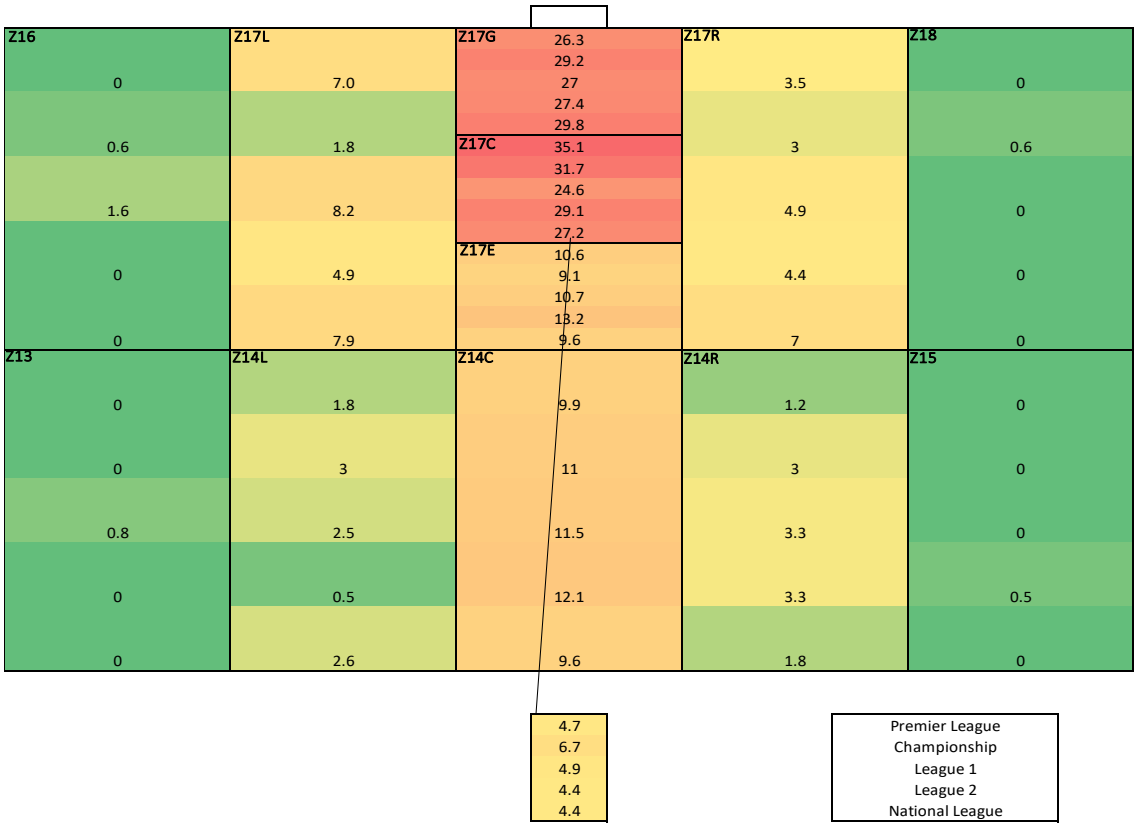

Figure 5: Goal location represented as a heat map.

Z17G and Z17C are the most common locations for goals to be scored from in each division, however the more frequent of these two zones is league

dependant. Z17C represents the highest number of goals scored in the Premier League, Championship and League 2 while in League 1 and the National League more goals are scored from Z17G. The Premier League showed the highest number of goals scored from Z17C, with 35.1% of its total goals being scored in this zone, while the National League, with 29.8% of total goals, contained the largest frequency for Z17G. The number of goals scored in Z17E and Z14C are very similar in all divisions, they range from 9.1% to 13.2%. There is a considerate drop in percentage of goals scored for all other zones excluding Z17G, Z17C, Z17E and Z14C.

Table 4 describes the part of the body used in the goal scoring action, also known as the method of goal scoring. In each league, the right foot is the most common method, followed by left foot and then by a header. League 2 shows the largest percentage, almost one in two, of goals scored using the right foot. Left footed goals are most common in League 1 (36%) while headed goals are most frequent in the Premier League (20.4%). Goals scored using 'other' parts of the anatomy and own goals are particularly uncommon actions.

Table 4: Body part used in goal scoring by division

	Premier League	Championship	League 1	League 2	National League
Right foot	72 (42.1%)	77 (46.9%)	53 (43.4%)	89 (48.9%)	55 (48.2%)
Left foot	58 (33.9%)	52 (31.7%)	44 (36.0%)	53 (29.1%)	32 (28.0%)
Header	35 (20.4%)	31 (18.9%)	21 (17.2%)	37 (20.3%)	23 (20.1%)
Other	2 (1.2%)	2 (1.8%)	1 (0.8%)	1 (0.5%)	0 (0.0%)
Own Goals	4 (2.3%)	2 (1.8%)	3 (2.5%)	2 (1.1%)	4 (3.5%)

Table 5 illustrates the number of touches used by the goal scorer in the goal scoring action. In all measured leagues, one touch finishes are by far the most frequent number of touches used to score a goal. The Championship, with 73.1% of all goals coming from one touch finishes, shows the highest frequency of this. There is little difference between two touch finishes and those requiring more than two touches in all leagues. Two touch finishes are more common in the Championship and League 2, while in League 1 a goal is just as likely to come from two touches as more than two touches. In the Premier League and National

League, goals from more than two touches are more common than exactly two. A very small percentage of all goals are own goals.

Table 5: Number of touches in the goal scoring action by division.

	Premier League	Championship	League 1	League 2	National League	Average
1 touch	117 (68.4%)	120 (73.1%)	77 (63.1%)	133 (73%)	77 (67.5%)	69.6%
2 touches	24 (14%)	22 (13.4%)	21 (17.2%)	28 (15.4%)	16 (14.0%)	14.7%
+2 touches	26 (15.2%)	20 (12.1%)	21 (17.2%)	19 (10.4%)	17 (14.9%)	13.7%
Own Goals	4 (2.3%)	2 (1.8%)	(3) 2.5%	2 (1.1%)	4 (3.5%)	2.0%

Table 6 shows the number of goals in each league that were produced by set-pieces and breaks this figure down further into the specific type of set-piece. Figure 6 graphically represents this information. Referring solely to set-pieces, a corner kick is most likely to produce a goal in all leagues – with the exception of the Championship where a goal from a penalty is just as likely. However, only in the Premier League are goals from a corner over twice as likely to occur as any other set-piece goal. Indirect free kicks are the second most common set-piece producer of goals in all leagues, with the exception of the Championship. Goals scored from throw-ins appear to be the least likely set-piece to produce a goal scored, except in the National League where they are just as frequent as goals scored direct from free kicks.

Table 6: Set-piece goals by division.

