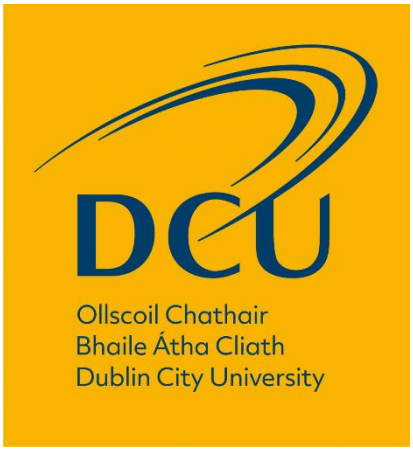

To Investigate Bilateral Kicking Accuracy in Ladies Gaelic Football

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Declaration Page:

I hereby certify that this material, which I now submit for assessment on the programme of study leading to the award of Master of Science (MSc) entirely my own work, and that I have exercised reasonable care to ensure that the work is original, and does not to the best of my knowledge breach any law of copyright, and has not been taken from the work of others save and to the extent that such work has been cited and acknowledged within the text of my work.

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I would like to thank my family, for continually helping me out throughout this Masters, but especially for running after footballs for me while carrying out the tests for this Masters.

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List of Abbreviations:

GAA – Gaelic Athletic Association

LGFA – Ladies Gaelic Football Association

LGF – Ladies Gaelic Football

AFL - Australian Football League

PA – Performance Analysis

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Abstract:

Background

Kicking accurately is essential in Gaelic games, and players who kick proficiently with both feet are viewed as highly skilled athletes. Bilateral ability in asymmetrical sport is a potentially advantageous and has been shown to be a key indicator to successful outcomes in games. While research has been done in other sports, very little is known about kicking accuracy among Ladies Gaelic Football Association (LGFA) footballers. The aim of this study is to investigate bilateral kicking accuracy in Ladies Gaelic Football. A secondary aim of this study is to analyse kicking accuracy within games in Ladies Gaelic Football.

Methods

Notational analysis was used to analyse the various forms of kicking in Ladies Gaelic Football. A total of 15 LGF pre-recorded games were analysed with a view to exploring the use of bilateral kicking in Ladies Gaelic games, and to investigate the role of kicking accuracy in successful game outcomes. A testing protocol to assess bilateral kicking performance in LGF players was developed. Kicking accuracy was measured in both dominant and non-dominant leg at a variety of angles from a distance of 20 meters. The assessment entailed two trials, one in which participants took all their kicks in sequential order, and another where they kicked in a randomised order.

Results

The results show that there are an average of 196 kicks in LGF games. The results show that significant differences exist between overall kick passing accuracy (p = .024 with a large effect size (η^2 = .17).), as well as significant differences in shooting accuracy (p = .012 with a large effect size (η^2 = . 21) between winning and losing teams. Further findings show that the dominant foot shooting performance was significantly greater than the non-dominant foot kicking performance. For both the controlled and the Randomised test all angles were more accurate on the dominant foot. For example,Angle A between the controlled dominant (Mean = 3.25 ±1.070) and the controlled non-dominant (Mean 1.65 ±1.348) there was a significant difference ($p < 0.000$ (two-tailed) η^2= 0.53, which is a large effect size).

Conclusion

This study suggest that kicking accuracy is an important factor in achieving success in LGF. This was shown by the results showing what types of kicking are most significant in each half. The results show that teams who perform better in their shooting in the first half are more likely to win the game. Whereas, shooting accuracy is not a significant differentiator in the second half, with kick passing accuracy shown to be significant in order to secure a win . Unsurprisingly, the dominant foot has been shown to perform better, but this reinforces the importance of bilateral skill development as a key component of coaching and session design. This thesis also presents a possible tool for coaches to assess bilateral kicking accuracy. These tools are important potential tools for the LGFA, for the development of the LGF game as well as a tool for individual teams and their coaches.

Chapter 1: Introduction

1.1 General Introduction

The Gaelic Athletic Association (GAA) is the largest sporting organisation in Ireland. It was founded in November first 1884 in Tipperary, to make athletics more accessible as well as to revive Irish traditions and sports. The organisation is comprised of Men's Gaelic football, Ladies Gaelic football, hurling, camogie, handball and rounders (GAA, 2022). In Gaelic Football, kicking the ball is one of the fundamental skills in the game, used to score and to pass to other players (Ball and Horgan, 2013). Ball and Horgan (2013) found that an average Gaelic football game contained an average of 205 kicks, with an overall success rate of 55%. The same study reported that that 74% of general play of a game is comprised of kicking. Given that the skill of kicking has such a prominent role, it seems important to further investigate kicking in Gaelic games, and particularly in the ladies game due to its growing popularity (Clerkin, 2021).

The Ladies Gaelic Football Association (LGFA) was founded in 1974 to provide Gaelic Football opportunities to female athletes wanting to play Gaelic Football. The LGFA works alongside the GAA to provide Gaelic Football for female and male athletes while still being an amateur sporting organisation. Ladies Gaelic Football is recognised as one of the fastest growing female sports in Europe (Clerkin, 2021). Within the LGFA the game of Gaelic Football is always evolving with trends from other sports or new rules to help progress the game. In recent times, the LGFA brought in a new rule, stating that any 45 metre free kick that is kicked successfully from the ground will be worth two points instead of the previous one point (*Ladies Gaelic Football*, 2020). This rule has placed an emphasis on the skill of kicking within Ladies Gaelic football. While this highlights the importance of kicking within the LGF, there is very little research on kicking accuracy in Gaelic games. For instance, there are very few studies that explore the ability to kick using both the dominant and non-dominant leg. Research in this area for Gaelic football could provide interesting findings that would be beneficial to both organisations, and in turn identify development tools to help coaches improve their players kicking proficiency.

Ladies Gaelic Football have a lot of similarities in how the game is played when compared to the Male Gaelic Football. They both play on the same size field, which ranges from 130 metres and 145 metres in length with it ranging from 80 metres to 90 metres in width. The games

are both divided into two halves, the LGF play 30 minutes a half, whereas the Men's game play 35 minutes a half. Both games share common skills needed to play the game, for example kicking, catching, hand passing and tackling. For both codes, there is 15 players on the field for each team, with 14 of them being outfield players, the non-outfield player is the Goalkeeper. The objective of the game is for one team to score more than their opposition, while defending and trying to stop the opposition from scoring.

The mastery of skills such as kicking is important as the game of Gaelic football continues to evolve. The LGFA have shown their willingness to innovate with the addition of different rules, coupled with an evolution of playing styles and an increased tactical emphasis. For these games to continue to improve at a prominent level, research is required in all aspects of the game to better inform the organisations, and to assist the coaches in developing their players. Findings could assist coaches to determine what skills are important, how to measure these skills and how to construct training drills to improve these skills (Carlow *et al.*, 2016). Research within these sports will not only help further inform development officers and coaches across all age groups but could also lead to higher performance levels for teams.

The aim of biomechanics in a sporting context is to assist performance improvements in sport as well as helping with injury prevention and rehabilitation (McGinnis, 2013, p.3). Glynn (2013) researched the technique differences between 'one-footed' and 'two-footed' soccer players by assessing their non-preferred leg. The study helps define how athletes might use different kicking techniques when kicking from their dominant vs their non-dominant leg. These findings show how biomechanical research helped coaches improve athletes in their sport and can help coaches find the technical problems that maybe preventing athletes from improving their general performance in areas such as kicking accuracy.

In Gaelic Football, kicking accuracy is a vital component of the game. Kicking is used to maintain possession, to pass the ball to other players, as well as shooting for points and goals. Similar to the LGF, kicking in Australian Football is important for the same reasons. One study investigated kicking accuracy in Australian Football League by examining the effect of pelvic and lower limb kinematics during the performance of a drop punt kick (Dichiera *et al.,* 2006). They found that the more skilful players support limbs had increased knee flexion while kicking. This lowers the kickers centre of gravity and increases the stability of the support limb. This is important for kicking accuracy as when a player is kicking a ball, they are balancing

on the support limb for the duration of the movement (Dichiera et al, 2006). This study reviewed the technical components of kicking in order to ascertain what allows an athlete to kick accurately versus what causes them to kick inaccurately. The ability to balance on your support limb is important for kicking accuracy, because while going through the kicking motion you are doing the hardest part of the motion while standing on one leg. If you are not completely balanced, i.e., you stumble during the movement, you will not get the correct connection with the ball to your foot, which will cause your kick to become inaccurate. The results suggest that the ability to balance on the support limb can have an influence on the accuracy of the kick. Again, these findings give coaches a practical tool in relation to their technical coaching.

Performance analysis is another tool that can be used to help coaches improve their athletes' kicking accuracy as well as their overall performance. Performance analysis can be used to identify a team's strengths and weaknesses, which can in turn help a coach develop and design practice to improve their team (Lago-Peñas *et al,* 2010). Performance analysis can be used in the LGF to identify trends being used by teams at all levels of the game. It can also be used to depict the frequency of the various skills being performed in games, for example, how many kick passes are taking place during the game. The information generated from such research would give baseline figures kicking in Gaelic games in order to assist coaches in the development of the skill of kicking.

This study aims to investigate bilateral kicking accuracy in Ladies Gaelic Football. Furthermore, a secondary aim is to investigate bilateral accuracy in the LGF, the intention is to compare the kicking accuracy of the dominant leg versus the nondominant leg. Through this analysis of kicking accuracy, the study aims to measure the various forms of kicking within competitive games, in the hope of establishing performance indicators that could be the difference between winning and losing games These performance indicators can potentially help coaches decide how to strengthen their team and help them win games. These would be such useful tools for coaches of all levels for development of their teams' skills and strategic plans for when they play games.

1.2 Aims

The aim of this study is to investigate bilateral kicking accuracy in Ladies Gaelic Football.

A secondary aim of this study is to analyse kicking accuracy within games in Ladies Gaelic Football.

1.3 Objectives

Analyse Kicking Accuracy within games in Ladies Gaelic Football:

1) To measure how accurate the various forms of kicking were within a competitive situation (e.g., Kick passing, Shooting and Frees).
2) To ascertain whether kicking accuracy contributes to winning outcomes in games.

Bilateral Kicking Accuracy Tests:

1) To compare the kicking accuracy between dominant and non-dominant feet.
2) To investigate whether dominant and non-dominant kickers had preferred angle to kick at goal from.

To identify a potential tool for the use of Ladies Gaelic Football coaches in assessing bilateral kicking accuracy.

Chapter 2: Literature Review

Within this review of the current literature, the various mechanisms and techniques that impact on kicking accuracy will be examined. The importance of bilateral transfer in different sports and skills development will also be explored. Lastly, it will discuss the use of performance analysis and performance indicators and the positive impact they can have for coaches in a variety of sports.

2.1 Biomechanical Considerations

Biomechanics is the study of forces and their effects on living systems. The aim for biomechanics in sport is to help with the improvement of performance in sport as well as helping with injury prevention and rehabilitation (McGinnis, 2013, p.3). Glynn (2013) researched the technique differences between 'one-footed' and two-footed' soccer players by assessing their non-preferred leg. Glynn (2013) defined a two-footed player as one that could accurately kick two of the three maximal effort instep soccer kicks with their non-preferred leg, while only losing 10% of ball speed compared to the ball speed of a kick from their preferred leg. While researching the technique differences between one-footed and two-footed players, Glynn's (2013) research showed that "two-footed players tend to run up straighter than their one-footed counterparts at an angle of around 30 degrees." The same study determined that the run-up angle and the pelvic rotation angle are key factors if a player is accurate with their non-preferred leg. These results build on previous research by Dichiera et al., (2006) with results also suggesting that accurate players tend to have a greater pelvic tilt as one of the factors of accuracy in a kick.

The research extends to other sports, with the biomechanical consideration of distance kicking in Australian Rules football being assessed (Ball, 2008). Players performed a minimum of five kicks until they generated a kick that was determined by the player and the coach as typical. They found that the main contributor to kicking for maximal distance within the Australian Rules Football (AFL) was greater foot speed (Ball, 2008). With foot speed being defined as the speed of the kicking leg towards the target during the last step before kicking the ball. They also found that the ball position in which the foot made contact was important, finding that when the ball was positioned higher off the ground and away from the support foot, the participant kicked the ball a longer distance. The position of the ball can't be too high or too far from the body or it will lose its optimal result of kicking a longer distance.

Getting the ball into the optimal position can be learned over time with practice on specific technique drills. But getting the ball to go the maximal distance is going to be no use in competitive situations without accuracy to a specific target. Research to combine how to get maximal distance with accuracy is an area that needs to be further investigation.

2.2 Leg Mass Considerations

While researching the effect of leg mass considerations on kicking accuracy Hart *et al.* (2016) also looked into the biomechanical consideration of foot velocity and its relationship with leg mass and kicking accuracy in Australian Football. They studied the effect of the relationship between leg mass, leg composition and foot velocity on kicking accuracy in Australian Football. They had athletes (n=31) complete ten drop punt kicks over twenty metres to a player target. The researchers did this because one of the most important skills to have in Australian Football is being able to kick a ball accurately over a specified distance to a specific target, for example another player on your team during a game (Hart et al, 2016). After this test fifteen of the participants were classified accurate and placed into an accurate group, whereas sixteen participants were put in an inaccurate group. The researchers developed a points-based system to categorise participants as accurate or inaccurate. A participant got one point if the kick was accurate, two points if the kick was moderately accurate and three points if it was inaccurate. The accuracy was judged on the location of the ball to the human sized target.

A participant was deemed accurate if they got between 10 to 18 points, whereas a participant was deemed inaccurate if they had between 19 to 30 points. The results showed there was no relationship between peak foot velocity and kicking accuracy (accurate: r = -0.035; inaccurate: r= -0.083) . Hart et al. (2016) did find that there was a significant difference between relative lean mass and relative fat mass in the accurate kicking group. They found that there was a significantly higher quantities of relative lean mass compared to lower quantities of relative fat mass in the kicking leg of the accurate group. This could potentially show how accurate kickers can have better control and coordination when kicking a ball compared to their inaccurate participants. More research needs to be done to prove that in Australian Football players, having increased lean mass compared to fat mass can help with the accuracy of the kick by allowing them to have more control and coordination when kicking. This result is important because if higher quantities of relative lean mass help with

getting a players control and coordination right to kick accurately, then more research can be done to see what lean mass percentage a player needs to be at to help with kicking accuracy.

2.3 Motor Performance

As discussed above, the potential impact of motor control and coordination has in sport is very high. Results show that motor control and coordination increases kicking accuracy in sport. These results show that more research needs to be done on the impact motor performance can have within different sports.

Haaland and Hoff (2013) researched the idea of training the non-dominant leg to test if it improves the bilateral motor performance of soccer players. The participants were divided into two groups: a control group and an experimental group. The control group trained on as normal, whereas the experimental group only used their non-dominant leg for all training drills, except full match play, for 8 weeks. The participants were blind to the conditions of the experiment. Haaland and Hoff, (2003) found that after 8 weeks, the experimental group's non-dominant leg advanced to roughly the skill that the dominant leg had shown in the pre-test period of the study.

The study also found that the experimental group showed substantial improvements compared to the control group when they used the dominant leg. Compared to the experimental group, the control group made no significant improvements on either their dominant or non-dominant leg over the course of the 8 weeks. This result from Haaland and Hoff shows some of the benefits on training the dominant and non-dominant leg consistently. Ideally, future research would assess whether the experimental group increased their use of the non-dominant leg in competitive matches after the 8-week intervention had ended. Additionally, a comparison on the frequency of use of both legs from both groups before and after this study in competitive matches would be very welcome.