	Premier League	Championship	League 1	League 2	National League
Set Piece Goals (total)	46 (26.9%)	38 (23.1%)	35 (28.6%)	47 (25.8%)	32 (28.0%)
Penalty	8 (4.7%)	11 (6.7%)	6 (4.9%)	8 (4.4%)	5 (4.4%)
Direct Free Kick	5 (2.9%)	5 (3%)	5 (4.1%)	8 (4.4%)	4 (3.5%)
Indirect Free Kick	10 (5.8%)	10 (6.1%)	10 (8.1%)	16 (8.8%)	8 (7%)
Corner	22 (12.9%)	11 (6.7%)	11 (9%)	19 (10.4%)	11 (9.6%)
Throw-in	1 (0.6%)	1 (0.6%)	3 (2.5%)	2 (1.1%)	4 (3.5%)

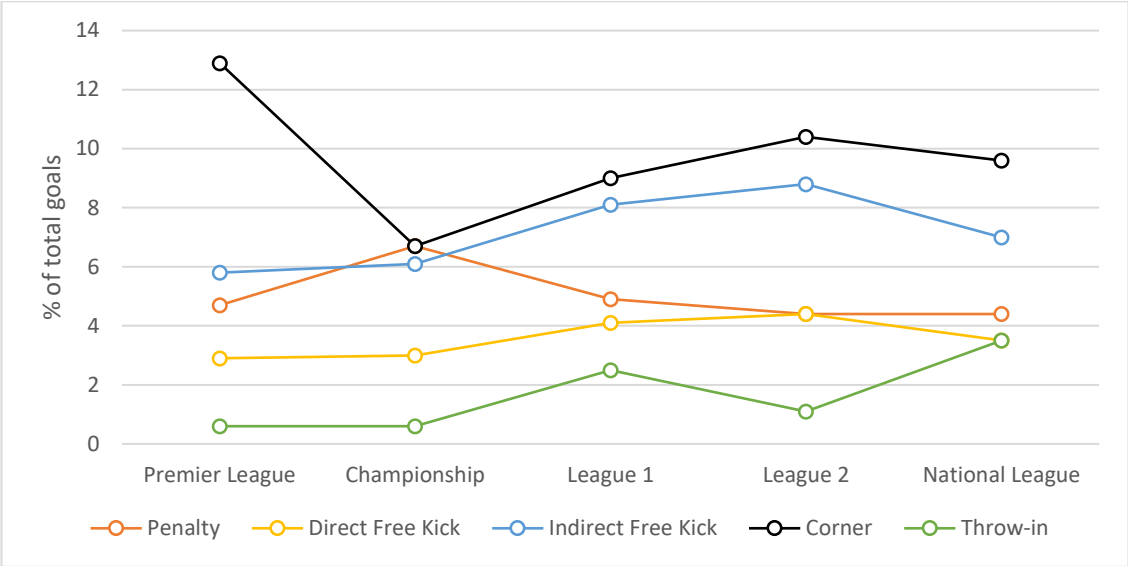

Figure 6: Set-piece goals separated by division.

The number and frequency of assists relating to the zones in which they occur and the league which they occur are visible on Table 7. This table includes the total number of assists in each zone as well as the percentage of total assists in the related division. Figure 7 presents a visual representation of the data collected on Table 7. In Figure 7, the percentage of assists in each area is accompanied by a colour. Area's shaded in red are consistent with higher frequencies while areas in green represent a lower frequency of assists in this area. Each individual zone on the map is separated by thick black lines and each zone contains five different frequencies which are representative of the five leagues being analysed. The first frequency in each zone represents the Premier League, while the second represents the Championship, third represents League 1, fourth represents League 2 and the fifth frequency represents the National League. Assists from corner kicks have also been included on the diagram and the most common zone for an assist to take place in each league has been made bold.

Table 7: Assist location by division.

	Premier League	Championship	League 1	League 2	National League
Corner R	5 (3.3%)	5 (3.7%)	4 (3.8%)	9 (5.8%)	3 (2.9%)
Z18	9 (6%)	9 (6.7%)	8 (7.7%)	7 (4.5%)	7 (6.7%)
Z17R	13 (8.7%)	22 (16.3%)	10 (9.6%)	13 (8.4%)	13 (12.4%)
Z17G	12 (8%)	7 (5.2%)	6 (5.8%)	6 (3.9%)	10 (9.5%)
Z17C	10 (6.7%)	6 (4.4%)	5 (4.8%)	11 (7.1%)	4 (3.8%)
Z17E	5 (3.3%)	8 (5.9%)	4 (3.8%)	13 (8.4%)	2 (1.9%)
Z17L	11 (7.3%)	12 (8.9%)	9 (8.7%)	16 (10.4%)	6 (5.7%)
Z16	9 (6%)	8 (5.9%)	9 (8.7%)	6 (3.9%)	6 (5.7%)
Corner L	6 (4%)	5 (3.7%)	1 (1%)	5 (3.2%)	3 (2.9%)
Z15	9 (6%)	6 (4.4%)	7 (6.7%)	4 (2.6%)	6 (5.7%)
Z14R	9 (6%)	13 (9.6%)	9 (8.7%)	6 (3.9%)	7 (6.7%)
Z14C	19 (12.7%)	12 (8.9%)	10 (9.6%)	12 (7.8%)	14 (13.3%)
Z14L	10 (6.7%)	4 (3%)	3 (2.9%)	10 (6.5%)	2 (1.9%)
Z13	3 (2%)	2 (1.5%)	6 (5.8%)	6 (3.9%)	5 (4.8%)
Z12	3 (2%)	2 (1.5%)	2 (1.9%)	3 (1.9%)	1 (1%)
Z11	12 (8%)	11 (8.1%)	5 (4.8%)	17 (11%)	6 (5.7%)
Z10	3 (2%)	0 (0.0%)	0 (0%)	0 (0%)	3 (2.9%)
Z9	0 (0%)	1 (0.7%)	0 (0%)	2 (1.3%)	0 (0%)
Z8	2 (1.3%)	1 (0.7%)	4 (3.8%)	3 (1.9%)	4 (3.8%)
Z7	0 (0%)	0 (0%)	2 (1.9%)	1 (0.6%)	1 (1%)
Z6	0 (0%)	0 (0%)	0 (0%)	1 (0.6%)	0 (0%)
Z5	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (1%)
Z4	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Z3	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Z2	0 (0%)	1 (0.7%)	0 (0%)	3 (1.9%)	1 (1%)
Z1	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Total	150	135	104	154	105

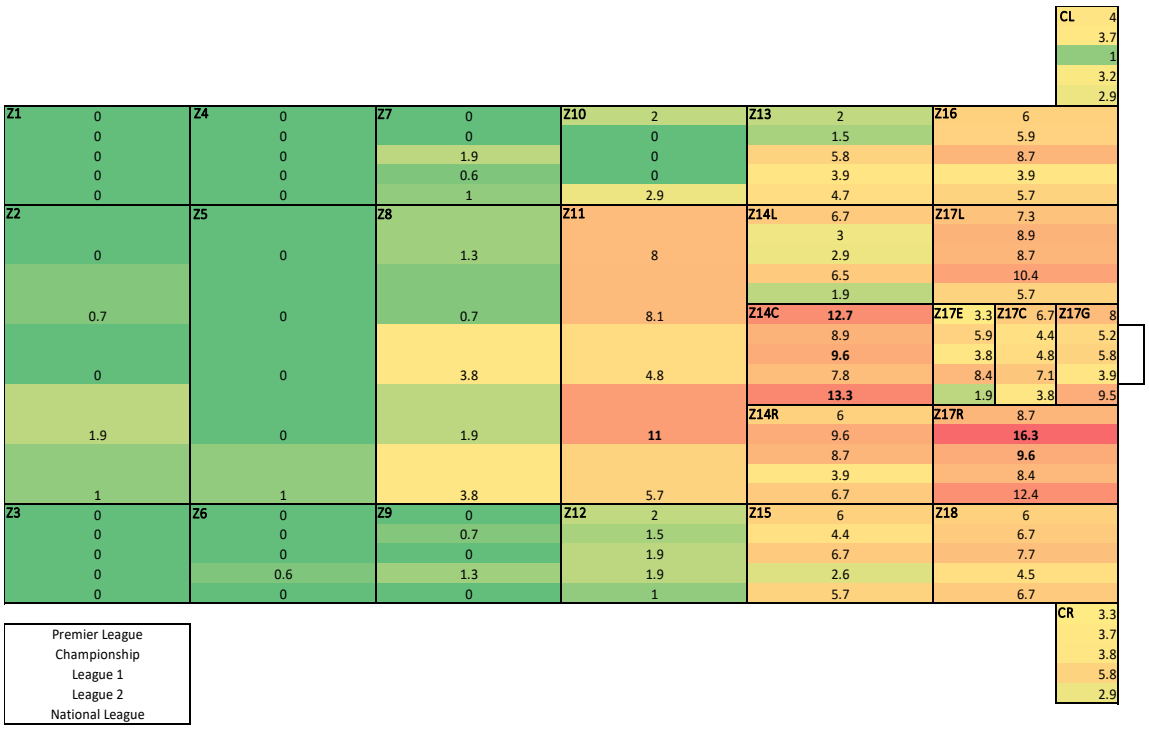

Figure 7: Assist location represented as a heat map.

The location of assist in each league is pictured in Figure 7. Assists appear to originate from central locations more often than in wide areas. Although, the most common assist location in each league is relatively varied. Both the Premier League and the National league record the majority of their assists in Z14C, assisting from there 12.7% and 13.3% of the time, respectively. The Championship see's the largest number of assists being produced in Z17R. These two locations, Z14C and Z17R, appear as the most likely assist locations in League 1 also. Contrastingly, League two produces the most assists (11% of total assists) in Z11. Considering all the wide areas on the pitch, Z16 and Z18 are the most common assist locations.

The number and frequency of pre-assists relating to the zones in which they occur and the league which they occur are visible on Table 8. This table includes the total number of pre-assists in each zone as well as the percentage of total pre-assists in the related division. Figure 8 presents a visual representation of the data collected in Table 8. In Figure 8, the percentage of pre-assists in each area is accompanied by a colour. Area's shaded in red are consistent with higher frequencies while areas in green represent a lower frequency of pre-assists in this area. Each individual zone on the map is separated by thick black lines and

each zone contains five different frequencies which are representative of the five leagues being analysed. The first frequency in each zone represents the Premier League, while the second represents the Championship, third represents League 1, fourth represents League 2 and the fifth frequency represents the National League. Pre-assists from corner kicks have also been included on the diagram and the most common zone for a pre-assist to take place in each league has been made bold.

Table 8: Pre-assist location by division.

	Premier League	Championship	League 1	League 2	National League
Corner R	5 (4.5%)	1 (1%)	3 (4%)	3 (3.2%)	1 (1.4%)
Z18	2 (1.8%)	13 (12.6%)	4 (5.3%)	4 (4.2%)	5 (7.1%)
Z17R	6 (5.5%)	2 (1.9%)	5 (6.7%)	5 (5.3%)	1 (1.4%)
Z17G	0 (0%)	0 (0%)	1 (1.3%)	1 (1.1%)	0 (0%)
Z17C	1 (0.9%)	1 (1%)	1 (1.3%)	0 (0%)	3 (4.3%)
Z17E	2 (1.8%)	0 (0%)	1 (1.3%)	2 (2.1%)	1 (1.4%)
Z17L	7 (6.4%)	3 (2.9%)	1 (1.3%)	3 (3.2%)	2 (2.9%)
Z16	2 (1.8%)	2 (1.9%)	6 (8%)	6 (6.3%)	2 (2.9%)
Corner L	4 (3.6%)	0 (0%)	2 (2.7%)	2 (2.1%)	4 (5.8%)
Z15	3 (2.7%)	8 (7.8%)	7 (9.3%	6 (6.3%)	4 (5.8%)
Z14R	9 (8.2%)	13 (12.6%)	3 (4%)	3 (3.2%)	8 (11.4%)
Z14C	14 (12.7%)	17 (16.5%)	9 (12%)	11 (11.6%)	5 (7.1%)
Z14L	8 (7.3%)	9 (8.7%)	3 (4%)	9 (9.5%)	3 (4.3%)
Z13	10 (9.1%)	9 (8.7%)	4 (5.3%)	8 (8.4%)	4 (5.7%)
Z12	4 (3.6%)	2 (1.9%)	1 (1.3%)	4 (4.2%)	3 (4.3%)
Z11	19 (17.3%)	12 (11.6%)	9 (12%)	9 (9.5%)	10 (14.3%)
Z10	3 (2.7%)	2 (1.9%)	1 (1.3%)	1 (1.1%)	3 (4.3%)
Z9	2 (1.8%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Z8	5 (4.6%)	4 (3.9%)	10 (13.3%)	8 (8.4%)	3 (4.3%)
Z7	1 (0.9%)	0 (0%)	1 (1.3%)	0 (0%)	2 (2.9%)
Z6	1 (0.9%)	0 (0%)	0 (0%)	2 (2.1%)	0 (0%)
Z5	2 (1.8%)	3 (2.9%)	1 (1.3%)	4 (4.2%)	1 (1.4%)
Z4	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (1.4%)
Z3	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Z2	0 (0%)	2 (1.9%)	2 (2.6%)	4 (4.2%)	4 (5.8%)
Z1	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Total	110	103	75	95	70