Grouios (2004) quoted Illman (2001) that the "potential benefits of two-sided dexterity in soccer are immense". If a player in soccer is efficiently able to use both feet when in a competitive game, they are less likely to be turned over when put onto their non-dominant side. The ability to use both sides in any sport makes a player more versatile. The ability to use both feet in a game, will increase confidence in a player. It will also allow more diverse opportunities in matches for the player and the team when they are under pressure to score

or when they are being defensive. To be able to rely on either leg allows you to defend a player no matter which side is their dominant side, as you are technically never put on your weak side when defending. The same can be said when attacking.

2.4 Lateral Asymmetry

Marinsek (2016) tested the influence of different motor practices on lateral asymmetry of performance with 40 preschool children. The participants were made up of 25 boys and 15 girls with a total of 40 children. All participants were measured for their lateral preference, out of the 40 participants, 34 of them were both right-handed and right footed. Participants lateral preference was determined as their dominant side. The participants were split into three groups. The first group practiced the skill with their dominant side, the second group practiced with their non-dominant side, whereas the third group practiced with both the dominant and non-dominant side. For this study the two object control skills were hand dribbling a ball for five metres in a straight line, and foot dribbling a ball for five metres in a straight line. The training component of the study happened four times a week for six weeks. Twice a week the participants practiced hand dribbling and then the other two sessions of the week they practised foot dribbling. Of the 30/40 minutes sessions 20 minutes is specifically used to practice the object control skills. Due to only six of the participants being dominant left-handed, there wasn't enough data to make a strong comparison, so their results were excluded. Marinsek found that when the participants practiced dribbling with both feet it resulted in better skill development with the non-dominant side when compared to practicing dribbling with both hands. These results suggest that practice at a young age can lead to reductions in lateral asymmetry. A continuation of this study could be to test these children when they are slightly older on the sport specific needs of the object control skill. The training can be done in a way where difficulty is increased as children perfect the skill, for example difficulty can be increased by changing the learning aspect from general practice to sport specific practice. General hand dribbling can be adapted to incorporate more basketball specific needs, whereas foot dribbling can be adapted to more soccer specific needs

Teixeira, Silva and Carvalho (2003) looked at the role of bilateral practice in the reduction of lateral asymmetries in soccer dribbling. All 24 participants (age 12-14 years) were practicing soccer regularly. The researchers found that speed of dribbling's lateral asymmetry was

reduced from the pre-test to the post-test, but only in the non-preferred leg. This was due to the high rate of improvement after the experimental training.

Bell *et al.* (2014) explored whether lean mass asymmetry influences force and power asymmetry during jumping. The participants were made up of 167 university student athletes. Bell et al found that lean mass is a key factor leading to athletes producing force and power. They also found that when power asymmetry is greater than 10% it can impair a person's jump height by approximately decreasing it by 3.5 inches.

Teixeira *et al.* (2011) researched the impact of leg preference and interlateral asymmetry of balance stability in soccer players. There were 22 participants for this study, with 11 of them being experienced soccer players and the other 11 being non-soccer players. All participants were right-handed and right footed. They assessed all participants on three balance tasks, with one being static and two being dynamic exercises. Participants did three trials for each leg and each task. The study found that during the comparison of leg preference profile there was a distinct preference of the right leg, in both the general and soccer-related mobilization tasks (Teixeira et al, 2011). These results suggest that practice of general balance and mobilization tasks on the non-preferred leg might improve soccer related mobilization task proficiency , along with other soccer related skill improvements.

Atkins *et al.* (2016) explored bilateral differences in ground reaction forces, measured during a deep squat exercise, with participants comprised of elite youth soccer players. They had 105 participants grouped through age (e.g., U13, U14, U15, U16 and U17). Atkins et al. stated that in previous studies within the older population found that bilateral asymmetry has been linked to lower extremity problems in older populations. Atkins et al.'s results show that there is a noticeable bilateral imbalance across the age groups for a functional movement, this imbalance continues to increase as they get older.

2.5 Bilateral Accuracy

The considerations above all lead to how important the use of bilateral limbs in a range of tasks in both sports and general day to day tasks. More and more research is being done in sport to show either how athletes are very asymmetrical when it comes to their sport related tasks. Also, the research is starting to show how with sports ever changing tactics to show

how important it is to be able to be able to use both sides of your body to have an advantage over your opponents.

Dichiera *et al.*(2006) aimed to examine pelvic and lower limb kinematics during the performance of a drop punt kick in Australian Football League (AFL). This was done to figure out what factors were associated with accurate kicking performance. They got 10 professional AFL players to kick 20 drop punt kicks to a target that was fifteen metres away using their chosen leg. Participants were deemed accurate if they had a kicking accuracy of 50% or above, and participants were deemed inaccurate if their kicking accuracy was below 50%. When aiming their kick, they had a life size cut out of a player as a target. Dichiera et al. found that accurate participants had greater pelvic tilt(accurate = 20.8°, inaccurate = 12.7°), and hip (accurate = 48.4°, inaccurate = 39.3°) and knee (accurate = 9.5°, inaccurate = 4.2°) flexion especially on the support limb (the limb not kicking the ball) at heel contact. Increased knee flexion of the support limb lowers the participants centre of gravity which then increases the stability of the support limb. This is important for accuracy because when a player is kicking a ball, they are balancing on one leg for the duration of the mechanism (Dichiera et al, 2006). The results suggest that the ability to balance on the support limb can influence the accuracy of the kick.

Palucci Vieira, Luiz Henrique De Souza Serenza *et al.*(2016) researched the impact of muscular strength on kicking performance in Futsal, with participants performing with their dominant leg and their nondominant leg. The participants kicked a ball 10m away from the goal with three attempts on each leg. There were 17 participants, with 13 being right foot dominant and four left foot dominant . Palucci and colleagues found that a 10-metre kicks' accuracy can't be predicted by joint, foot and ball speeds or muscular strength of the lower limbs. A limitation of this study was that they tested the muscular strength in a lab, which can give unreliable data for actual game situations. In a lab, a participant will not have the same movements when testing sporting skills compared to doing a test in the area, they play the sport in.

2.6 Bilateral Transfer

Stöckel, Weigelt and Krug (2011) researched the ability to learn a basketball dribbling task as part of bilateral practice. They had 52 children as participants. With 17 of them being female and 35 being male. All participants were dominant right-handed. The participants were split into two groups. The first group learned the skill using the dominant hand first and then switched over to learning it on the non-dominant hand, whereas the second group started learning the skill on their non-dominant hand and then transitioned to their dominant hand. There were eight sessions in which they were taught the skill, so group one practiced their dominant hand for the first four sessions and then transferred over to their non-dominant hand for the latter four sessions. Group two did the opposite and practiced with their non-dominant hand for the first four sessions and then swapped to their dominant hand for the last four sessions. The study found that the previously learned skill was transferred better to the game like situation that was simulated in the transfer test for participants in the non-dominant to dominant hand group. The participants in the nondominant to dominant hand group transferred the previously learned skill better to the game like situation simulated in the transfer test compared to the dominant to nondominant hand group. These findings show the importance of teaching a new skill equally to both dominant and non-dominant hands/feet. This is perhaps contrary to the prevailing practice of focusing on gaining proficiency on the dominant side initially, and then moving on to the non-dominant side (Stöckel, Weigelt and Krug, 2011).

Boroujeni and Shahbazi (2011) researched bilateral transfer in terms of badminton short service. Thirty-six female participants were chosen at random to do the test. The 36 participants were split into two groups. There were 18 participants in each group. One group did the task from dominant hand to non-dominant hand, while the other group did the task from non-dominant hand to dominant hand. Boroujeni and Shahbazi found that "the transfer was non-significant from the dominant hand to non-dominant hand and vice versa." Stöckel, Weigelt and Krug's research disputes Boroujeni and Shahbazi's results that the bilateral transfer doesn't have a significant difference between the dominant hand to the non-dominant hand and vice versa. This contradiction between the results might be because of the difference of age between the participants. In Boroujeni and Shahbazi's paper the participants were college students, whereas Stöckel, Weigelt and Krug's participants were

children. Children are only defining their dominant hand while learning new motor skills as they grow up, whereas college students have already defined their dominant hand. The participants in in Stöckel, Weigelt and Krug's study learned the skill simultaneously, this could allow the transfer to be greater because they learned it bilaterally instead of learning it on the dominant side first and then transferring compared to Boroujeni and Shahbazi's participant.

Liu and Wrisberg (2005) researched the immediate and delayed bilateral transfer of throwing accuracy in both male and female children. There were 160 boys and girls as participants, of the ages of 6,8,10 and 12 years old. There were 40 participants from each age group. Exclusion criteria ensured that potential participants who played basketball for more than 3 hours per week were excluded from the study. From each age group participants were assigned at random to either the control or the experimental group. There was a total of 160 participants, with 40 participants in each age group (ages 6, 8, 10 and 12 years). Liu and Wrisberg found that there was reduced variance between the experimental and control groups results for the delayed transfer test when they were compared to those of the immediate transfer test. This shows that there needs to be more research done in the delayed test for bilateral transfer after 24 hours. As the delayed test in this study was at the 24-hour mark. A limitation of this study is that the delayed test for participants was only 24 hours after the other tests. There should be a series of delayed tests for example 24 hours after, a week after etc. A series of delayed tests would assess if there were a continued reduction of bilateral performance as the test continues, like the performance of the 24-hour delayed test in this study. Liu and Wrisberg research found that a child learning a throwing accuracy task can be improved by previous practice with the child's opposite limb.

2.7 Performance Analysis

The above research discusses the different variables that might contribute to helping or decreasing the skill level. But to do this research to a high level they need to know what skills are the most important for each sport they are looking to research. This is where performance analysis can become particularly important as it can show the skills that are most commonly used in the sport and also which skills need the most research to help the athletes improve.

Performance analysis can be used to identify a team's strengths, which can help the coach develop and improve them. Also, it can identify a team's weaknesses, which can then help the coach to decide what drills to use in training to help improve those weaknesses (Lago-Peñas *et al,* 2010). Lago-Peñas et al explored what game related statisitics discriminated winning, drawing and losing teams within the spanish soccer league. In their research they analysed all 380 games over the course of a season. When analysisng the games they divided them into different outcomes. These groups were; variables related to goals scored, variables related to offense, variables related to defence and contextual Variables. In Figure 1 below it describes the variables used within those groups.

Table 1

Variables studied in the Spanish soccer league 2008-2009.

Group of variables	Variables or game statistics or performance indicators
Variables related to goals scored	Total shots; Shots on goal; Effectiveness [1].
Variables related to offense	Assists; Crosses; Offsides committed; Fouls received; Corners; Ball possession.
Variables related to defence	Crosses against; Offsides received; Fouls committed; Corners against; Yellow cards; Red cards.
Contextual variable	Venue

Open in a separate window

[1]Effectiveness=Shots on goal×100 / Total shots

Figure 1: Taken from Lago-Peñas et al (2010)

Lago-Peñas found that "winning teams made more shots and shots on goal than losing and drawing teams." They also concluded that the variables that determine the result of game in the spanish league are; total shots, shots on goal, crosses, crosses against, ball possession and venue.

Table 1: Comparison of Performance Indicators in Soccer Match Analysis

PERFORMANCE INDICATORS	CATEGORIES		AUTHORS	
	Attacking Play	Defensive play	Lago-Peñas *et al.*, 2010	Castellano, Casamichana and Lago, 2012
TOTAL SHOTS	✓		✓	✓
SHOTS ON GOAL	✓		✓	✓
OFFSIDES COMMITTED	✓		✓	✓
FOULS RECEIVED	✓		✓	✓
CORNERS	✓		✓	✓
BALL POSSESSION	✓		✓	✓
OFFSIDES RECIEVED		✓	✓	✓
FOULS COMMITTED		✓	✓	✓
CORNERS AGAINST		✓	✓	✓
YELLOW CARDS		✓	✓	✓
RED CARDS		✓	✓	✓
EFFECTIVENESS	✓		✓	
ASSISTS	✓		✓	
CROSSES	✓		✓	
CROSSES AGAINST		✓	✓	
VENUE			✓	
GOALS SCORED	✓			✓
SHOTS OFF TARGET	✓			✓
TOTAL SHOTS RECEIVED		✓		✓
SHOTS ON TARGET RECIEVED		✓		✓
SHOTS OFF TARGET RECIEVED		✓		✓

Other studies have looked at similar performance indicators. Castellano, Casamichana and Lago (2012) analysed 177 games between three world cup tournaments (soccer). The World cups analysed were Korea/Japan 2002, Germany 2006, and South Africa 2010. They analysed the games to identify what match statistics best determine the outcome of a game in those world cup. The split it into two categories; those related to attacking play and those related to defence. The 16 variables that they divided into the two categories are outlined in Table 1 above. They excluded any games within the three world cups that went to extra time, which brought the original 192 matches down to the 177 matches analysed. When the data was analysed with the three world cups, the researchers found that the variables that had the biggest impact over the course of the tree world cups were total shots and shots on target (both made and received) Though this finding was not as consistent when the three world cups were analysed seperately.

Pertinent to this thesis, the author sought to understand the performance analysis landscape in a Gaelic games' environment. The Gaelic Athletic Association (GAA) is the largest sporting organisation in Ireland. They promote and control the national games of Hurling, Gaelic Football, Handball and Rounders (GAA, 2022). Carlow *et al.* (2016) researched the level of engagement with performance analysis that coaches in the GAA have. There were 144 GAA coaches as participants (89% male). They all had at least a level 1 coaching qualification. Just under half of the coaches surveyed had previously used performance analysis. With so few coaches using performance analysis within the GAA, it would be interesting to see how many coaches are using performance analysis within the Ladies Gaelic Football Association, as there is no current research available on the resources used for performance analysis in Ladies Gaelic Football.

Only 35% of the GAA coaches reported having similar access to performance analysis tools as rugby, hockey, and soccer coaches. The study found that in performance analysis tools, 81% of coaches used match statistics whereas on 49% of coaches had access to match video. Majority of coaches said that they were never (39%) or rarely (20%) given a post-match video. 27% of the coaches that to took part of the study found that their lack of knowledge of how to use performance analysis was the biggest barrier they faced when coaching. This study highlighted a key aspect of training that needs improvement when attending coaching courses within the GAA coach education program. Teaching performance analysis shouldn't

be left to one of the higher awards in coaching, it should be taught in increments as you work your way up the awards. If coaches were trained at a lower award level about the benefits and how to do performance analysis that suits their team's skill ability, it might help them train their team to improve their skills effectively. If coaches learn how to do performance analysis, they can look at their team and statistically back up where their teams' weaknesses and strengths as well as looking at their opposition's weaknesses and strengths. Future research should seek to understand why coaches are not learning how to use performance analysis, and how to help the development of easy-to-use resources for coaches learning how to use performance analysis for the first time.

2.8 Performance Indicators:

To do match analysis to a high standard in any sport, you need to know what performance indicators to look out for in the sport. Every sport is going to be different. Some sports Like Gaelic football, Soccer and Australian Football use kicking accuracy as a performance indicator, as it is a skill used predominantly in competitive matches. Without defining the performance indicators in the sport, you are doing match analysis for, you will not get accurate results for those matches.

Performance indicators are important in every sport, at any level. Performance indicators help coaches find the strength and weaknesses in their team, in the individuals in their team and their opposition. It is important to see the strengths of your opposition so you know what you are up against, so that you can help coach your players to adapt to each opposition's strengths.

The most common performance indicators that are mentioned are shown in Table 2.