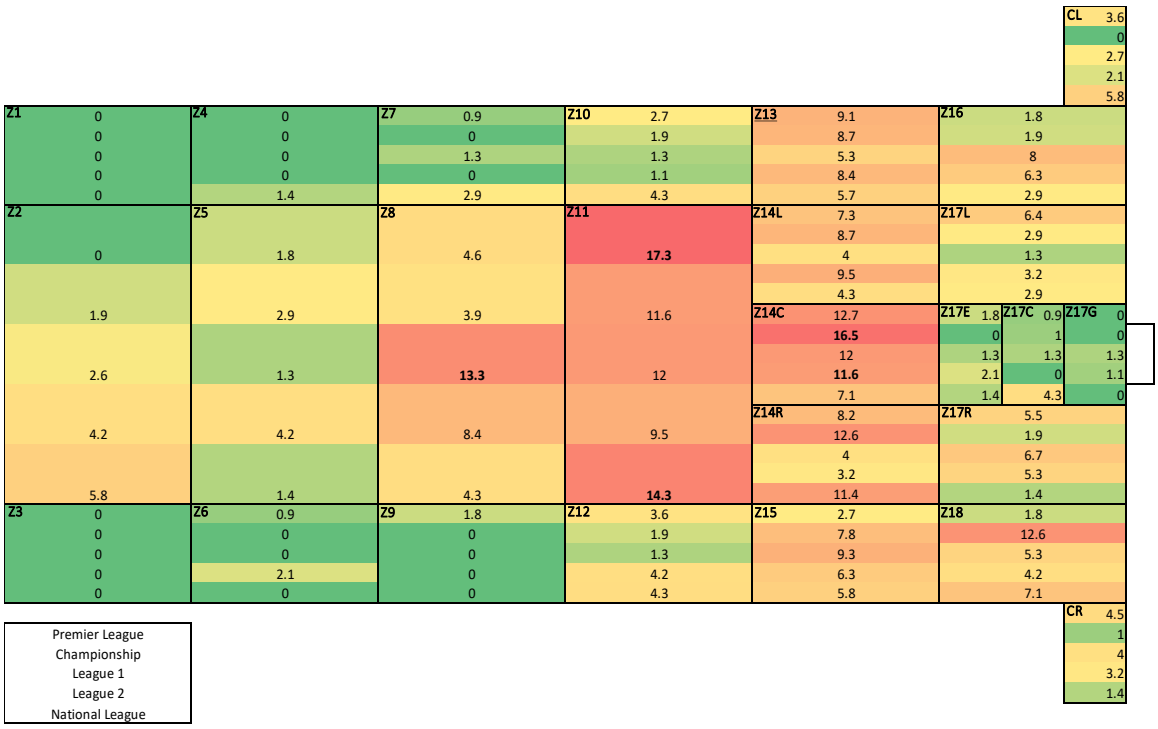

Figure 8: Pre-assist location represented by a heat map.

Figure 8 shows the most prominent locations for the pre-assist, the action before the assist. Just as the location of assists varied across each division, the most common pre-assist locations also offer a level of variance. Again, the Premier League and National League share their most common zone, with 17.3% and 14.3% respectively, of pre-assists originating from Z11. The Championship and League 2 also shared the same zone for their largest number of pre-assists, with 16.5% and 11.6%, respectively, being produced in Z14C. Only in League 1 is the most common location for the pre-assist inside the attacking team's defensive half. 13.3% of all pre-assists in League 1 come from Z8, however the defensive half has become busier in relation to pre-assist actions when compared to assists. Regarding the wide areas of the pitch, Z13 and Z15 now appear most frequent.

Table 9 illustrates the timing of goals scored between each league and attempts to identify differences between each league. Figure 9 gives a visual representation of this data. There is a large fluctuation between goal scoring times in each league. There also appears to be no consistent period of time throughout all leagues where goals are more likely to be scored. A goal is most likely to be scored in the 46-60 minute period in the Premier League, League 1 and League 2 while the 76-90 minute period is most likely for a goal in the

Championship. Then, in the National League, the most likely time is the 16-30 minute period.

Table 9: Time of goal scoring by division.

	Premier League	Championship	League 1	League 2	National League
0-15	22 (12.8%)	22 (13.4%)	13 (10.7%)	18 (9.8%)	15 (11.3%)
16-30	22 (12.8%)	23 (14.0%)	16 (13.1%)	24 (13.1%)	25 (18.9%)
31-45	23 (13.5%)	27 (16.45)	20 (16.3%)	31 (17.0%)	22 (16.6%)
1IT	5 (2.9%)	3 (1.8%)	5 (4.1%)	2 (1.1%)	2 (1.5%)
46-60	39 (22.8%)	19 (11.6%)	23 (18.9%)	34 (18.6%)	11 (8.3%)
61-75	26 (15.2%)	31 (18.9%)	19 (15.5%)	33 (18.1%)	22 (16.6%)
76-90	25 (14.6%)	32 (19.5%)	21 (17.2%)	31 (17.0%)	24 (18.1%)
2IT	9 (5.2%)	7 (4.2%)	5 (4.1%)	9 (4.9%)	11 (8.3%)

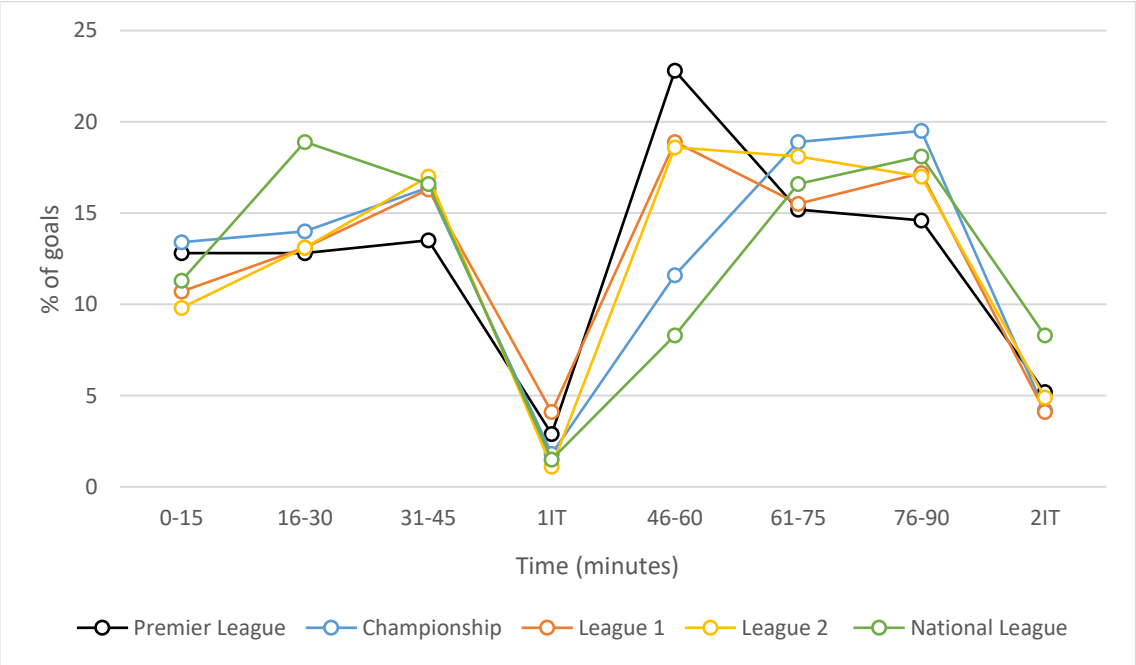

Figure 9: Time of goal scoring by division.

Table 10 shows how goal location is effected by the stage of the match. Figure 10 gives a graphical representation of this data. There is a notable spike in goal scoring in Z17G in 2nd half injury time with 42.8% of all goals in that time slot being scored in that zone. This is the exact opposite to the occurrence in 1st half injury time when goal scoring from Z17G is at its lowest. Z17C remains within a range

of 23.7% to 34.9% for the entire match and is most frequent between the 61st and 75th minute. Z14C is highest in the opening fifteen minutes before dropping off and recording a secondary peak in 2nd half injury time. Z17E, similar to Z17C, peaks in the middle of the second half. Z17R and Z17L remain quite stable excluding the dramatic increase in scoring from Z17R in 1st half injury time.

Table 10: The effect of time on goal location.

	0-15 minutes	16-30 minutes	31-45 minutes	1st half injury	46-60 minutes	61-75 minutes	76-90 minutes	2nd half injury
Z17G	23 (26.7%)	32 (29.9%)	34 (27.6%)	3 (17.6%)	39 (31.4%)	29 (22.4%)	34 (25.9%)	18 (42.8%)
Z17C	27 (31.4%)	33 (30.8%)	41 (33.3%)	5 (29.4%)	34 (27.4%)	45 (34.9%)	31 (23.7%)	10 (23.8%)
Z17E	5 (5.8%)	13 (12.1%)	10 (8.1%)	2 (11.8%)	13 (10.5%)	20 (15.5%)	17 (12.9%)	3 (7.1%)
Z17L	6 (7%)	6 (5.6%)	7 (5.7%)	1 (5.9%)	10 (8.1%)	5 (3.9%)	4 (3.1%)	4 (9.5%)
Z17R	3 (3.5%)	4 (3.7%)	3 (2.4%)	3 (17.6%)	4 (3.2%)	3 (2.3%)	13 (9.9%)	0 (0%)
Z14C	18 (20.9%)	11 (10.3%)	16 (13%)	1 (5.9%)	8 (6.5%)	11 (8.5%)	17 (12.9%)	7 (16.6%)
Z14L	2 (2.3%)	4 (3.7%)	3 (2.4%)	0 (0%)	3 (2.4%)	3 (2.3%)	1 (0.7%)	0 (0%)
Z14R	0 (0%)	1 (0.9%)	3 (2.4%)	1 (5.9%)	6 (4.8%)	4 (3.1%)	4 (3.1%)	0 (0%)
PS	2 (2.3%)	3 (2.8%)	6 (4.9%)	1 (5.9%)	7 (5.6%)	9 (6.9%)	10 (7.6%)	0 (0%)

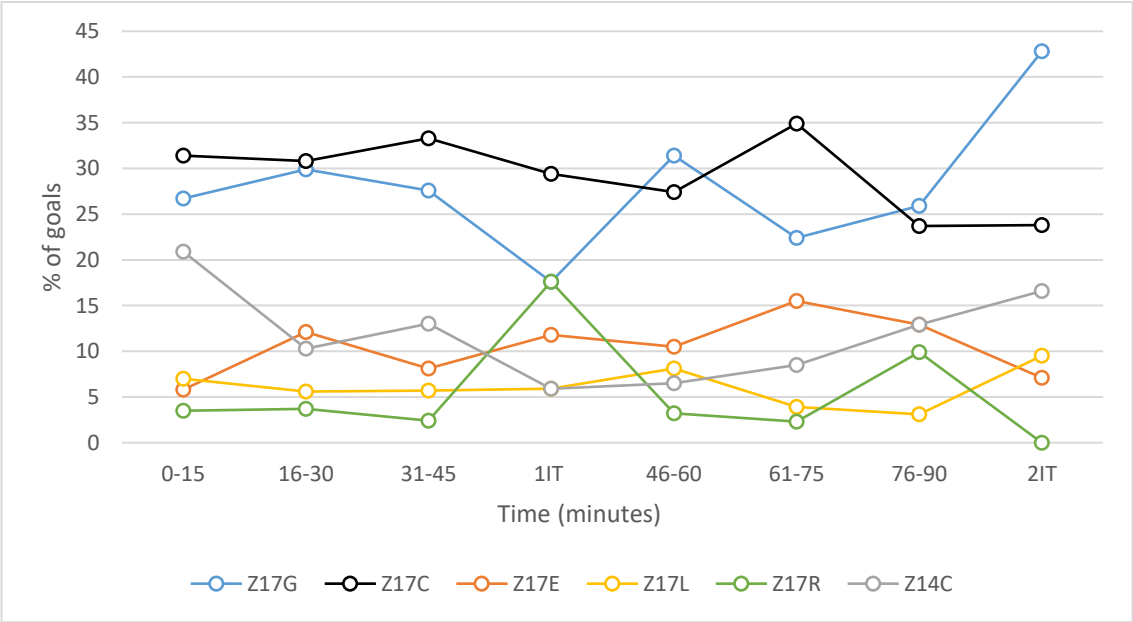

Figure 10: The effect of time on goal location.

Table 11 shows the effect the scoreline in a match has on the location of goal-scoring. Figure 11 gives a graphical representation of this data. Goal scoring from Z17G is most common when a team is drawing and at its lowest (16.4%) when a team is winning by two or more goals. Goals from Z17C are most likely to occur when a team is two or more goals behind and continues to be a more likely goal location than Z17G when a team is in the lead by any scoreline. Z17E shows a spike in goal scoring when a team is leading by two or more and also becomes a more likely goal location than Z17G in this situation. A goal from Z14C is most likely to occur when a team is winning by one goal and least likely when a team is winning by 2 or more.

Table 11: The effect of scoreline on goal location.