Table 2: Comparison of the most common Performance Indicators

MOST COMMON PERFORMANCE INDICATORS	AUTHORS		
	McGuigan, Hughes and Martin, 2018	Daly and Donnelly, 2018	Kelly *et al.*, 2021
POSSESSION SHARE %	✓		✓
SCORES	✓		✓
GOALS	✓		✓
POINTS	✓		✓
SHOT SUCCESS %	✓		✓
TOTAL KICKOUTS WON %	✓	✓	✓
TURNOVERS	✓		✓
TURNOVER RATE %	✓		✓
FREE KICKS (INSIDE 45)	✓		
SCORE FROM PLACE BALL %			✓

McGuigan, Hughes and Martin (2018) researched performance indicators in club level football in the Ulster club championship for the years 2015 and 2016. The championship in Gaelic football is divided into three tiers of difficulty: Junior, Intermediate and Senior. They analysed 48 games in the Ulster championship over the two seasons, with 16 matches being in each of the different tiers of difficulty. The analysis of this study provides club coaches with another form of statistics for match analysis, more importantly statistics of what it takes to win in the Ulster Club Championship in each tier. It is especially important to have the statistics of each tier for club coaches because each tier had different performance indicators that lead to teams' success in the championship. For example, McGuigan, Hughes and Martin found that at senior level possession count or possession makes the difference between a winning or a

losing team at that level, whereas at the intermediate level, a winning performance is shown to be linked to having more possession in the game.

Kelly *et al.* (2021) analysed games from the 2019 and 2020 Senior Ladies Intercounty All-Ireland Championship to help provide a profile of a successful team within the Ladies Gaelic Football Association. Thirty-one games were analysed over the two seasons. 25 performance variables were used in the analysis of the games. Figure 2 below shows the 25 variables and the results comparing the winning and losing teams. Kelly et al. predicted that the winning teams would be considerably superior to their losing opponents. The found that of the 25 performance variables used in Ladies Gaelic Football, winning teams had and advantage over their opposition in 22 of those variables..” Successful performances were determined by winning teams having better ability to win possession through kickouts and turnovers over their opponents.

Table 2. Mean and STD for performance indicators of winning (n = 31) versus losing (n-31) performances (n = 62) across two Senior Ladies football championship seasons (2019–2020).

	Senior Performances		
Outcome	Winning Teams	Losing Teams	
Performance Variable	Mean ± Std.Dev	Mean ± Std.Dev	*P* Value
Total Possession Count	47 ± 7	44 ± 6	**0.010^**
Possession Share %	52 ± 3	48 ± 3	**0.009^**
Inside 45's	40 ± 8	33 ± 6	**0.001^**
Attacks (Retaining Ball Inside 45)	36 ± 7	29 ± 5	**0.001^**
Inside 45 Creation %	84 ± 7	75 ± 8	**0.001^**
Attack Creation %	66 ± 9	46 ± 10	**0.001^**
Territorial Effectiveness % (Attack to Score)	46 ± 10	37 ± 11	**0.000^**
Shot Count	29 ± 7	23 ± 7	**0.002^**
Scores	17 ± 5	11 ± 4	**0.000^**
Points	14 ± 4	9 ± 4	**0.000^**
Goals	3 ± 2	2 ± 1	**0.001^**
Cumulative Score	23 ± 8	15 ± 5	**0.000***
Productivity	3.51 ± 0.86	2.49 ± 0.83	**0.000^**
Goal Productivity	4.72 ± 1.29	3.21 ± 1.08	**0.000***
Shot: Score %	58 ± 9	48 ± 12	**0.000^**
Shot: Score from Play %	55 ± 8	41 ± 12	**0.000^**
Shot: Score from Placed Ball %	75 ± 22	66 ± 26	0.164^
Total Own Kickouts	17 ± 5	23 ± 6	**0.000^**
Own Kickouts Won	13 ± 4	16 ± 4	**0.001^**
Own Kickout Won %	77 ± 13	72 ± 14	0.150^
Opposition Kickouts Won	7 ± 5	4 ± 3	**0.005^**
Opposition Kickout Won %	28 ± 14	23 ± 14	0.145^
Turnovers	23 ± 5	26 ± 7	**0.001^**
Turnover Rate %	48 ± 8	58 ± 11	**0.000^**
Total Fouls Committed	21 ± 6	19 ± 5	**0.039^**

^Paired T-test used, * Wilcoxon signed ranked test used.
Bold where significance found ($p \leq 0.05$)

Figure 2: Taken from Kelly et al 2021

Daly and Donnelly (2018) analysed the performance of kick-out distribution and effectiveness in Senior championship football. Daly and Donnelly's aim was to analyse kick-out strategies from a coach's point of view. Using video analysis, they analysed eight men's intercounty ulster Senior intercounty football championship matches. The distance and direction of the kick-outs were the variables analysed whereas the factors to measure the success of the kick-outs were retaining possession, attack building and scoring opportunities made. Throughout eight games there were 351 kick-outs. Daly and Donnelly analysis found that " the mean number of kick-outs per match was 44 (±9.9). The most common distance kick-out was 65m+ with 53.8% (±19.9), whilst 57.6% (±13.9) of kick-outs were directed to the wings." These statistics are helpful to coaches who don't have access to performance analysis tools for their own team or who are only beginning to use performance analysis, as they can use these statistics to help with the training of kick-outs with their teams. Winning possession from your own team kickout is especially important as it is one of the very few moments in the game where a player (goalkeeper) is not receiving any pressure from the opposition. The goalkeeper also tends to kick it a significant distance, which allows the ball to travel the field through possession faster, helping players to get into scoring positions faster.

2.9 Conclusion

It is clear that many factors contribute an athletes kicking accuracy, from the stance of the support limb (Dichiera *et al.*, 2006), to overall body position, to leg composition and foot velocity (Hart *et al.*, 2016). The lack of one, or a number of these factors, can be an underlying factor in why an athlete's level of kicking accuracy is not as developed as it should be. Given its suggested importance towards an increased chance of winning (Hart *et al.*, 2013), it seems logical that more research should be done in sports that have a high percentage of kicking within their general play, i.e. Gaelic Football (Ball and Horgan 2013). Ideally, athletes in such sports should be continually tested on these variables when they are in peak condition, so that if they get injured or are away from the game for any reason, they have baseline scores as reference to their game readiness.

While the need for further research in kicking accuracy seems clear, there are also further facets within kicking accuracy that should be explored. Exploring the use of the dominant and

non-dominant feet in kicking sports could give great insight for both coaches and governing organisations. Research within kicking accuracy and the use of dominant and non-dominant sides is a relatively new area, but there is an acute lack of studies in this area focusing solely on women's sport. Women's sport doesn't generate the same level of interest in the literature (Lebel *et al.*, 2021) which is surprising, considering to the popularity of women's sport in recent years. In Gaelic games, the Ladies Gaelic Football All Ireland Final 2019 hit a record level of attendance for an amateur sport with 56,114 attendees at the final, just 2000 attendees less than the professional 2019 Women's World Cup (*RTE*, 2019). Yet even with the growing level of interest in women's Gaelic games, there is little research published about kicking accuracy in women's sport let alone within LGF. With participation numbers in Ladies Gaelic football continuing to rise (Clerkin, 2021a) alongside the increased profile of the LGF competitions, it seems prudent that research specific to kicking accuracy in the LGF be prioritised. In order for this research to take place however, an exploration into the accuracy of kicking and the use of dominant versus non-dominant kicking needs to be undertaken.

Chapter 3: Performance Analysis as a tool to examine kicking accuracy in Ladies Gaelic Games

3.1 Introduction

The Gaelic Athletic Association (GAA) is the largest sporting organisation in Ireland promoting games including Gaelic football, hurling, handball, and rounders (GAA, 2014). The LGFA works alongside the GAA in providing Gaelic football for female athletes (Ladies Gaelic Football Association, 2022). Ladies Gaelic Football (LGF) is the most popular female sport in Ireland, with registered players numbering over 200,000 (LGFA,L, 2020). To put this in context, women's soccer in England has 120,557 members, 40% less than the LGFA (FIFA, 2019) . The LGF All Ireland final in 2019 became one of the largest female spectator events in the world with 56,114 attendees.

The concept of Gaelic football is similar for both the female and male versions of the game, with the primary aim being to maintain possession and score more than the opposition (Reilly and Collins, 2008). There are however, some variations in the rules. LGF games are played on the same size pitch, but are slightly shorter in length with two 30 minute halves (as opposed to 35 mins in the men's), and use a smaller football than the men (size 4 versus size 5). Kickouts can be taken from the hand or the ground from the 13 metre line after an opposition wide, and from the 21 metre line when a score occurs. In contrast to the men, there are no kickout marks or advanced attacking marks, and recently the LGFA began awarding two points for a 45m free being kicked directly over the bar (LGFA, L, 2020).The main differences between the two are the lack of contact allowed in the ladies game, and that in LGF the ball can be picked up directly from the ground. Some attacking elements of LGF games are goalkeepers' kickouts, kicking, handpassing and scoring. Some defensive elements of play are near hand tackling and blocking the ball from being kicked/scored. Some skills of the game that are used in both attacking and defensive play are handpassing, catching and kicking.

Ladies Gaelic football (LGFA) competitions are split into Club, College and Intercounty. Every player that plays within the LGFA plays for a club. When players are at college they can decide to play and represent their college. Intercounty Players are compiled of the best players from all the clubs across each specific county and compete at the highest level in the game. At

College level the LGFA is divided into different divisions that consists of a League and a Championship. If playing in the lower divisions, winning the league and/or championship allows the team to move to a higher division. The Highest Division in the College set up for the LGFA is referred to as the O Connor Cup division. Both Club and Intercounty Level championship are split into three different sections. These are called the Junior, Intermediate and Senior championships. The League typically is divided into approximately 4 divisions or more. Similar to the College set up if you win in either the lower league division or championship, the team moves up into a higher division.

While there has been significant growth in both players and spectator appeal of LGF, there is little to no research detailing match play demands or performance metrics in order to benchmark performance. As such, LGF coaches are forced to seek knowledge from the men's equivalent in the GAA. While the GAA is an amateur organisation, the senior intercounty Gaelic football competitions are considered elite with a previous case study showing a team competed in 13 competitive games and completed 78 training sessions over the course of a season (McGahan *et al.*, 2020). As such, professional sports science and related supports are widely available to prepare these teams (Keyes, 2016). One such service is performance analysis (PA). Castellano, Casamichana and Lago (2012) found that the main aim of match analysis is to identify the strengths and weaknesses a team, which can inform training design to develop both. Furthermore, PA is now established as an essential element of intercounty GAA teams (GAA, 2013).

Carlow *et al.* (2016) reported that 69% of GAA coaches utilised PA to inform the content of their training several times a month, with the use of PA prominent throughout the GAA and LGF, from club football (sub-elite) all the way up to intercounty (elite) football. When PA is used as intended within any level in sport, it allows a team to highlight the strengths and weaknesses of their performance, with the aim of increasing their chances of performing better in future games (Carlow et al., 2016). A multitude of PA studies report that increased use of accurate attacking elements of play compared to the opposition, provide that team with a statistically significant higher probability of winning. Grant et al. (1999) reported that differences between the winning and losing teams are mainly evident in both the frequency and effectiveness of shots at goal and pass completion. Robertson et al (2016) found similar findings in elite Australian Rules football, suggesting superior team kicking accuracy and goal

conversion rates compared to the opposition represent the two most important performance indicators relative to successful match outcomes.

These studies show comparable findings in two different sports, Australian rules and soccer, and highlights that a team with more accurate attacking elements are more likely to succeed in that game. While these studies only analysed the outcome of the performance indicators, they failed to report how the performance indicators were measured, for example which foot the ball was kicked with and the rate of success. A performance indicator represents relevant and important aspects of play (O'Donoghue, 2010 p.152). One of the most common, and arguably the most important performance indicators in team sports is scoring proficiency. Players are seldom encouraged to practise with their non-preferred foot at elite level (Farrow and Ball, 2011), even though previous studies report this is ill advised and can be detrimental from a scoring proficiency perspective (Moore *et al.*, 2017) .Studies producing results such as left and right foot accuracy, as well as the frequency of dominant and non-dominant foot kicking, could give further insight to both performance analysts and coaches alike. The findings produced from such studies would produce data that could be used as benchmark data for performance comparisons, as well as informing training processes and session design (Houtmeyers, Jaspers and Figueiredo, 2021).

Ball and Horgan (2013) found that male GAA games contained an average of 205 kicks per game, with an overall success rate of 55%. The variety of kicks were comprised of 74% in general play, 20% free kicks and 6% side-line kicks. There is, to the best of the author's knowledge, no studies that have looked at the same research question in ladies Gaelic games. Considering there is an average of 205 kicks per game in men's Gaelic football (Ball & Horgan, 2013), it would be interesting to see how many kicks on average happen in LGF. A further aspect of kicking in sport which lacks data in the women's game is the analysis of the ratio of kicking with the left and right foot. Research that seeks to fill the gaps identified above has the potential to very helpful for coaches and the LGFA to help with the development of the sports specific skills that may aid players chances in the execution of attacking and defensive plays of the ball during competition.

This study aims to analyse kicking in LGFA games. Secondary aims of the thesis were to analyse the ratio of kicks with the right and left foot and explore the impact of kicking towards winning outcomes.

3.2 Methods

The analysis was done through notational analysis from pre-recorded games. Fifteen matches were analysed in total from the years 2017 – 2020, Eight at intercounty level and seven at college level. The pre-recorded videos of the matches used were publicly available videos, so no consent was required. All videos were accessed from YouTube, from either the LGFA YouTube channel or TG4 (an Irish speaking TV/Video service) YouTube channel. Those fifteen specific games were used due to the high-quality video of the game, as a lot of the publicly available videos had reduced quality or were not showing the full game. All participants were female with their age ranging between 18 years to 35 years. Analysis of participants was undertaken for all player positions.

Seven out of the 15 games were college level games. One of these college level games was in the division two (Giles Cup) championship. One of these college games was in the division one league. The other five college games were in the division one (O Connor Cup) championship, with two of them being the championship final.

Eight out of 15 of the games were part of the Senior Ladies All Ireland series. Four of these games were in the group stages of the championship. Three were provincial finals (Ulster, Munster, and Connaught), with the last game was the Senior Ladies All Ireland Championship Final.

Inclusion criteria for the selection of games to analyse were as follows. Games must have been played between 2017-2020, college or intercounty games, and must have been of a standard of Division 2 or better. Games must have been online as a publicly available recording and must be of sufficient quality as to allow a thorough analysis of the game. Games falling outside these criteria were not included.

Before analysing the games, the performance indicators that we were going to be analysing were set. The Performance Indicators were set to be any action that involved kicking the ball, for example kick passing and kick outs. See Table 3 for the full list of performance indicators and their definitions.

Table 3: Performance Indicator Definitions

PERFORMANCE INDICATOR	DEFINITION
ACCURATE PASS	When a player kicked the ball either directly to another player on their team or when a member of the same team won it shortly after.
INACCURATE PASS	When a player kicked the ball aiming for another player on the team, but an opposing player won the ball
PASS	When one member of the team kicked the ball aiming for another member of the team
POINT	When the ball was kicked between the two posts and over the crossbar of the opposition's goals.
PENALTY	When a player is fouled within the box and is awarded a penalty. The aim of a penalty is to score a goal. Only the oppositions goalie can defend a penalty.
FREE	When a player is fouled by the opposition or if the ball goes out of play e.g., side-line ball and a 45.
GOAL	When the ball was kicked in between the two posts and under the crossbar of the oppositions goal.

In order to ascertain the most common shooting distance in Ladies Gaelic games, a subsample of games was chosen. To analyse the frequencies of shooting distance. Six high level college games were examined. Performance analysis techniques were used to analyse the distance frequencies in the selected games. The standard lines on any pitch were utilised as reference points and shooting distance arcs were utilised to calculate shooting distance of each shot.

3.3 Statistical Analyses

All data were analysed using SPSS 27. Descriptive analyses were produced and undertaken to assess normality in the dataset. The Kolmogorov-Smirnov test of normality reported no significant findings, and the Normal Q-Q plot histogram showed reasonably straight lines, both indicating that the sample is of normal distribution. A series of independent sample t-tests were conducted to analyse differences between passing and shooting completion, to compare performance across winning and losing games specifically between; pass completion (both right and left foot), goal and point shooting, and free kick success. A further series of t-tests were conducted across the same variables with a breakdown between the first and second halves in these games. Statistical significance was set at $p < 0.05$. Effect size(η^2) is reported using eta squared, which classifies 0.01 as a small effect, 0.06 as a medium effect and 0.14 as a large effect (Cohen, 1988).

3.4 Results

Descriptive Results

The descriptive results show that there are an average of 195.4 (±16.1) kicks per LGF game. Further descriptive statistics were undertaken to produce Table 4 Which shows the breakdown of kicked passes and kicked shot.

Table 4: Descriptive values on total, successful and unsuccessful kicked passes and shots

	MEAN (±STANDARD DEVIATION)	***MIN***	***MAX***	***PERCENTAGE SUCCESS***
TOTAL PASSES SUCCESSFUL	*43.4 (±10.5)*	*20*	*60*	79.2%
TOTAL PASSES UNSUCCESSFUL	*11.4 (± 3.4)*	*6*	*19*	20.8%
TOTAL PASSES	*54.7 (± 11.2)*	*33*	*73*	-
TOTAL POINTS SUCCESSFUL	*10.4 (± 3.1)*	*4*	*17*	51.5%
TOTAL POINTS UNSUCCESSFUL	*9.8 (± 2.7)*	*6*	*17*	48.5%
TOTAL POINTS	*20.3 (± 4.6)*	*10*	*28*	-
TOTAL GOALS SUCCESSFUL	*1.8 (± 1.6)*	*0*	*7*	45.4%
TOTAL GOALS UNSUCCESSFUL	*2.1 (± 1.9)*	*0*	*6*	54.6%
TOTAL GOALS	*3.9 (± 2.7)*	*0*	*11*	-
TOTAL FREES SUCCESSFUL	*17.4 (± 3.6)*	*10*	*27*	83.8%
TOTAL FREES UNSUCCESSFUL	*3.4 (± 1.6)*	*1*	*8*	16.2%
TOTAL FREES	*20.8 (± 4.3)*	*13*	*32*	-

Kicking Accuracy Results

An independent-samples t-test was conducted to compare the kicking accuracy in 15 Ladies Gaelic football matches. Comparisons were made across the entire sample to explore whether there were statistically significant differences in teams that won or lost in relation to their overall kick passing accuracy (left and right foot); overall point shooting accuracy, overall goal shooting accuracy, and overall free taking accuracy. Descriptive statistics as well as results are shown in Table 5.

Table 5: Comparison of mean (±SD) of kicking accuracy across winning and losing teams

	N	MEAN (±SD) WINNING TEAMS	MEAN (±SD) LOSING TEAMS	SIG. P VALUE (95% CONFIDENCE INTERVALS)	EFFECT ETA^2
TOTAL PASSES SUCCESSFUL	15	47.6 (± 9.3)	39.1 (± 10.2)	0.024* (1.2, 15.8)	0.17
TOTAL POINTS SUCCESSFUL	15	11.5 (±2.3)	9.4 (±3.5)	0.066 (-.1, 4.3)	-
TOTAL GOALS SUCCESSFUL	15	2.5 (±1.7)	1.1 (±1.0)	0.012* (0.3, 2.5)	0.21
TOTAL LEFT FOOT PASS SUCCESSFUL	15	13.5 (±11.2)	9.5 (±6.2)	0.237 (-2.8, 10.8)	-
TOTAL RIGHT FOOT PASS SUCCESSFUL	15	60.9 (±11.9)	56.9 (±12.4)	0,369 (-5.1, 13.2)	-
TOTAL FREES SUCCESSFUL	15	17.3 (±4.0)	17.6 (±3.3)	0.806 (-3.1, 2.4)	-

There was significant difference in scores for overall kick passing accuracy between winning (*M* = 47.6, *SD* = 9.3) and losing teams (*M* = 39.1, *SD* = 10.2, *p* = .024), with a large (effect size (η^2 = .17). There was also significant difference in scores for overall goal shooting accuracy between winning (*M* = 2.5 *SD* = 1.7) and losing teams (*M* = 1.1, *SD* = 1.0;, *p* = .012), and again has a large effect size (η^2 = . 21). There were no significant differences between left and right foot kicking accuracy between winning and losing teams, or in overall point shooting or overall free taking accuracy, as reported in Table 5.

Kicking Accuracy across halves Results

Table 6: Comparison of means of kicking accuracy of 1st Half vs 2nd Half across winning and losing teams

	N	MEAN (±SD) WINNING TEAMS	MEAN (±SD) LOSING TEAMS	SIG. P VALUE (95% CONFIDENCE INTERVALS)	EFFECT SIZE ETA^2
1ST HALF PASS SUCCESSFUL	15	24.5 (±5.9)	21.2(±6.3)	0.147 (-1.2,7.9)	-
1ST HALF POINTS SUCCESSFUL	15	6.3(±1.5)	5.0(±1.7)	0.032* (0.1,2.5)	0.21
1ST HALF GOAL SUCCESSFUL	15	1.1(±1.1)	0.3(±0.5)	0.010* (0.2,1.6)	0.29
1ST HALF LEFT SUCCESSFUL	15	7.3(±6.5)	5.8(±4.2)	0.450 (-2.6,5.6)	-
1ST HALF RIGHT SUCCESSFUL	15	31.3(±5.7)	29.4(±7.4)	0.443 (-3.0,6.8)	-
1ST HALF FREE SUCCESSFUL	15	9.1(±3.0)	8.9(±2.1)	0.835 (-1.8,2.2)	-
2ND HALF PASS SUCCESSFUL	15	23.1(±7.1)	17.9(±5.4)	0.033* (0.4,9.8)	0.21
2ND HALF POINTS SUCCESSFUL	15	5.1(±1.959)	4.4(±2.4)	0.365 (-0.9,2.4)	-
2ND HALF GOALS SUCCESSFUL	15	1.3(±1.3)	0.8 (±0.8)	0.181 (-0.3,1.3)	-
2ND HALF LEFT SUCCESSFUL	15	6.2(±5.3)	3.7(±2.6)	0.116 (-0.7,5.6)	-
2ND HALF RIGHT SUCCESSFUL	15	29.7(±8.5)	27.5(±7.1)	0.449 (-3.7,8.1)	-

Statistical significance was set at p < 0.05. Effect size is reported using eta squared (η^2), which classifies 0.01 as a small effect, 0.06 as a medium effect and 0.14 as a large effect*

When the same analyses were undertaken but across both halves of the game, there were significant difference in scores for first half point shooting accuracy between winning (*M* = 6.3, *SD* = 1.5) and losing teams (*M* = 5.0, *SD* = 1.7, *p* = .032), with a large effect size (η^2 = .21). There was also significant difference in scores for first half goal shooting accuracy between winning (*M* = 1.1, *SD* = 1.1) and losing teams (*M* = 0.3, *SD* = 0.5, *p* = .010), with a large effect size (η^2 = .29).

There was significant difference in scores for second half kick passing accuracy between winning (*M* = 23.1, *SD* = 7.1) and losing teams (*M* = 17.9, *SD* = 5.4, *p* = .033), and again a large effect size was found (η^2 = 021). There were no other significant findings, as reported in Table 6.

Kicking Distance Results

Lastly, a subsample of games was chosen to analyse the frequencies of shooting distance. Six high level college games were examined. The analysis showed that the most common distance LGF players are shooting from is approximately 20m, as shown in Table 7.

Table 7: Results of in game shooting distance of LGF players

DISTANCE (M)	GAME 1	GAME 2	GAME 3	GAME 4	GAME 5	GAME 6	TOTAL SHOTS	% TOTAL SHOTS
5M	2	-	1	-	-	-	3	1.0%
10M	1	-	3	2	-	4	10	4.0%
13M	1	1	-	-	1	-	3	1.2%
15M	11	9	7	9	11	14	61	25.4%
20M	**16**	**20**	**20**	**18**	**18**	**19**	**111**	**44.6%**
25M	11	9	5	4	9	4	42	16.9%
30M	2	2	-	3	3	-	10	4.0%
35M	-	1	1	1	1	-	4	1.6%
40M	1	-	-	1	-	2	4	1.6%
45M	1	-	-	-	-	-	1	1.6%

3.5 Discussion

This study aimed to analyse kicking in LGF games and it was found on average there are 195.9 kicks in LGF games. In addition, a secondary aim sought to analyse the ratio of kicks with the right to left foot to investigate whether bilateral kicking is a facet in the Ladies' game. On average per game, for everyone left footed kick there was 4.89 right footed kicks. Lastly, the analyses showed that kicking accuracy is significant towards winning outcomes in LGF games.

Ball and Horgan (2013) found that an average Gaelic football game contained an average of 205 kicks, with an overall success rate of 55%. From this study's analysis we found that over the course of 15 games, there was on average 196 kicks per LGF Game. Out of the 196 kicks there was on average 141 successful kicks per game. This gave a success rate of 72% per game. These results show that in the current LGF game, the athletes have a substantially higher rate of successful kicks than that of the analysis of the men's game in Ball and Horgan's 2013 paper. . These are somewhat surprising results, as LGF games are ten minutes less in duration to the men's game but have a similar number of kicks per game. This may be due to an increased emphasis on kicking within the LGF coaching community, which could also explain the increased accuracy in kicking versus the men's game.

The average number of left footed kicks per game was 33, with 23 of those being successful kicks. This creates a success rate of 69% on average for left footers per game. Whereas for right footers there was on average 163 kicks, with 118 of them being successful. This creates a success rate of 72% for right footer on average per game. These stats show a 3% difference in the success rate between left footed kickers and right footed kickers in a game, with right footed kickers have the higher success rate. While the results presented here may suggest that left footed kickers are more accurate, it should be considered with caution, due to the relatively small sample size of games. Future studies should seek to include a much larger number of games from all levels of the game.

From the analyses of the games, it was found that kick passing accuracy is very important towards winning or losing the game. This was apparent when the results showed that overall kick passing accuracy was significantly higher in winning teams to losing teams (p = 0.024, , η^2 = .17, large effect). But when this was analysed further by breaking it down to first half vs

second half, only the second half kick passing was significant. The first half showed to be not significant with a value of (p = 0.147) compared to a second half with a significant value of (p = 0.033, η^2 = .21, large effect). This result shows that for winning teams the accuracy of their kick passing became more important in the second half compared to the first half. This result could be linked to fatigue and tiredness from the athletes as the game gets closer to ending(Castellano, Casamichana and Lago, 2012). The results suggest that winning teams are more proficient with their kick passing accuracy under fatigue and coupled with the significantly lower accuracy levels from the losing teams, suggests that the winning team would also have more possession due to the inaccuracies of their opponent. More possessions in games has been shown to be a significant factor in winning games (McGuigan, Hughes and Martin, 2018).

When comparing the results over the two halves across winning and losing teams, the only other significant values were first half goals and points shooting accuracy. The shooting accuracy for goals in the first half is significant (p = 0.010, η^2 = .29, large effect), as was the first half point shooting accuracy (p = 0.032, η^2 = .21, large effect). These results suggest that a strong start to a game is likely significantly increase your chances of winning. There were no differences between winning and losing teams in the second half, with no significant differences between second half goal shooting accuracy (p = 0.181) or point shooting accuracy (p = 0.36). Again, fatigue could be an issue as the game progresses with shooting becoming more erratic in the second half. These results mirror research by Grant et al. (1999) reporting that differences between the winning and losing teams are mainly evident in both the frequency and effectiveness of shots at goal and pass completion. The results also highlight the value of detailed analyses of games, with significant findings that could impact how a team wishes to play.

When performance analysis is used as intended within any level in sport, it can allow a team to identify their strengths and weaknesses related to their performance, which can allow coaches to plan or intervene with the aim of increasing performance in the future (Carlow *et al.*, 2016). The findings indicate which performance indicators that involve kicking are most significant, and in which half, in order to be successful against an opposing team. This may seem like stating the obvious, the results show that teams who perform better in their

shooting in the first half are more likely to win the game. Interestingly, shooting accuracy is not a significant differentiator in the second half, with kick passing accuracy shown to be significant in order to secure a win. The results from this study are important for Ladies Gaelic football coaches as well as players and could inform coaches in identifying key areas to focus on in terms of tactical and technical improvements.

3.5.1 Limitations

While many of the findings presented in this study are novel in nature, some must be taken with caution. Considering the growth of LGF outlined in the introduction, the sample size of 17 games is relatively small in comparison. Future research should seek to analyse a larger number of games to put forward more generalisable results. The variety of games analysed could also be seen as a limitation, with a large variance in standards of players potentially taking part. In the authors opinion, future studies should look to analysis a larger sample size from intercounty, collegiate and club levels. The age profiles of players involved should also be taken into account to highlight trends across young and more experienced players. Lastly, while the comparison of total kicks in LGF games analysed in this study against the men's game may have produced a surprising finding, this should also be taken with caution. While the research by Ball (2013) is unique in this nature, Gaelic football has changed considerably over the last decade, and as such comparisons may not be reflective of current trends. Future research should seek to compare recent data in both the male and female games to ascertain a true comparison.

3.5.2 Conclusion

This study backs up previous findings that kicking accuracy is a key determinant of winning games (Lago-Peñas *et al.*, 2010). It seems logical to suggest that future research should seek to explore the best tools to assess both kicking and shooting accuracy. While such tools exist in other sports (Castellano, Casamichana and Lago, 2012) , there are very few in Gaelic games, and to the best of the authors knowledge nothing exists in the women's game. Furthermore, with the increasing game demands in LGF, a method of assessing bilateral kicking accuracy, with particular attention to shooting accuracy, would be welcomed. Such research would help

coaches design interventions to help their players improve both their dominant and non-dominant foot kick passing and shooting accuracy, which these results have shown are an important factor towards successful outcomes in games.

Chapter 4: Bilateral Kicking Accuracy in Ladies Gaelic Football

4.1 Introduction

The use of bilateral skills in any sport are very important. Illman (2001) quoted that the "potential benefits of two-sided dexterity in soccer are immense". If a player in soccer is efficiently able to use both feet when in a competitive game, they are less likely to be turned over when put onto their non-dominant side (Grouios, 2004). Haaland and Hoff's (2003) study shows some of the benefits skill wise of training the dominant and non-dominant leg consistently in soccer. One of these benefits was that the non-dominant leg advanced to roughly the skill level of the dominant leg that was shown in the pre-test of the study. This result was shown after the experimental group practiced with only their non-dominant leg for eight weeks. This study is an example of one of the many benefits of focusing on improving a player's weaker limb.

The studies above show the importance of bilateral training in participants that already could perform the skill on their dominant limb, whereas, Stöckel, Weigelt and Krug, (2011) researched the ability to learn a basketball dribbling task as part of bilateral practice. Their participants were 52 children who were all right-hand dominant . The participants were split into two groups. Group one learned the task on their dominant hand first and then switched over to using their non-dominant hand. Whereas Group two learned the skill on their non-dominant hand and then changed over to their dominant hand. The research found that the skill was better transferred over when the skill was taught to the non-dominant hand first before transferring over to the dominant hand. This suggests a potential novel method to teach new skills to children or anyone new to the sport. This study also shows how important it is to teach skills on both dominant and non-dominant sides to develop a well-rounded bilateral athlete (Stockel, Weigelt & Krug, 2011).

The ability to use both sides in any sport makes a player more versatile (Grouios, 2004), and being overly proficient on one side is known as lateral asymmetry (Marinsek, 2016). Marinsek (2016) tested the influence of different motor practices on lateral asymmetry of performance in 40 preschool children. Participants lateral preference was determined as their dominant side, and of the 40 participants, 34 of reported as right-handed and right footed. Three groups were formed to examine a variety of practice interventions on two object control skills, bouncing a ball and foot dribbling a ball. The first group practiced the skills with their

dominant side only, the second group only practising with their non-dominant side, and the third group with both their dominant and non-dominant sides. The results found that the second group increased their dribbling performance on the non-dominant side in comparison to the other groups (Marinsek, 2016). These findings suggest that practice at a young age can lead to reductions in lateral asymmetry. These results show coaches how important it is to develop the basic skill on both the dominant and the non-dominant side at a young age, so that when that get older it is easier to progress to the harder skill on both sides. Marinsek's research backed up previous studies (Stockel, Weigelt & Krug, 2011) by proving that the practice of both dominant and non-dominant can help develop the skills used by the participants hand or feet. This is relevant in the context of this thesis as Gaelic games in played with both upper and lower body limbs.