	2 or more behind	1 Behind	Drawing	1 Ahead	2 or more ahead
Z17G	10 (16.4%)	35 (24.3%)	112 (31.7%)	40 (29.2%)	15 (23.4%)
Z17C	18 (29.5%)	47 (32.6%)	98 (27.8%)	39 (28.5%)	25 (39.1%)
Z17E	11 (18%)	15 (10.4%)	33 (9.3%)	14 (10.2%)	8 (12.5%)
Z17L	4 (6.6%)	7 (4.9%)	20 (5.7%)	7 (5.1%)	5 (7.8%)
Z17R	7 (11.5%)	7 (4.9%)	12 (3.4%)	6 (4.4%)	1 (1.6%)
Z14C	3 (4.9%)	21 (14.6%)	47 (13.3%)	14 (10.2%)	5 (7.8%)
Z14L	2 (3.3%)	0 (0%)	11 (3.1%)	1 (0.7%)	2 (3.1%)
Z14R	8 (2.7%)	5 (3.5%)	8 (2.7%)	4 (2.9%)	0 (0.0%)
PS	12 (3.4%)	7 (4.9%)	12 (3.4%)	12 (8.8%)	3 (4.7%)

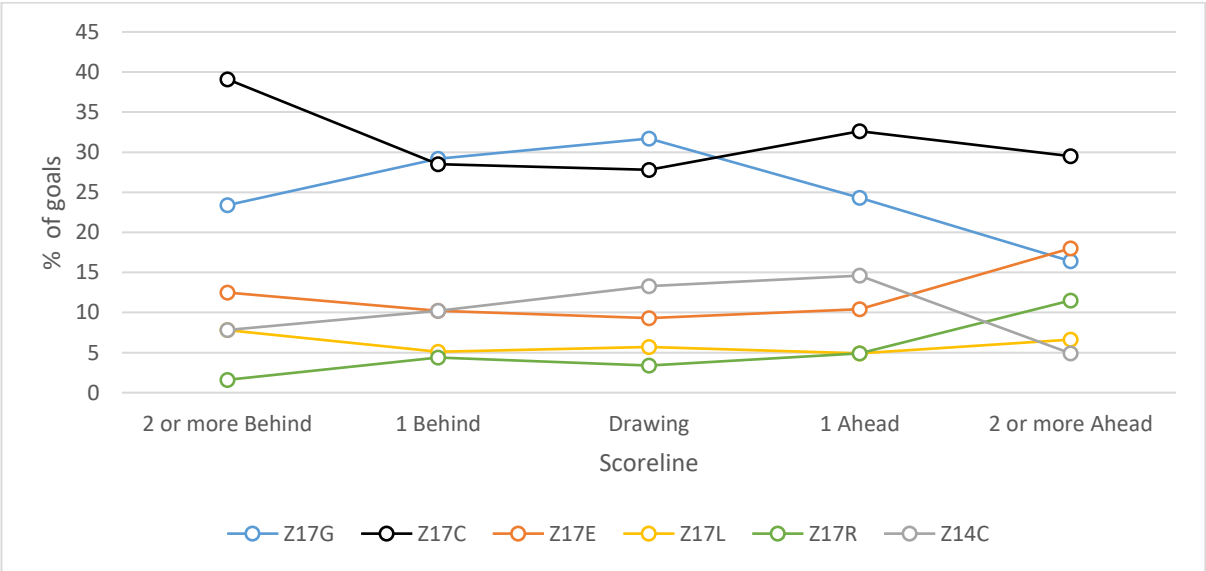

Figure 11: The effect of scoreline on goal location.

7. Discussion

7.1 Purpose of Study

The purpose of this research was to investigate any trends which may exist in the action of, and the actions prior to, goal scoring in English football. Included in this analysis is the top five divisions in the English footballing ladder (Premier League, Championship, League 1, League 2 and National League). Furthermore, other influencing factors on goal location, such as time in match and scoreline, were investigated. There is a paucity of studies which compare specific performance outcomes, such as goals, across different divisions in English football. Detailed analysis of goal, assist and pre-assist location is also unaccounted for in previous research and thus, the purpose of this study was to explore the gaps stated and uncover possible differences across the English Football Leagues.

7.2 Summary of Results

A myriad of variances between each division were identified in data collection and outlined in the results section. While goal location, goal method and number of touches in the goal scoring action were relatively consistent in each division, there were levels of variability in the role of set-pieces within the goal scoring action. Assist and pre-assist location differed considerably across all divisions and in many cases the most common zone for an assist or pre-assist to occur was contrasting. The time of goal-scoring appears to vary greatly between divisions, where different peaks in goal scoring occurred at different times during the match. Finally, the situation of the match, referring to both the time in match and scoreline, affected the location of goal scoring further.

7.3 Goal Location

Goal location has received increasing levels of research in recent years (Wright et al., 2011; Durlik & Bieniek., 2014; Rathke, 2017). However, previous research has failed to identify a common division of the penalty area and with no consistent division of the penalty area developed, it is difficult for exact comparisons to be made with past research. That said, Z17G and Z17C are identified as the most common locations for goal scoring in each division and while zones similar to these in Wright et al. (2011) are identified as the most successful location to shoot

from, they are not shown to be the most common location for goal scoring. In Wright et al. (2011), the area most closely resembling Z17E, using some of Z17R and Z17L, appears to be the most common goal location. This is inconsistent with the findings of this study, as Z17L and Z17R are shown to be far less common locations for goals to be scored from.

Rathke (2017) showed that a difference exists between the central three zones in the penalty area (Z17G, Z17C and Z17E) and the wide areas (Z17R and Z17L). This is consistent with the findings of this study, where the wide areas account for 5.7% (Z17L) and 4.4% (Z17R) of all goals scored compared to Z17E which produced 10.8% of all goals. There is a considerable difference between the wide zones in the penalty area, in four leagues out of five, Z17L has a higher percentage of goals than Z17R. This finding has been previously unreported by similar studies but may relate to the tendency for players to shoot with their right foot in Z17L and the left foot in Z17R. This ultimately relates to this studies finding that the majority of goals scored in every division are with the right foot. Z14C appears to contradict the argument in modern coaching which discourages shooting from outside the box, being a more likely location for goal scoring than Z17E in the Championship and League 1, and just as likely in the National League. That said, the penalty area (Z17) is certainly the most likely zone of the pitch for a goal to be scored in. When analysing the penalty area as a whole, 78.8% of all goals were scored from within the area. This is similar to the 79.6% recorded by Yiannakos and Armatas (2006) but significantly lower than the 89.5% recorded by Yiannis (2014).

7.4 Goal Method

In all five analysed divisions the right foot is the most common part of the body used in goal scoring, with the percentage of goals ranging from 42.1% to 48.9%. This is to be expected with the majority of the general population (75%-80%) having a preference for their right foot and around of 79% of World Cup players preferring and having bias towards the use of their right foot (Carey, Smith, Smith, Shepherd, Skriver, Ord & Rutland, 2001). The left foot is the second most common part of the body used in the goal scoring action, ranging from 28% to 36% of all goals scored. Few studies differentiate between feet when assigning the method of scoring. Durlik and Bieniek (2014), Wright et al (2011) and

Charalampos et al. (2013) all failed to differentiate between left and right foot goals. Their findings stated that 79.5%, 72% and 75% of goals, respectively, were scored with the player's feet. These figures are similar to the findings of this study if right and left foot goals were to be combined in each league. The frequency of headers in each league, ranging from 17.2% to 20.4%, is similar to the work of Yiannis (2014), who reported that 18.1% of goals are headed goals. Wright et al. (2010) findings sit just outside this range, with 17% of all goals scored being headers.