Dichiera *et al.*, (2006) researched the impact that pelvic and lower limb kinematics have on the performance of a drop punt kick in Australian Football. This study was done to figure out some of the different factors that influence accurate kicking in Australian Football. 10 Professional AFL players kicked 20 drop punt kicks to a target that was fifteen metres away using their chosen leg. If the participant hit the target with a kicking accuracy of over 50%, they were deemed accurate. The study found that the accurate participants had an increased pelvic tilt, and hip and knee flexion on the support limb. Increased knee flexion of the support limb helps lower the kickers centre of gravity, which allows the participants to have better stability of the support limb. This is important for accuracy because when a player kicks a ball, they are balancing on one leg for majority of the action (Dichiera et al 2006).

These results above suggest that the ability to balance on the support limb can impact the accuracy of the kick. This finding is important as it suggests a component of kicking technique that inaccurate players may need to focus on. This is relevant in a Gaelic football context, both the male and female versions of the game. Ladies Gaelic Football (LGF) is played on a standard size GAA pitch, which ranges from 130 metres and 145 metres in length with it ranging from 80 metres to 90 metres in width. In a LGF game there is 15 players on the field for each team, with 14 of them being outfield players, the non-outfield player is the Goalkeeper. A LGF match is divided into two halves, with each lasting a minimum of 30 minutes, with extra injury time decided by the referee of the match. The objective of the game is for one team to score more than their opposition, while defending and trying to stop the opposition from scoring. Some

of the skills used in LGF games are handpassing, kicking, tackling, blocking, scoring and catching.

The male version of the game has significant research in various fields, an example of this in keeping with the context of this study is Ball and Horgan (2013) found that male GAA games contained an average of 205 kicks per game, with an overall success rate of 55%. The variety of kicks were comprised of 74% in general play, 20% free kicks and 6% side-line kicks. As mentioned above, there seemed to be no studies that have looked into this research question for Ladies Gaelic Football (LGF).As mentioned in Chapter 3 we found that on average there are 195.9 kicks per game in Ladies Gaelic Football with a 71.91% success rate. Another area of interest looking at kicking in sport which lacks data in the women's game is the ratio of kicking with the left and right foot. Research that seeks to fill the gaps identified above has the potential to very helpful for coaches and the LGFA to help with the development of the sports and its athletes.

As detailed in chapter 3 previously, findings comparing kicking accuracy across winning and losing teams in Ladies Gaelic Football games, showed only first half shooting accuracy were significant (point shooting accuracy (p = 0.032 and η^2 = 0.21) and goal shooting accuracy (p = 0.010 and η^2 = 0.29). These results show that winning teams tend to start games strong as they achieve a higher shooting accuracy than their opponents. However, as games progress into the second half, shooting accuracy is not significant (point shooting accuracy (p =0.365) and goal shooting accuracy (p = 0.181) . Fatigue could be a factor as the game develops, with shooting accuracy decreasing as athletes get tired (Castellano, Casamichana and Lago, 2012). These results show an aspect of the game that both winning and losing teams need to improve on, especially in the second half of the game, and also open up an area of research into shooting accuracy in Ladies Gaelic Football. This coupled with the importance of bilateral skills as highlighted above, it seems logical that further research should seek to analyse shooting accuracy across the use of dominant vs non-dominant feet in Ladies Gaelic Football.

This study aims to investigate bilateral kicking accuracy in Ladies Gaelic Football. A comparison will be undertaken to ascertain the accuracy of the dominant leg versus the non-dominant leg in a variety of different kicking positions. A secondary aim is the identification of a potential tool for the use of Ladies Gaelic Football coaches in assessing bilateral kicking accuracy.

4.2 Methods

4.2.1 Participants

Participants were recruited through team managers and club chairpersons. Players from three clubs and one intercounty team agreed to take part in the study. The participants from two of the club teams were playing at the intermediate championship level for the duration of the data collection period, whereas the other club team were playing at senior championship level for the duration of the data collection period. The intercounty team compete in the senior championship in the all-Ireland series.

Table 8: Description of Inclusion/Exclusion Criteria

INCLUSION CRITERIA	EXCLUSION CRITERIA
A REGISTERED LGFA PLAYER	Wasn't registered with the LGFA
HAD TO BE OVER 18	Was under the age of 18
PLAYING AT INTERMEDIATE OR SENIOR LEVEL	Junior club status
WAS INJURY FREE AT THE TIME OF TESTING	Injured at time of data collection

As reported in table 8, for participants to be included in this study they had to be registered players within the LGFA. They had to be over the age of 18 and had to self-report as injury free at the time of testing. Only Intermediate or Senior club players were included in the testing. This was to make sure that the participants that tested were training and competing at a level that was representative of a holistic Ladies Gaelic Football playing cohort.

All participants self-reported themselves injury free before taking part in testing. Players were recruited in all field positions. Eleven of the participants were forwards, five of the participants were defenders, three of the participants were midfielders, and one of the participants was a goalkeeper. The reason for the inclusion of a goalkeeper is that during a game, a goalkeeper is the only position where the player must kick the ball at some stage during the game. In addition, the modern game continues to evolve with more goalkeepers coming out and taking the long range frees. Goalkeepers are also involved in the transition of the ball up the field in attacking situations through the use of hand and foot.

Table 9: Description of Participants

NUMBER OF PARTICIPANTS	**20**			
CLUB/INTERCOUNTY LEVEL	Intermediate Club	Senior Club		Senior Intercounty
	9	6		5
AVERAGE YEARS PLAYING LADIES GAELIC FOOTBALL	16.5 years			
FIELD POSITIONS	Goalkeeper	Defender	Midfield	Forward
	1	5	3	11
AVERAGE AGE OF PARTICIPANTS	22.7 ± 3.7 years			
DOMINANT RIGHT FOOTED	19			
DOMINANT LEFT FOOTED	1			
NUMBER OF PARTICIPANTS PLAYING CLUB FOOTBALL	20			
NUMBER OF PARTICIPANTS PLAYING COLLEGE FOOTBALL	6			
NUMBER OF COLLEGE PLAYERS THAT PLAY INTERCOUNTY	1			
NUMBER OF PARTICIPANTS PLAYING INTERCOUNTY FOOTBALL	5			

All participants received a plain language statement and were required to complete an informed consent form before taking part. Participants were given time to ask any questions before and throughout the testing. Ethical approval was obtained from Research Ethics Committee in Dublin City University.

There was no sample size calculation conducted due to the struggle to gather participants for the study. This study was conducted during a global pandemic, so because of this we had to adhere to strict Covid-19 guidelines to prevent infection. This caused us to have a very small cohort of participants.

4.2.2 Procedure

This study was split into two assessments, a control and an experiment test. The control test had the participants kicking from the cones in order of angles A through E, as depicted in Figure 3. The experimental test had participants kicking from the cones in a randomised order called out by the assessor. This was to reduce the chances of participants test familiarity and thus impacting the results (Liu and Wrisberg, 2005).

The time between the two tests was on average 15 ± 17 days. When testing, the researcher made sure to only conduct the assessment on days when the weather was not inclement. This was to ensure that the weather had as little implications as possible for the results, i.e. a strong wind could have had the potential to increase the difficulty of the kick. Each test took approximately 18 minutes and 30 seconds.

The testing took place in various locations but all on standard GAA pitches. The participants all wore standard GAA attire during testing (e.g., football shorts, boots), and a standard size 4 ball was used, similar to that which would be used in a game setting. The testing procedure was explained to all participants before the assessment. All participants were given the chance to ask any questions throughout the testing procedure and were free to withdraw at any time. All players completed a routine injury prevention warmup prior to taking part in the assessment.

For the set up five cones were put down 20 metres away from the centre of the goal line at five different angles that were 30 degrees apart. The cones were labelled A, B, C, D and E. The testing was set up as shown in Figure 3.

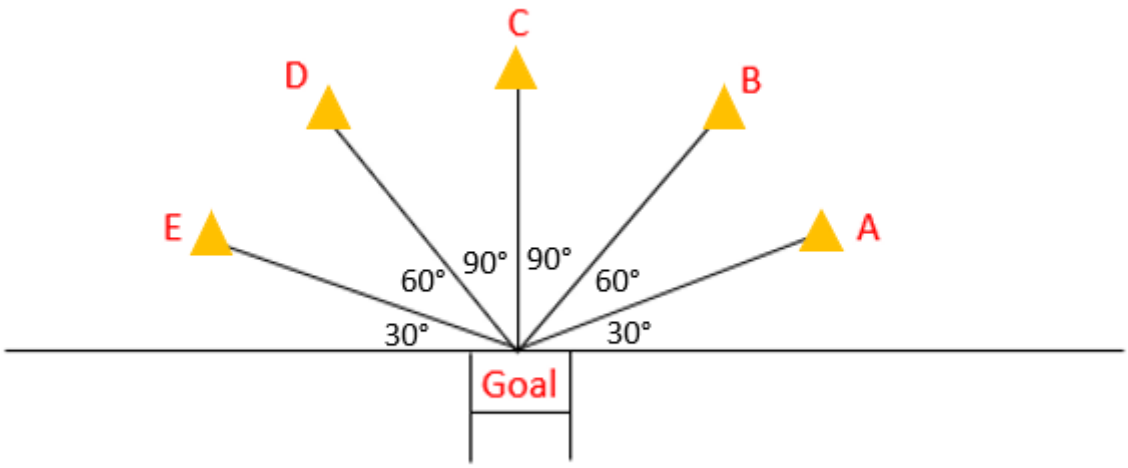

Figure 3: Testing Set-up

4.2.3 Calculation of angles

The calculation of angles was done using the sin, cos, and tan formulas:

$$Sin\ (\vartheta) = \frac{Opp}{Hyp}, Cos\ (\vartheta) = \frac{Adj}{Hyp}, Tan(\vartheta) = \frac{Opp}{Adj}$$

It was decided the angles would be 30° apart, this was to allow having 5 different angles within a 180° area, which is the area in front of a goal. The distance away from goal was to be 20 metres from the centre of the goal line. Angle C was a 90° angle from the goal line. The angle calculations for Angles A, B, D and E are shown in the Figures 4,5, 6 and 7:

Angle A:

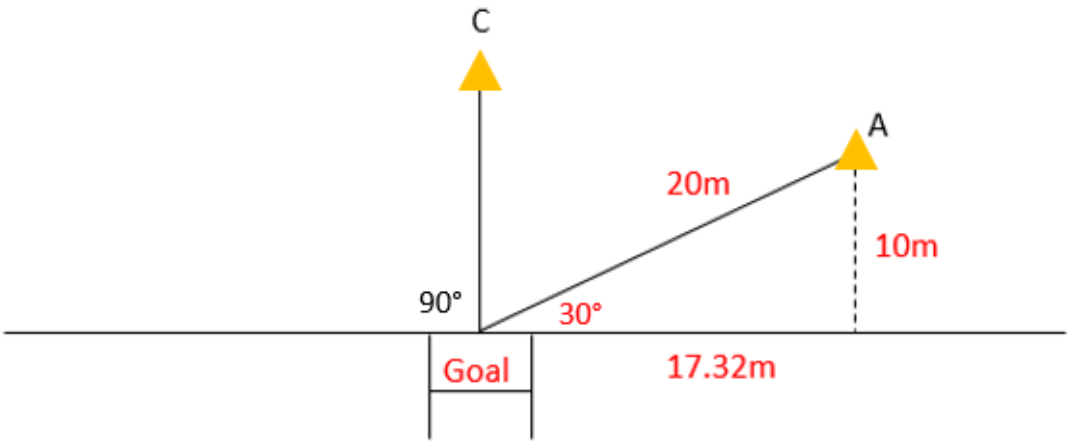

Figure 4: Calculation of Angle A

$$Sin\ (\vartheta) = \frac{Opp}{Hyp}$$

$$Sin\ (30) = \frac{Opp}{20}$$

$$20\big(Sin(30)\big) = Opp$$

$$20(0.5) = Opp$$

$$10m = Opp$$

$$Cos\ (\vartheta) = \frac{Adj}{Hyp}$$

$$Cos(30) = \frac{Adj}{20}$$

$$20\big(Cos(30)\big) = Adj$$

$$20(0.866) = Adj$$

$$17.32m = Adj$$

Angle B:

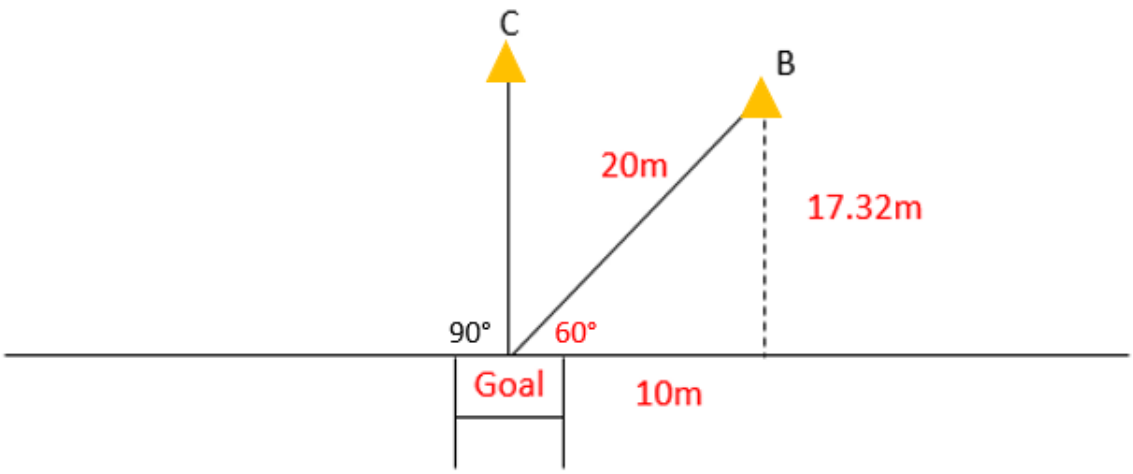

Figure 5: Calculation of Angle B

$$Sin(\vartheta) = \frac{Opp}{Hyp}$$

$$Sin(60) = \frac{Opp}{20}$$

$$20\left(Sin(60)\right) = Opp$$

$$20\ (0.866) = Opp$$

$$17.32m = Opp$$

$$Cos(\vartheta) = \frac{Adj}{Hyp}$$

$$Cos(60) = \frac{Adj}{20}$$

$$20\left(Cos(60)\right) = Adj$$

$$20(0.5) = Adj$$

$$10m = Adj$$

Angle D:

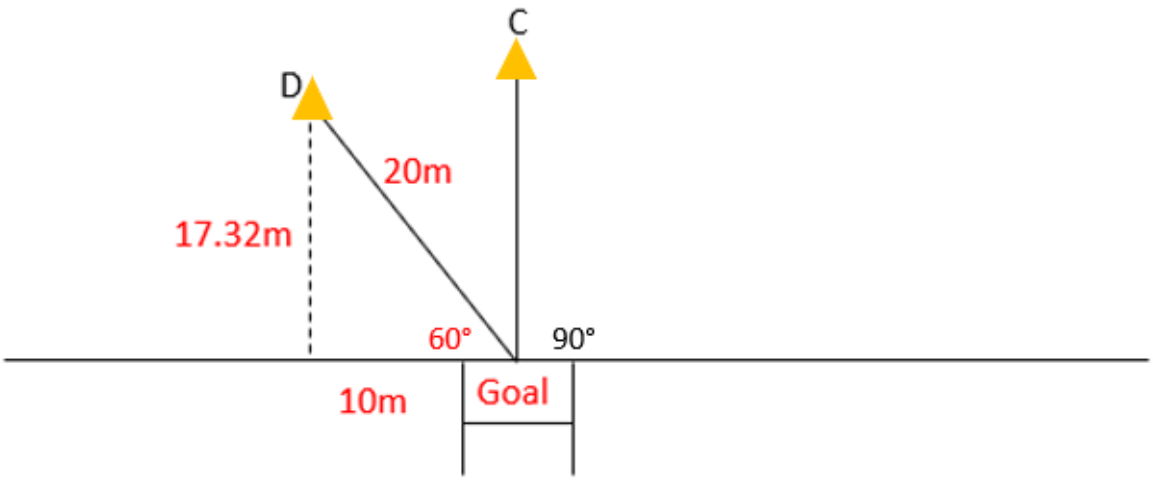

Figure 6: Calculation of Angle D

$$Sin\ (\vartheta) = \frac{Opp}{Hyp}$$

$$Sin\ (60) = \frac{Opp}{20}$$

$$20\big(Sin(60)\big) = Opp$$

$$20(0.866) = Opp$$

$$17.32m = Opp$$

$$Cos\ (\vartheta) = \frac{Adj}{Hyp}$$

$$Cos(60) = \frac{Adj}{20}$$

$$20\big(Cos(60)\big) = Adj$$

$$20(0.5) = Adj$$

$$10m = Adj$$

Angle E:

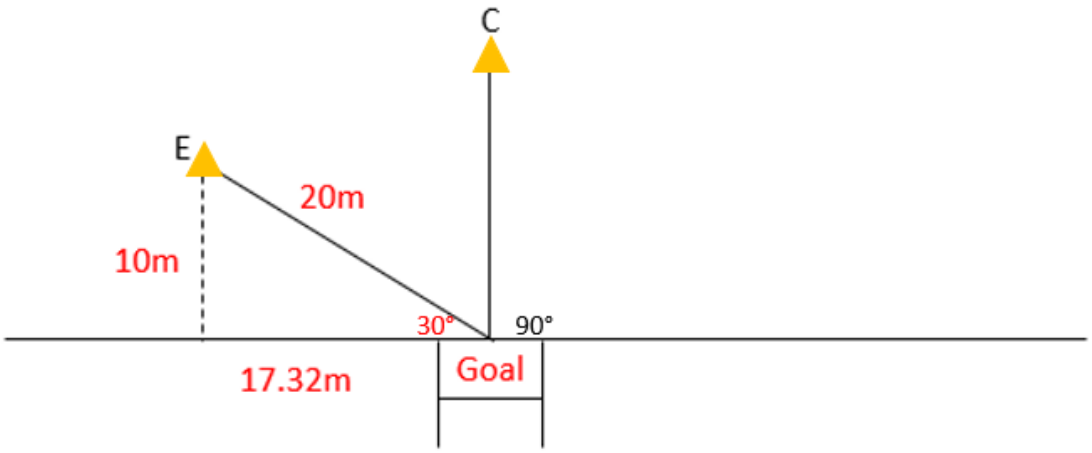

Figure 7: Calculation of Angle E

$$Sin\ (\vartheta) = \frac{Opp}{Hyp}$$

$$Sin\ (30) = \frac{Opp}{20}$$

$$20\big(Sin(30)\big) = Opp$$

$$20(0.5) = Opp$$

$$10m = Opp$$

$$Cos\ (\vartheta) = \frac{Adj}{Hyp}$$

$$Cos(30) = \frac{Adj}{20}$$

$$20\big(Cos(30)\big) = Adj$$

$$20(0.866) = Adj$$

$$17.32m = Adj$$

4.2.4 Control Test

Participants were asked to kick the football in punt kick style. A punt kick can be used to pass the ball further down the pitch to one of your teammates or it can be used to score. A punt kick is where you drop the ball onto the kicking leg and kick the ball with instep of the foot while keeping your toes pointed in the direction of your target (GAA, 2022 b). The punt kick is not a stationary kick, because after you hit the ball with the kicking leg you complete the kick by following through. Participants were also allowed to do a slight run/walk up to mimic

how a player might punt kick in a game. They were not allowed to pass the cone. How to kick a punt kick is demonstrated by figure 8 below.(LGFA, 2022)

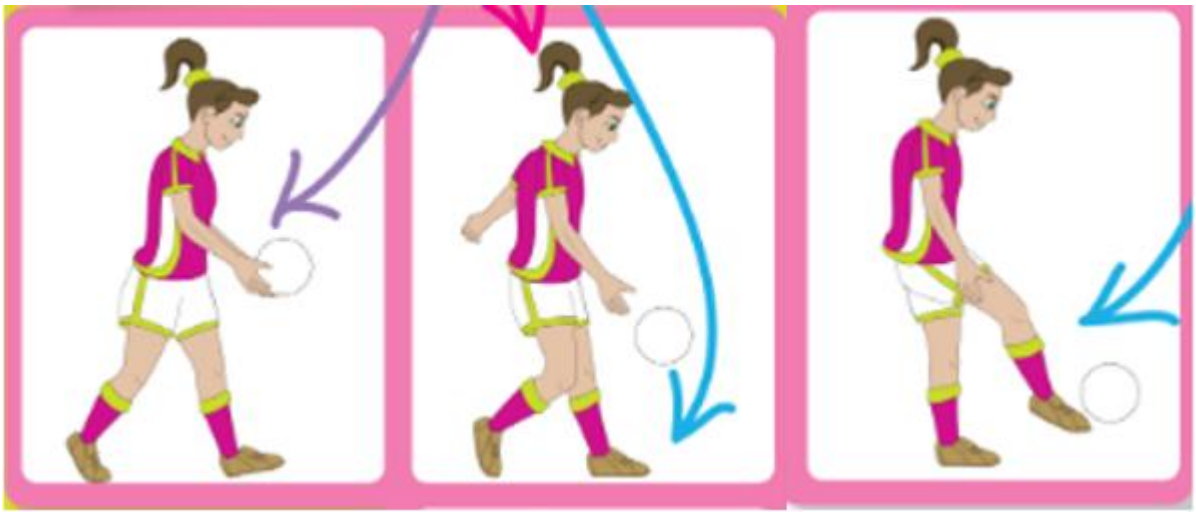

Figure 8: Demonstration of a Punt Kick (LGFA,2022)

Control Test Procedure:

1. All players tested during training after their warmup and stretches with their team.
2. Each participant kicked five balls at each cone as shown in figure 3 (A, B, C, D and E) on their dominant kick leg (25 kicks).
3. Participants started at cone A on their dominant leg and kicked all five footballs at that cone before proceeding to cone B.
4. Participants kicked all five footballs at each cone until they had finished cone E. There was no time limit for these kicks.
5. Participants followed the cones in alphabetical order e.g., Cone A to B to C etc.
6. They then took a two-minute recovery before starting their non-dominant leg at cone A
7. Participants repeated steps three and four on their non-dominant leg.
8. Participants did a total of 50 kicks across the five cones on both their dominant and non-dominant legs
9. Once finished testing, participants completed a cool down

4.2.5 Experimental Test

The experimental test had the participants kicking the ball in a randomised order, that was called out by the assessor. This test was done to compare the scores of the control test to the experimental test, to make sure that the participants don't get too familiar with the testing procedure, that it impacts the results (Liu and Wrisberg, 2005).

Participants were asked to kick the football in punt kick style, as if they were taking a free in a game. This meant that they were allowed a slight run/walk up to the cone before shooting. They were not allowed to pass the cone.

<u>Experimental Test Procedure:</u>

1. All players tested during training after their warmup and stretches with their team.
2. Each participant kicked five balls at each cone as shown in figure 3 (A, B, C, D and E) on their dominant kick leg (25 kicks).
3. For this test participants started on a random cone and continued to do the rest of their dominant leg in a randomised order.
4. The order was called out at random by the investigator.
5. Participants continued to do this until all the balls were kicked at the five cones on their dominant leg. There was no time limit for these kicks.
6. They then took a two-minute recovery before starting their non-dominant leg and repeating the procedure.
7. Participants repeated steps three and four on their non-dominant leg.
8. Once finished testing, participants did a cool down.
9. Participants did a total of 50 kicks across the five cones on both their dominant and non-dominant legs

All participants fully completed the testing without any complications.

4.2.6 Data collection

Data was collected on a standard GAA football field. The data was collected through pen and paper method. The test scores for both assessments for dominant and non-dominant leg were recorded. Descriptive data were collected from participants; level of football (e.g., club, college, or county), date of birth, how long they had been playing football, dominant foot, and field position that they most played. All documents containing any participants personal

information was securely filed in a locked cabinet, with access only given to the investigators of this study. Participants were issued with a unique identifier code to ensure anonymity.

The results for both tests were recorded in a table that was formatted as seen in Figure 9.

Dominant Leg: **Non-Dominant Leg:**

	A	B	C	D	E		A	B	C	D	E
Trial 1						Trial 1					
Trial 2						Trial 2					
Trial 3						Trial 3					
Trial 4						Trial 4					
Trial 5						Trial 5					
Total:						**Total:**					

Figure 9: Empty Results Table

A score was accomplished if the participant kicked the ball over the bar from each specific cone. A number one was put in the table corresponding the participant if kicked accurately. A score of zero was counted if the participant kicked the ball wide or, if the ball dropped short, if it went into the goals or under the crossbar or hit the crossbar. A zero was put in the table to denote participants kicked it inaccurately. Accuracy at each position (A-E dominant, A - E non-dominant) in each condition (controlled and randomised) was obtained by summing the five trials taken at each angle to give an accuracy score of 0-5., These results were recorded for both dominant and non-dominant legs over the two assessment periods.

4.3 Statistical analysis

Data was collected by pen and paper method, and then transferred into Microsoft Excel (Version 2207). Excel was used to develop the SPSS sheet formatting, prior to transferring the data into SPSS. All data were analysed using SPSS version 27. Paired samples t-tests were used to compare shooting proficiency between the dominant and non-dominant legs at each angle in both the controlled and the randomised conditions. Two-way repeated measures ANOVA were conducted to explore differences in kicking proficiency for each angle between conditions (controlled and randomised), for the dominant and the non-dominant leg separately. Statistical significance was set *at* $p < .05$.

4.4 Results

Table 10: Controlled Dominant vs Controlled Non-Dominant Paired Samples T-tests data

	CONTROLLED						
ANGLE	Dominant	Non-Dominant	*t*	Sig	Eta-Squared	Mean (±SD)	95% Confidence Interval
A	3.25 ±1.07	1.65 ±1.35	4.66	0.00*	0.53	1.60 (± 1.54)	(0.88, 2.32)
B	3.45 ±0.76	2.20 ±1.11	5.225	0.00*	0.59	1.25 (± 1.07)	(0.75, 1.75)
C	3.50 ±1.32	2.30 ±1.34	2.990	0.01*	0.32	1.20 (± 1.80)	(0.36, 2.04)
D	3.40 ±1.05	2.70 ±1.22	2.33	0.03*	0.22	0.70 (± 1.34)	(0.07, 1.33)
E	2.70 ±1.22	1.95 ±1.19	2.162	0.04*	0.20	0.75 (± 1.55)	(0.24, 1.48)

Comparisons between dominant and non-dominant foot kicking accuracy for the control and the randomised condition were analysed using paired sample t-tests, as seen in Table 10 and Table 11

In the control condition, significant differences were seen between dominant and non-dominant foot accuracy, as shown in Table 10, in the comparison of shooting performance at Angle A between the controlled dominant (Mean = 3.25 ±1.070) and the controlled non-dominant (Mean 1.65 ±1.348) there was a significant difference ($t(19) = 4.66$, $p < 0.000$ (two-tailed)). There was a mean decrease of 1.6 with a 95% confidence interval ranging from 0.881 to 2.319. The eta squared statistic (0.53) indicated a large effect size. There were also significant differences shown in Angle B ($t(19) = 5.23$, $p < 0.000$, $\eta^2 = 0.59$), Angle C ($t(19) = 2.99$, $p < 0.000$, $\eta^2 = 0.32$), Angle D ($t(19) = 2.33$, $p < 0.000$, $\eta^2 = 0.22$), and Angle E ($t(19) =$

2.16, $p < 0.000$, $\eta^2 = 020$). Full details are shown in Table 10. Angle A (m =1.60 (± 1.54)) and B (m=1.25 (± 1.07)) were the most accurate angles for the Control test.

Table 11: Randomised Dominant vs Randomised Non-Dominant Paired Sample t-test (Statistical significance was set at $p < 0.05$*. Effect size is reported using eta squared, which classifies 0.01 as a small effect, 0.06 as a medium effect and 0.14 as a large effect).

RANDOMISED

ANGLE	Dominant	Non-Dominant	*t*	Sig	Eta-squared	Mean (±SD)	95% Confidence Intervals
A	3.10 ±1.25	1.60 ±1.43	4.359	0.00*	0.50	1.50 (± 1.54)	(0.78, 2.22)
B	3.55 ±1.32	1.55 ±1.23	6.686	0.00*	0.70	2.00 (± 1.34)	(1.37, 2.63)
C	3.45 ±1.00	2.50 ±1.40	2.894	0.01*	0.31	0.95 (± 1.47)	(0.26, 1.64)
D	3.35 ±1.23	2.05 ±1.47	3.997	0.00*	0.22	1.30 (± 1.46)	(0.62, 1.98)
E	2.45 ±0.95	2.10 ±1.170.	1.437	0.17	-	0.35 (± 1.09)	(0.16, 0.86)

In the randomised condition, significant differences were seen between dominant and non-dominant foot kicking accuracy, as shown in Table 11. In the comparison of shooting performance at Angle A between the Randomised dominant (Mean = 3.10 ±1.252) and the Randomised non-dominant (Mean 1.60 ±1.348) there was a significant difference ($t (19) = 4.36$, $p < 0.000$ (two-tailed)). There was a mean decrease of 1.5 with a 95% confidence interval ranging from 0.780 to 2.220. The eta squared statistic (0.50) indicated a large effect size. There were also significant differences shown in Angle B ($t (19) = 6.86$, $p < 0.000$, $\eta^2 = 0.70$), Angle C ($t (19) = 2.89$, $p = 0.009$, $\eta^2 = 0.31$), and Angle D ($t (19) = 3.99$, $p = 0.001$, $\eta^2 = 0.22$), There were no significant difference between the randomised dominant versus non-dominant kicking proficiency at Angle E ($t (19) = 1.44$, $p = 0.167$). Full details are shown in Table 11. For both the controlled and the randomised test all angles were more accurate on

the dominant foot compared to the non-dominant foot. Angle B (m= 2.00 (± 1.34)) and Angle A (m=1.50 (± 1.54)) were the angles with the best accuracy for the Randomised Tests.

Two separate two-way repeated measures ANOVA were used to investigate kicking accuracy scores by angle (five different angles) and condition (controlled and randomised order) for 1) the dominant leg, and 2) the non-dominant leg. Mean scores are shown in Table 10.

Table 12: Two-Way Repeated Measures for Dominant Leg in both the Controlled and Randomised Tests

	WILKS' LAMBDA		**SIGNICANT**	
	VALUE	**F**	**VALUE**	**PARTIAL Eta^2**
CONDITION	0.994	0.115	0.739	0.006
ANGLE	0.440	5.098	0.008	0.560
CONDITION* ANGLE	0.949	0.216	0.926	0.051

For the dominant leg, there was no interaction effect for angle and condition on kicking accuracy (Wilk's lambda = .949, F (4, 16) = .216, p > .05). When looking at the main effects, there was no significant effect for condition on kicking accuracy (Wilk's lambda = .994, F (1, 19) = .115, p > .05), however there was a significant main effect for angle on kicking accuracy (Wilk's lambda = .440, F (4, 16) = 5.10, p > .05, multivariate partial eta squared = .560) This is a large effect size.