The number of touches in the goal scoring action is consistent across each league. One touch finishes are by far the most common type of goal in all five leagues, ranging from 63.1% to 73.1%. The work of Durlik and Bieniek (2014) falls within this range, they found that 69.3% of goals were first time finishes in the Premier League, very similar to the 69.6% recorded in this study. There appears to be no linear occurrences in Table 5 which would suggest that the level of competition has no influence on the number of touches used in goal scoring actions. Nonetheless, the argument still exists that in higher divisions a player has less time on the ball and therefore less time to take touches to shoot. While there is no evidence of this within Table 5, it may also be the case that players in higher divisions are greater skilled in the art of dribbling and using ball control to create opportunities to score.

The role of set-piece goals varies across each English division. League 1 shows the highest percentage of total goals from set-pieces with 28.6%. The Championship, with 23.1% of all goals, has the lowest percentage. Corner kicks are the most frequent set-piece goals in each league, followed by indirect free kicks, penalties, direct free-kicks and throw-ins. In all divisions an indirect free kick is twice as likely to produce a goal as a direct free kick. Yiannakos and Armatas (2006) stated that 40% of goals scored from set-pieces were from corners, with 30% coming from free-kicks, both indirect and direct. If free kicks were combined, the Championship, League 1 and League 2 would show similar results to those of Yiannakos and Armatas (2006). However, the Premier League would still record more goals from corners than direct and indirect free kicks combined, possibly due to the increased emphasis on coaching and practicing set routines for corner kicks and the targeting of these specific types of set-pieces as a method of goal scoring within this league.

7.5 Assist and Pre-Assist Location

Assist location is far less frequently referred to in research than goal location when examining recent studies. What is even less common is investigation into assist location in divisions below the Premier League. Durlik and Bieniek (2014) examined assist location in the Premier League and showed that the largest number of assists came from the area of Z18 located closest to the touchline. This evidence is not supported by this study as Z14C produced the largest number of assists in the Premier League. However, in the Durlik and Bieniek (2014) study, Z14C was the second most frequent zone. The third most common was Z16, directly opposite their most frequent Z18. The work of Durlik and Bieniek (2014) appears to suggest that the majority of assists in the Premier League come from wide areas and crosses. Smith et al. (2013) deem a cross to be the most frequent assist action but while they did not determine which zone these crosses came from, it is likely that a substantial number came from wide zones. This study contradicts the findings of both Durlik and Bieniek (2014) and Smith et al. (2013) as the most common assist location for each league is a central zone, which supports the theory that short passes are the most likely form of assist (Charalampos et al., 2013). The most common assist zone in the Championship and League 1 is Z17R, implying that cut-backs rather than crosses are the preferred method of assist for modern teams. The most common assist location in League 2 is Z11, the only league where the most frequent location is in the midfield third, suggesting that longer passes may be a more common tactic in League 2.

Figure 8 shows that the pre-assist action is more common in the midfield and defensive zones than the assist action. That said, Z14C is still the most common location for a pre-assist to occur in the Championship and League 2. Curiously, the most common location for a pre-assist in League 2 is closer to the goal than the most common assist location. Pre-assists are most common in Z11 in the Premier League and National League and in Z8 in League 1. This shows that many attacks in these divisions are direct in nature, as they travel from midfield and defensive areas in only two actions before the goal is scored. Wright et al. (2011) show a similar trend, with the majority of goals coming from attacks which start in the midfield and defensive third of the pitch. Pre-assists are still more likely to occur in central areas than in wide zones.

7.6 Time and Scoreline

Numerous studies have looked to identify the time period within a football match where goals are scored most often. It is accepted that the second half holds greater likelihood (Yiannakos & Armatas, 2006; Yiannis, 2014) of containing goals scored as this is often when teams require a goal to change the outcome of the game. For this same rationale, the final 15 minutes have been shown to contain the most goals in the Premier League (Durlik and Bieniek, 2014). However, their evidence is contradictory to the findings of this study which suggest that the 46-60 minute period is most common in the Premier League. Armatas et al. (2007) also showed evidence that the final 15 minutes is the most likely period for a goal to be scored in, but this was only the case for the Championship. All other analysed leagues goal scoring peaked at different times, both League 1 and League 2 peak in the 15 minute period after half-time while goal scoring in the National League peaked in the 16-30 minute time period. Similar to the work of Yiannis (2014) and Gurkan et al. (2017), in most divisions there are over double the amount of goals scored in second half injury time when compared to first half injury time, due to the necessity for teams to score goals late in matches.

The zones closest to the goal are anecdotally deemed to be ‘high percentage’ zones in current coaching environments. This is supported by this studies analysis of goal location. Goals from Z17G peak when matches are tied which may suggest that teams put more effort into getting into these high percentage zones at the beginning of the match, when it is 0-0, or when the game is in the balance. The dramatic decrease recorded when winning may suggest teams are less concerned about getting into these high percentage areas when leading and are happier to try to score from further away, with lower percentage shots. The fact that the percentage of goals from other zones (Z17C, Z17E and Z14C) increases when leading also contributes to this theory. Lago-Ballesteros et al. (2012) and Ruiz-Ruiz et al. (2013) recorded more penalty area entries when teams are losing compared to drawing or winning and this is partly supported by the frequency of Z14C goals decreasing when losing and the dramatic increase in Z17C goals when a team is at least two goals behind. However this is only partly supported, due to the fact that Z17G scoring decreases when behind.

Goal location is also affected by the time in the match. Peaks in goal scoring in Z17G are observed in 2nd half injury which may suggest that teams who need to score late in matches excessively focus their efforts on getting the ball into this area. However, goals from Z14C also increase in both the 75-90 minute period and second half injury time which would indicate a greater number of attempts from outside of the penalty area later in the game. Z14C's highest peak is in the first 15 minutes, which may indicate that it is advantageous to shoot from greater distance earlier in the game or that shooting from distance early in a match is more common.

7.7 Conclusion

Goal scoring is the ultimate measure of performance in football (Swarc, 2007) and it has received significant research in recent years (Wright et al., 2011; Durlik & Bieniek., 2014; Rathke, 2017). In turn, English football is viewed to be one of the most exciting footballing environments in the modern world. However, few studies have looked to link these and identify trends and frequent occurrences in goal scoring between each of England's top 5 leagues. Few notable trends between divisions exist in goal scoring alone but when analysing the two actions prior to the goal, the assist and pre-assist, greater differences are evident. That is to say that goal scoring does not appear to differ amongst divisions, but the build-up play immediately prior to the goal scoring action does. There is also differences across divisions in the time of goal scoring, as goal scoring peaks occur at different times. Goal location does appear to be affected by both the time elapsed in the match and the scoreline.

7.8 Limitations

Limitations of this study were undoubtedly the sample size and also the inability to access all footage from chosen matches. The sample size of 60 matches per league allowed for a range of 122-182 goals to be analysed from each league. Previous work by Smith et al. (2013), who concluded that 3.43 goals were scored per game, did not appear accurate. This resulted in less goals being analysed than initially targeted. A greater sample size would improve the accuracy of this studies results.

As previously mentioned, 50 out of the 771 goals involved in the data collection process had elements of which, could not be accessed due to the unavailability of footage. While this only equates to 6.5% of all goals, the majority of these seem to originate from the least funded league in the study, the English National League. Greater access to goals from this league in particular would have improved elements of the results. Future research should analyse the assist and pre-assist actions in greater detail, with specific attention being paid to the 'pre-assist to assist to goal' process, identifying which pre-assist and assist zones relate most frequently to goal scoring zones. Furthermore, greater analysis of the role of dribbles in the goal scoring process is required in future research.

7.9 Practical Implications

When carrying out performance or notational analysis on events in football matches, it is vital to ensure that the findings of the analysis have significance to those involved within the sport and can be used to better understand or perform. The findings of this study have numerous practical applications for managers and coaches.

- Knowledge of the specific pitch zones which produce the most goals can influence tactics and attack creation strategies for managers and coaches.
- Knowledge of the number of touches most commonly used in the goal scoring action may influence finishing and shooting practices for managers and coaches.
- Knowledge of the type of set-pieces which produce the most goals may indicate to managers and coaches which set-pieces should receive the most attention.
- Knowledge of the division specific pitch zones which produce assists and pre-assists may influence managers and coaches' tactics and attack creation methods, as well as influencing training methods.
- Knowledge of the division specific time period in the match which produces the most goals can influence a manager and coaches' tactics when deciding whether to emphasise attack or defence.

References

Araya, J. & Larkin, P. (2013). Key performance variables between the top 10 and bottom 10 teams in the English premier league 2012/13 season. *University of Sydney Papers in HMHCE*, 2, 17 - 29

Armatas, V., Yiannakos, A. & Sileloglou, P. (2007). Relationship between time and goal scoring in soccer games: analysis of three world cups. *International Journal or Performance Analysis in Sport*, 7 (2), 48-58.

Carey, D., Smith, G., Smith, D., Shepherd, J., Skriver, J., Ord, L. & Rutland, A. (2001). Footedness in world soccer: an analysis of France '98. *Journal of Sports Sciences*, 19, 855-864.

Charalampos, M., Yiannis, M., Michalis, M. & Zisis, P. (2013). Analysis of goals scored in UEFA Champions League in the period 2009/2010. *Serbian Journal of Sports Sciences*, 7 (2), 51-55.

Durlik, K. & Bieniek, P. (2014). Analysis of goals and assists diversity in English Premier League. *Journal of Health Sciences*, 4 (5), 47-56.

Gurkin, O., Ertetik, G. & Muniroglu, S. (2017). Analysis of goals scored in UEFA Champions League by the time periods. *International Journal of Science Culture and Sport*, 5 (3), 140-147.

Hughes, M. & Franks, I. (2007). Analysis of passing sequences, shots and goals in soccer. *Journal of Sports Sciences*, 23 (5), 509-514.

Lago-Ballesteros, J., Lago-Penas, C. & Rey, E. (2012). The effect of playing tactics and situational variables on achieving score-box possessions in a professional soccer team. *Journal of Sports Sciences*, 30 (14), 1455–1461.

Lago, C., & Martin, R. (2007). Determinants of possession of the ball in soccer. *Journal of Sports Sciences*, 25 (9), 969–974.

Lago-Penas, C. & Gomez-Lopez, M. (2014). How important is it to score a goal? the influence of the scoreline on match performance in elite soccer. *Perceptual & Motor Skills*, 119 (3), 774-784.

Liu, H., Hopkins, W., Gomez, A. & Molinuevo, J. (2013). Inter-operator reliability of live football match statistics from OPTA Sportsdata. *International Journal of Performance Analysis in Sport*, 13, 803-821.

Liu, H., Gomez, M., Lago-Peñas, C. & Sampaio, J. (2015). Match statistics related to winning in the group stage of the 2014 Brazil FIFA World Cup. *Journal of Sports Sciences*, 33 (12), 1205-1213.

Perin, C., Vuillemot, R. & Fekete, J. (2013). Soccer stories: a kick-off for visual soccer analysis. *Visulisation and Computer Graphics*, 19 (2), 2506-2513.

Potthast, W. (2010). Motion-differences in goal kicking on natural and artificial soccer turf systems. *Footwear Science*, 2 (1), 29-35.

Rahnama, N., Reilly, T. & Lees, A. (2002). Injury risk associated with playing actions during competitive soccer. *British Journal of Sport Medicine*, 36 (5), 354-359.

Rathke, A. (2017). An examination of expected goals and shot efficiency in soccer. *Journal of Human Sport and Exercise*, 12, 514-529.

Redwood-Brown, A. (2008). Passing patterns before and after goal scoring in fa premier league soccer. *International Journal of Performance Analysis in Sport,* 8 (3), 172-182.

Reilly, T., Bangsbo, J. & Hughes, M. (1995). *Science and Football III*. London: Routledge.

Ruiz-Ruiz, C., Fradua, L., Fernandez-Garcia, A. & Zubillaga, A. (2013). Analysis of entries into the penalty area as a performance indicator in soccer. *European Journal of Sport Science*, 13 (3), 241-248.

Smith, S., Callaway, A. & Broomfield, S. (2013). Youth to senior football: a season long case study of goal scoring methods between under 16, under 18 and first team. *International Journal of Performance Analysis in Sport*. 13, 413-427.

Swarc, A. (2007). Efficacy of successful and unsuccessful soccer teams taking part in finals of Champions League. *Research Yearbook*, 13 (2), 221-225.

Tenga, A., Holme, I., Ronglan, L. & Bahr, R. (2010). Effect of playing tactics on goal scoring in Norwegian professional soccer. *Journal of Sport Sciences*, 28 (3), 237-244.

van Ours, J. & van Tuijl, M. (2011). Country-specific goal scoring in the ‘dying seconds’ of international football matches. *International Journal of Sport Finance*, 6, 138-154.

Wright, C., Atkins, S., Polman, R., Jones, B. & Sargeson, L. (2011). Scoring opportunities in professional soccer. *International Journal of Performance Analysis in Sport*, 11, 438-449.

Yiannakos, A. & Armatas, V. (2006). Evaluation of the goal scoring patterns in European Championship in Portugal 2004*. International Journal of Performance Analysis in Sport*, 6 (1), 178-188.

Yiannis, M. (2014). Analysis of goals scored in the 2014 world cup soccer tournament held in Brazil. *International Journal of Sports Studies*, 4 (9), 1017-1026.