Table 13: Two-Way Repeated Measures for Non-Dominant Leg in both the Controlled and Randomised Tests

	WILKS' LAMBDA VALUE	F	SIGNIFICANT VALUE	PARTIAL Eta^2
CONDITION	0.953	0.941	0.344	0.047
ANGLE	0.620	2.451	0.088	0.380
CONDITION*ANGLE	0.669	1.979	0.146	0.331

For the non-dominant leg, there was no interaction effect for angle and condition on kicking accuracy (Wilk's lambda = .669, F (4, 16) = 1.979, p > .05). When looking at the main effects, there was no significant effect for condition on kicking accuracy (Wilk's lambda = .953, F (1, 19) = .941, p > .05), however there was no significant main effect for angle on kicking accuracy (Wilk's lambda = .620, F (4, 16) = 2.451, p > .05, multivariate partial eta squared = .380) This is a large effect size.

4.5 Discussion

This study aimed to investigate bilateral kicking accuracy in Ladies Gaelic Football. When investigating bilateral accuracy in LGF, we aimed on comparing the accuracy of the dominant leg versus the nondominant leg in a variety of different kicking positions. The results, unsurprisingly, showed that participants were more accurate with their dominant leg compared to their non-dominant leg. A secondary aim was to identify a potential tool for Ladies Gaelic Football coaches in assessing bilateral kicking accuracy. This study provides an assessment tool for coaches to use to assess their athletes bilateral kicking accuracy.

As shown in the results, in the assessment of the controlled dominant vs controlled non-dominant kicking accuracy showed that the dominant leg is more accurate for all angles. When comparing dominant to non-dominant, Angle E was the only angle that was found to be approaching non-significance (p = 0.044 and $eta^2 = 0.20$). Angle E was the angle with the lowest mean for both the dominant and non-dominant leg, and this could potentially be the position that the participants found most difficult due to the acute angle to the goal. This shows an angle that players need to improve their kicking proficiency with both their dominant and non-dominant feet. These findings can help coaches focus on developing activities (Lago-Peñas *et al,* 2010) with a focus on improving kicking accuracy for both dominant and non-dominant feet, but with a particular emphasis on helping their athletes develop more accuracy at Angle E, as this study has shown that it is the weakest angle for accuracy. As previously discussed, performance analysis is an important tool for coaches as it can be used to identify a team's strengths and weaknesses (Lago-Peñas *et al,* 2010), and this assessment can do the same.

Similar to the results from the Controlled test, the Randomised test reported lower means for the non-dominant side compared to the dominant side. In both assessments the participants were more accurate with their dominant side than their non-dominant side, and this replicates findings from Teixeira *et al.* (2011), who found that there was an obvious preference for a specific leg over the other. When comparing the kicking accuracy across the angles in the randomised test, there was significant differences in kicking accuracy for all angles except for Angle E (p = 0.167). There was a significant difference between kicking

performance of the Controlled attempts at Angle A, but no significant difference in the Randomised assessment at the same angle.

When looking at the comparison of kicking accuracy between the two non-dominant components of the assessments, the controlled versus the randomised, Angle D was the only angle that reported a significant difference (p = 0.028 and $eta^2 = 0.23$), with the controlled non-dominant scoring significantly higher. When looking back at the mean score as way of explanation, Angle D had the highest mean compared to the other angles in the controlled non-dominant. This could be because 19 out of 20 of the participants were right foot dominant and within the GAA and LGF it is traditionally believed that anywhere around where Angle D is considered to be a left-footers free takers ideal kicking space. This result backs up this concept that is traditionally believed anecdotally in in the GAA/LGF community (*Do You Need 2 Free Takers – Gaelic Stats*, 2016).

These results show that there is variance in the strength in the dominant leg compared to the non-dominant leg. Teixeira, Silva and Carvalho (2003) looked at the role of bilateral practice to reduce this difference between dominant and non-dominant sides. They found there was a high rate of improvement after their experimental training, which helped improve the non-dominant side of the participants. This helps back up results like Marinsek (2016) who showed the importance of training skills on both the dominant and non-dominant leg from a young age, whether the skill involved dribbling with your hands or dribbling with your feet. Building on the foundations laid by the previous literature, coupled with the initial findings from this study, future research should seek to increase the development of bilateral practice, and the testing protocol outlined in this study is a tool that may allow coaches to measure their athletes progress.

Interestingly, these results show that the controlled versus randomised nature of the assessment had no real bearing on kicking accuracy. When conducting this study it was expected that the participants would perform better in the Control test compared to the Randomised. The reason the researcher thought the Control test would do better was because of the potential impact of test familiarity. The Randomised test was created to reduce the chances of participants test familiarity and thus impacting the results (Liu and

Wrisberg, 2005). The non-significant findings when comparing the controlled versus randomised kicking suggest future research should focus on just one portion of the assessment. This is important as coaches now have a practical tool in which they can use to assess their player kicking accuracy in a time friendly manner. While ultimately the results just reinforced the idea that people tend to be more accurate on their dominant leg compared to non-dominant leg, it is important as it has not been done previously in the Ladies game.

4.5.1 Limitations

A limitation to these results is that 19 out the 20 participants were right foot dominant. This limits the findings as it doesn't allow an equal picture to compare right footed vs left footed accuracy on either the dominant or non-dominant leg. Future research should seek to repeat the test with a large and more diverse sample of participants. Due to having to conduct this study within an ongoing pandemic, it was a struggle to gather a large number of participants. This was due to the strict Covid-19 guidelines, and as such future research should try to replicate this study with a bigger cohort. Even though these limit the findings, this study is still important as the results can help future research in Ladies Gaelic Football by providing a tool to help assess bilateral kicking accuracy. This tool will also help coaches to assess their athletes to find where they need the most improvement in regards of their accuracy on both their dominant and non-dominant leg.

A flaw in the study design had the lead researcher ask for total years playing Ladies Gaelic Football. The author now believes that the question should have asked how long they were playing at that specific level of Ladies Gaelic Football. This is a limitation as it could have specified how experienced each player is at their current level and given further depth to the analyses.

All testing for this study was done outside on standard GAA pitches, because of this we had to deal with the uncontrollable factor of the weather. A strong wind could have had the potential to increase the difficulty of the kick for the participant and then that would give the study a false result. Equally, heavy rain could lead to underfoot conditions not being ideal for a kicker. While the weather was not a factor in this study, future research should seek to include a uniform pitch and have calm weather throughout testing.

This study had two tests to complete. Each test took approximately 18 minutes and 30 seconds. The time to do each test causes a practical limitation for coaches in the LGF. Volunteer coaches are already under a time constraint to get their training drills done in a specific time, which means if they were to do these tests correctly, they would only get max 3 participants done during training. This means it could take a long time to get their whole team done if they were doing it themselves during training. When comparing the results of the controlled vs randomised test, it was found to be non-significant. This means even though each test will take just over 18 minutes, coaches only have to do one test per player instead of two, and they can pick either procedure of the test.

While beyond the scope of the current study, future studies should seek to consider physiological factors into account when replicating the assessment, for example, collecting information related to nutritional status of players, prior to testing, additionally a time of day range for the completion of the test, to inform if diurnal variation was a potential limitation with data collection

4.5.2 Conclusion

This study shows the importance of LGF players being able to use both their dominant and non-dominant leg. The results showed that players are more accurate with their dominant leg compared to their non-dominant leg for both tests. This shows that coaches need to put more emphasis on kicking drills that use both the dominant and the non-dominant leg. Future research should consider the limitations for this study when replicating it. A significant limitation that should be considered when replicating this study, is the number of participants used in the study. Future research should try to have a larger and more diverse cohort. A cohort that has equal number of dominant right footed and dominant left footed players, to make sure the results reflect a more diverse grouping of players.

Future research in this area should be aimed towards creating simple and effective tools that can be used for coaches at every level of Ladies Gaelic Football. These tools should help coaches see where their players skill level currently at so they can use specific drills to improve the skills that need to be improved. To conclude, this study is important for LGF as it provides a tool that coaches could easily replicate at any level.

Chapter 5: Discussion and Conclusion

This thesis aimed to investigate kicking in Ladies Gaelic Football and the objectives of this research were accomplished by conducting two different studies. Initially, it was deemed necessary to conduct analyses to provide baseline data around kicking in LGF games. The first study analysed kicking accuracy in LGF through measuring the accuracy of the various forms of kicking within competitive games. The second study sought to compare the accuracy of the dominant foot and the non-dominant foot when kicking. Two different kicking tests were conducted with 20 participants. The participants had to attempt to kick five footballs at five different angles on each foot with the aim being to kick it accurately over the bar and to score a point. A comparison was conducted on the accuracy of the dominant leg versus the non-dominant leg in a variety of different kicking positions. Not unexpectedly, the findings showed that the participants were more accurate on their dominant leg rather than their non-dominant leg. These results proved our hypothesis that LGF players would be more accurate on their dominant foot over their non-dominant foot.

As mentioned above, study one aimed to analyse kicking in LGF games. It was found that there are an average of 196 kicks in LGF games. In addition, a secondary aim sought to analyse the ratio of kicks with the right to left foot to investigate whether bilateral kicking is a facet in the Ladies' game. On average per game, for every one left footed kick there was 4.89 right footed kicks. While this results is interesting, it is difficult to say if this is a significant finding due to the lack of previous data in the field. While the lack of previous research in LGF makes comparisons difficult, it is hoped this study can help provide some findings towards advancing the ladies game.

Through analysing kicking accuracy in the selected LGF games, it was hoped to establish performance indicators that contribute to teams winning games. From the analysis of the games, it was found that kick passing accuracy is very important towards winning or losing the game, with overall kick passing accuracy shown to be significant towards a successful outcome. Upon deeper examination only the second half kick passing was significant. This shows that for winning teams the accuracy of their kick passing became more important in the second half compared to the first half. Whether these findings are linked with fatigue and tiredness from the athletes as the game progresses (Castellano, Casamichana and Lago, 2012) is something that could be explored further, however this is evidence that teams placing a

premium on kick passing accuracy are setting themselves up to succeed in competitive games. This study backs up previous findings that kicking accuracy is a key determinant of winning games (Lago-Peñas *et al.*, 2010).

Another indicator found to be significant in terms of teams being successful when comparing the first half versus the second half was shooting accuracy. The result showed that shooting accuracy for both goals and points were significantly higher in the first half for winning teams, but not in the second, suggesting that to win a game you need to start off strong. This reinforces previous literature reporting that differences between the winning and losing teams are mainly evident in both the frequency and effectiveness of shots at goal (Grant et al., 1999). The breakdown of the results across the first half and second half suggest accurate performance indicators that could help a team win in Ladies Gaelic Football. When performance analysis is used as intended within any level in sport, it allows a team to highlight the strengths and weaknesses of their performance, with the aim of increasing their chances of performing better in future games (Carlow *et al.*, 2016). This could assist coaches in providing benchmark figures to compare to their own team's performance, and could potentially help them develop more effective training sessions. Not only can performance analysis be used to show coaches what it takes to coach a winning team, but it can be used as a development tool for underage coaches, as it can provide a visual aspect to their coaching, especially if their athlete isn't grasping what exactly the skill should look like.

As mentioned earlier, a key aim of this study was to investigate bilateral kicking accuracy in Ladies Gaelic Football, and to compare the accuracy of the dominant leg versus the nondominant leg in a variety of different kicking positions. The dominant leg has been shown to be more accurate for each of the kicking angles, in both the controlled and randomised assessments. These findings back up previous research that reported that athletes were stronger on their dominant limb compared to their non-dominant (Teixeira *et al.*, 2011). Looking at the non-dominant kicking accuracy specifically, the assessment showed the highest level of accuracy at Angle D. While the vast majority of the participants were right foot dominant, this is anecdotally believed to be an ideal position for left footed players (*Do You Need 2 Free Takers – Gaelic Stats*, 2016). While this is not a scientifically valid finding, it opens

up an area for future research, a study into the best angles for both right and left footed kickers in Gaelic games.

These results back up previous research done by Teixeira, Silva and Carvalho (2003) who looked at the role of bilateral practice to reduce this difference between dominant and non-dominant sides. They found there was a high rate of improvement after their experimental training, which helped improve the non-dominant side of the participants. This helps back up results like Marinsek (2016) who showed the importance of training skills on both the dominant and non-dominant leg from a young age, whether the skill involved dribbling with your hands or dribbling with your feet. Combining this study's results and previous literature, future research should also look at the development of training to improve bilateral practice.

As well as providing coaches with insights into how they should conduct their practice, the assessment utilised in this study could also be a useful tool for coaches to assess their own teams kicking accuracy and to measure their athletes progress across time. Given that the results show no significant difference in either the controlled or randomised versions of the assessment, either version could be implemented. Given the time constraints and amateur ethos of Gaelic games, any effective tools that can be employed in a time effective manner should be welcomed.

This study presents a range of different results that could help inform the LGFA and coaches alike. The analysis of the bilateral kicking accuracy provides a tool for the association and coaches, to help them assess the skill level of their athletes dominant and non-dominant leg's kicking accuracy over a range of different angles. The performance analysis results will give coaches a set of baseline figures for comparison, as well as findings that can help their team be more successful. The information presented here can also further inform training session design in order to help develop their athletes. This thesis opens up an area of research in LGF that can be used a tool for the assessment and development of the athletes within the sport. While there are certainly limitations to this study, the author believes that the findings presented could help guide the LGFA towards the development of the modern game.

5.1 Future Research and Limitations

This study was the first that we know of that investigates bilateral kicking accuracy in Ladies Gaelic Football but is not without limitations. One such limitation was the low number of participants. A combination of a shortened season and the Covid-19 pandemic dramatically decreased the testing window within the timeframe for this research thesis. As this study only had 20 participants, the results presented are not generalizable to the full playing population of Ladies Gaelic games. Future research should seek recruit a larger number of participants across a wide geographical spread.

Another limitation linked to the small sample size was the fact that of the 20 participants, only one self-reported as left foot dominant. As such, all findings may be skewed as they don't have an equal distribution of left and right footed participants. Future research should seek to recruit an equal number of left and right footed participants.

Future research should also look into having a more diverse skill level of participants. This will allow the results to have a broader outlook on bilateral kicking accuracy in Ladies Gaelic Football.

When collecting the data, a flaw in the research design saw the research asking the participants for total years playing LGF, instead the author should have asked how long they were playing at that specific level of LGF. This is a limitation as it could have specified how experienced each player is at their current level and given another layer of depth to the analyses.

All testing for this study was done outside on standard GAA pitches. The weather, specifically the wind, is an uncontrollable aspect to testing outside in Ireland, because a strong wind could have had the potential to increase the difficulty of the kick for the participant and then that would give the study a false result. While this was not an issues in the study presented here future studies should seek to replicate the same testing on a uniform pitch in similar weather conditions, while possibly implementing procedures around weather constraints.

Another limitation of this study was the time it took to complete both tests. Each test took approximately 18 minutes and 30 seconds. The time to do each test could present challenges for coaches in the LGF. Volunteer coaches are already under a time constraint to get their training drills done in a specific time, which means if they were to do these tests correctly,

they would only get max 3 participants done during training. This means it could take a long time to get their whole team done if they were doing it themselves during training. When comparing the results of the controlled vs randomised test, it was found to be non-significant. This means even though each test will take just over 18 minutes, coaches should only have to do one test per player instead of two.

While beyond the scope of the current study, future studies should seek to consider physiological factors into account when replicating the assessment, for example, collecting information related to nutritional status of players, prior to testing, additionally a time of day range for the completion of the test, to inform if diurnal variation was a potential limitation with data collection

Study one also used a small sample size to analyse kicking in LGF. The sample size for the current study was fifteen games. Future research should look at expanding their sample size to be larger and more diverse. An example of diversity would be to analyse games from each level of the Intercounty All Ireland series, i.e. Junior, Intermediate and Senior, as this would show if there are any differences in kicking accuracy across the different levels of Ladies Gaelic Football. Another benefit of having a larger sample size would be to have more analysis that represents the LGF population by potentially having more data that represents both dominant left footed kickers and dominant right footed kickers.

Future research in this area should be aimed towards creating simple and effective tools that can be used for coaches at every level of Ladies Gaelic Football. These tools should help coaches see where their players skill level currently at so they can use specific drills to improve the skills that need to be improved. To conclude, this study is important for LGF as it provides a tool that is very easy to replicate at any level i.e., Intercounty or club level.

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Appendices

Appendix A – Plain Language Statement

Plain Language Statement

Bilateral Kicking Accuracy performance in Female Gaelic Football

Principal Researcher: Dr Davide Susta – davide.susta@dcu.ie – (01) 700 4782

Student Researcher: Lauren Gilsenan – Lauren.gilsenan4@mail.dcu.ie – (086) 245 1499

School of Health and Human Performance, Dublin City University

Aim of Study: To compare the accuracy of kicking a Gaelic Football from the dominant and non-dominant foot and to see which angle is best suited to dominant right and left footed players.

If you agree to participate in this study, you will be required to take part in a task before one of your usual training sessions. This testing will take approximately 25 minutes and you will be given clear instructions throughout the testing. There is no time limit for completing the test.

Testing Procedure:

- The study will be conducted in the University football pitch. Usual GAA gear is required.
- 2 tests per player is required. The first test will be in order from Cone A to E. the second test will be randomized cones until complete.
- Each testing will take approximately 25 minutes.
- In total, you will be required to kick 50 footballs per test
- You will be required to punt kick 5 footballs from each of 5 cones at various angles from the goal and your score will be recorded out of 5 for each.
- You will first complete this using your dominant kicking foot. You will then have a 2-minute break.

- You will be required to follow the same procedure again using your non-dominant kicking foot.
- You will be given your results on completion of the test.

Benefits of Testing: You will be given your results at the end of the test. These results can be used to determine if any additional training is required on either your dominant and/or non-dominant leg and the best scoring position for you.

Risks of Testing: Participation in this testing is very low risk. A 10-minute warm up will be done beforehand to reduce any injury risk. In the unlikely event of injury, there are staff present that will deal with any injury which occurs.

Your Consent:

This Plain Language Statement contains detailed information about the research project. Its purpose is to explain to you as openly and clearly as possible all the procedures involved in this project before you decide whether or not to take part in it.

Please read this Plain Language Statement carefully. Feel free to ask questions about any information in the document. You may also wish to discuss the project with a relative or friend. Feel free to do this. Once you understand what the project is about and if you agree to take part in it, please sign the Consent Form and return it to one of the researchers. By signing the Consent Form, you indicate that you understand the information and that you give your consent to participate in the research project.

You will be given a copy of the Plain Language Statement and Consent Form to keep as a record.

Data Protection: All of the participants information will be securely stored. The results obtained from this study will be used for an Undergraduate Final Year Project and may be published in academic journals. This data will be retained for 12 months under university regulations for examinations and disposed of by a named investigator after its retention period.

Information will be presented as a group and you will not be identified in this study by name. Confidentiality of information can only be protected within limitations of the law. It is possible for data to be subject to subpoena, freedom of information claim or mandated reporting by some professions.

By partaking in this study, you are participating on a voluntary basis. You can withdraw from this study at any time during the process. There will be no penalties for withdrawal before the completion of this study.

If you have any questions at any time, please contact any of the researchers

OR

If you want information on where the results of this research have been published, this information will be provided once you email either of the researchers indicated above.

If participants have concerns about this study and wish to contact an independent person, please contact:

The Secretary, Dublin City University Research Ethics Committee, c/o Research and Innovation Support, Dublin City University, Dublin 9. Tel 01-7008000, e-mail **rec@dcu.ie**

Appendix B – Consent Form

Declaration of Informed Consent

Project Title: Bilateral Kicking accuracy performance in Female Gaelic Football

Principal Investigators: Dr. Davide Susta – davide.susta@dcu.ie

Student Investigators: Lauren Gilsenan – lauren.gilsenan4@mail.dcu.ie

Institution: School of Health and Human Performance, Dublin City University

Please Complete the Following (circle Yes or No for each question):

I have read the Plain Language Statement (or had it read to me)	*Yes/No*
I understand the information provided	*Yes/No*
I have had an opportunity to ask questions and discuss the study	*Yes/No*
I have received satisfactory answers to all my questions	*Yes/No*
I have informed the investigators of any medical conditions	*Yes/No*

All information collected will be securely stored with only the named investigators having access to this data. The results of this data will be used for a Masters thesis and may be disseminated into the scientific community e.g. meetings, journals

Confidentiality can only be protected within the limits of the law. It is possible for data to be subject to subpoena, freedom of information claim or mandated reporting by some professions.

I understand that my participation in this study is voluntary, and I may withdraw from this Research Project at any time.

I have read and understood the information in this form. My questions and concerns have been answered by the researchers, and I have a copy of this consent form. Therefore, I consent to take part in this research project.

Participants signature: _____

Name in Block Capitals: _____

Witness: _____

Date: _____

Appendix C – Data Collection Sheet

Date: _____

Name: _____

ID: _____

LGFA Career: _____

Birthday: _____

Player Position: _____

Level: ☐ Club

☐ College/University

Intercounty ☐

Controlled Order (A-E):

Dominant Leg: **Non-Dominant Leg:**

	A	**B**	**C**	**D**	**E**		**A**	**B**	**C**	**D**	**E**
Trial 1						Trial 1					
Trial 2						Trial 2					
Trial 3						Trial 3					
Trial 4						Trial 4					
Trial 5						Trial 5					
Total:						**Total:**					

Randomised Order:

Dominant Leg: **Non-Dominant Leg:**

	A	**B**	**C**	**D**	**E**		**A**	**B**	**C**	**D**	**E**
Trial 1						Trial 1					
Trial 2						Trial 2					
Trial 3						Trial 3					
Trial 4						Trial 4					
Trial 5						Trial 5					
Total:						**Total:**					

Appendix D – Notational Performance Analysis

	DCU									UL							
	Pass	Point	Goal	Kickout	Left	Right	Free	Penalty		Pass	Point	Goal	Kickout	Left	Right	Free	Penalty
1st half	26/32	19/15	1/1	7/8	5/5	38/51	7/8	0		27/35	5/12	0/1	9/12	10/13	27/47	8/8	0
2nd half	16/20	6/9	2/5	4/5	4/6	24/33	6/7	1/1		16/23	2/7	0	8/11	5/8	27/39	6/8	0
Total	42/52	15/24	3/6	11/13	9/11	62/84	13/15	1/1		43/58	7/19	0/1	17/23	15/21	54/86	14/16	0

	DCU (A)									UCD							
	Pass	Point	Goal	Kickout	Left	Right	Free	Penalty		Pass	Point	Goal	Kickout	Left	Right	Free	Penalty
1st half	13/20	6/12	3/3	10/11	6/8	26/38	5/6	0		22/26	7/11	1/1	9/12	2/7	37/43	9/10	0
2nd half	18/20	5/11	0/2	5/6	3/5	25/34	5/7	0		20/28	3/5	2/2	9/10	0	34/45	8/8	0
Total	31/40	11/23	3/5	15/17	9/13	51/72	10/13	0		42/54	10/16	3/3	18/22	2/7	71/88	17/18	0

	DCU									DIT							
	Pass	Point	Goal	Kickout	Left	Right	Free	Penalty		Pass	Point	Goal	Kickout	Left	Right	Free	Penalty
1st half	25/33	5/12	0	9/11	6/10	33/46	9/11	0		20/27	6/9	3/5	3/9	8/11	24/39	5/6	0/1
2nd half	22/29	2/5	1/2	5/7	1/2	29/41	5/6	0		36/46	1/5	4/6	4/6	9/12	36/51	9/12	0
Total	47/62	7/17	1/2	14/18	7/12	62/87	14/17	0		56/73	7/14	7/11	7/15	17/23	60/90	14/18	0/1

	DCU									UCC							
	Pass	Point	Goal	Kickout	Left	Right	Free	Penalty		Pass	Point	Goal	Kickout	Left	Right	Free	Penalty
1st half	25/29	4/7	0/3	6/11	6/10	29/40	11/12	0		21/27	8/11	1/2	4/5	2/3	32/42	14/16	0
2nd half	18/20	5/11	1/2	4/5	3/5	25/33	8/11	0		13/17	1/4	1/1	9/13	1/1	23/34	5/7	0
Total	43/49	9/18	1/5	10/16	9/15	54/73	19/23	0		34/44	9/15	2/3	13/18	3/4	55/76	19/23	0

	DCU (A)									UCD							
	Pass	Point	Goal	Kickout	Left	Right	Free	Penalty		Pass	Point	Goal	Kickout	Left	Right	Free	Penalty
1st half	29/40	4/7	0/1	7/9	3/5	37/52	10/13	0		25/30	5/12	1/1	6/7	1/2	36/48	9/11	0
2nd half	19/23	4/10	1/1	9/11	4/8	29/38	10/12	0		23/24	7/9	1/1	6/10	1/2	36/43	9/9	0
Total	48/63	8/17	1/2	16/20	7/13	66/90	20/25	0		48/54	12/21	2/2	12/17	2/4	72/91	18/20	0

	CAVAN									KERRY							
	Pass	Point	Goal	Kickout	Left	Right	Free	Penalty		Pass	Point	Goal	Kickout	Left	Right	Free	Penalty
1st half	31/40	6/14	0	12/14	9/15	40/53	5/8	0		25/29	7/11	2/6	3/10	6/8	31/48	11/11	0
2nd half	23/33	7/14	0/1	8/12	4/5	34/55	10/13	0		32/40	5/11	2/3	7/10	5/9	41/54	11/13	0
Total	54/73	13/28	0/1	20/26	13/20	74/108	15/21	0		57/69	12/22	4/9	10/20	11/17	72/102	22/24	0

	ARMAGH									CORK							
	Pass	Point	Goal	Kickout	Left	Right	Free	Penalty		Pass	Point	Goal	Kickout	Left	Right	Free	Penalty
1st half	35/43	4/10	0/2	9/12	18/29	30/28	10/12	0		20/22	5/12	1/1	8/9	5/6	29/38	8/8	0
2nd half	17/23	5/7	4/5	8/11	16/21	18/25	6/8	0		22/26	6/12	2/3	8/11	0	38/52	9/11	0/1
Total	52/66	9/17	4/7	17/23	34/50	48/53	16/20	0		42/48	11/24	3/4	16/20	5/6	67/90	17/19	0/1

	GALWAY									WATERFORD							
	Pass	Point	Goal	Kickout	Left	Right	Free	Penalty		Pass	Point	Goal	Kickout	Left	Right	Free	Penalty
1st half	22/26	6/11	1/1	7/8	5/8	31/38	11/12	0		14/20	4/8	1/1	8/10	0/1	27/38	7/8	0
2nd half	20/23	6/12	0	1/2	8/11	19/26	4/5	0		20/25	0/2	1/1	8/9	1/1	28/36	10/11	0
Total	42/49	12/23	1/1	8/10	13/19	50/64	15/17	0		34/45	4/10	2/2	16/19	1/2	55/74	17/19	0

	DUBLIN									MAYO							
	Pass	Point	Goal	Kickout	Left	Right	Free	Penalty		Pass	Point	Goal	Kickout	Left	Right	Free	Penalty
1st half	20/23	5/10	1/2	12/14	0	38/50	7/7	0/1		18/21	5/14	0	10/10	4/4	29/41	10/13	0
2nd half	21/26	5/9	2/3	6/8	0/1	34/45	8/10	0		21/28	5/13	0	12/13	4/4	34/50	10/15	0
Total	41/49	10/19	3/5	18/22	0/1	72/95	15/17	0/1		39/49	10/27	0	22/23	8/8	63/91	20/28	0

	UL									UCD							
	Pass	Point	Goal	Kickout	Left	Right	Free	Penalty		Pass	Point	Goal	Kickout	Left	Right	Free	Penalty
1st half	17/22	9/12	0/2	3/7	5/6	24/37	9/12	0		23/31	5/10	0/1	9/10	9/12	28/40	11/12	0
2nd half	29/33	7/12	1/2	7/10	11/14	33/43	10/11	0		14/19	5/9	1/3	7/11	5/9	22/33	7/10	0
Total	46/55	16/24	1/4	10/17	16/20	57/80	19/23	0		37/50	10/19	1/4	16/21	14/21	50/73	18/22	0

	UL									DCU							
	Pass	Point	Goal	Kickout	Left	Right	Free	Penalty		Pass	Point	Goal	Kickout	Left	Right	Free	Penalty
1st half	17/21	7/11	0/2	9/12	4/7	29/40	13/14	0		28/34	7/15	0	9/10	2/3	42/56	5/6	0
2nd half	10/13	10/13	0/1	8/8	8/11	20/24	13/15	0		32/35	5/8	1/1	11/13	1/2	48/55	13/15	1/1
Total	27/44	17/24	0/3	17/20	12/18	49/64	26/29	0		60/69	12/23	1/1	20/23	3/5	90/111	18/21	1/1

	DONEGAL									MONAGHAN							
	Pass	Point	Goal	Kickout	Left	Right	Free	Penalty		Pass	Point	Goal	Kickout	Left	Right	Free	Penalty
1st half	30/36	5/10	1/5	12/13	22/24	26/40	10/13	0		26/33	9/13	0/2	8/12	14/18	29/42	10/11	0
2nd half	24/32	6/12	1/3	10/12	17/26	25/33	7/9	0		29/33	6/13	0/2	10/12	8/12	37/48	11/13	0
Total	54/68	11/22	2/8	22/25	39/50	51/73	17/22	0		55/66	15/26	0/4	18/24	22/30	66/90	21/24	0

	KERRY									DONEGAL							
	Pass	Point	Goal	Kickout	Left	Right	Free	Penalty		Pass	Point	Goal	Kickout	Left	Right	Free	Penalty
1st half	14/22	2/6	0/3	5/9	2/8	19/32	7/9	0		30/35	6/9	0/5	7/7	7/9	36/47	10/10	0/1
2nd half	13/16	4/8	2/5	7/12	4/5	22/36	9/10	0		28/31	6/14	0	4/6	4/7	34/44	10/12	0
Total	27/38	6/14	2/8	12/21	6/13	41/68	16/19	0		58/66	12/23	0/5	11/13	11/16	70/91	20/22	0

	KERRY									WATERFORD							
	Pass	Point	Goal	Kickout	Left	Right	Free	Penalty		Pass	Point	Goal	Kickout	Left	Right	Free	Penalty
1st half	24/31	5/14	0	4/4	6/12	26/37	9/11	0		8/17	3/4	1/1	11/12	12/13	11/21	6/9	1/1
2nd half	14/16	8/13	1/1	7/9	7/7	23/32	7/7	0		12/16	3/9	0/2	7/13	7/15	15/25	7/9	0
Total	38/47	13/27	1/1	11/13	13/19	49/69	16/18	0		20/33	6/13	1/3	18/25	19/28	26/46	13/16	1/1

	GALWAY									MAYO							
	Pass	Point	Goal	Kickout	Left	Right	Free	Penalty		Pass	Point	Goal	Kickout	Left	Right	Free	Penalty
1st half	32/39	7/12	3/5	4/4	17/21	29/39	15/16	0		19/28	4/5	0	15/17	1/2	37/49	10/11	0
2nd half	23/28	4/8	0	5/9	6/8	26/37	12/16	0		10/14	4/14	1/2	5/7	2/2	18/35	7/12	0
Total	55/67	11/20	3/5	9/13	23/29	55/76	27/32	0		29/42	8/19	1/2	20/24	3/4	55/84	17/23	0