ASSESSING PLAYER PERFORMANCE IN AUSTRALIAN FOOTBALL USING SPATIAL DATA

Karl Jackson

A thesis presented for the fulfillment of the requirements

for the degree of Doctor of Philosophy

at Swinburne University of Technology

2016

Abstract

This thesis creates a new method for assessing player performance in Australian football, specifically for an application to the Australian Football League (AFL).

Data have been captured by Champion Data as the official statistics provider to the AFL since 1999. More than 100 event types are recorded for each game, such as possessions, disposals, tackles and goals. Up to 50 variables are available to describe the context, quality and location of such events.

A full investigation of this information was performed to extract relevant traits of the data, and to improve on existing methods of analysis and available knowledge within the industry. Two outcomes of this exploratory analysis were a visual representation of data through the use of heatmaps, and a new measure for kicking ability called 'kick rating'. Heatmaps have been used by AFL clubs since 2008 as a way of communicating information to players and extracting information about team and player tactical traits. Kick ratings have been used by AFL clubs since 2011 as a development tool for their own players, and for scouting of opposition players.

The data were also compiled into a player performance measure ('Equity Ratings'), where the spatial locations of each event acted as a basis for evaluation. For each event, the rating system calculates the equity of the player's team before and after the event to measure the objective contribution that the event made to a team's position.

Players who consistently improve the position of their team are rewarded with a large positive rating. Worsening the position of the team results in a negative rating. In this manner, the quality of a player's involvements will be considered more important than previous rating systems which placed more emphasis on the quantity of a player's involvements in a game.

Equity Ratings proved to be the most comprehensive measure of player performance that has been applied to AFL - showing decreased bias towards midfield players and a higher correlation to match results. A cross-season evaluation of player performance was then compiled to assess long-range performance. This combined measure has been adopted by the league as the 'Official AFL Player Ratings', hosted on the official website of the league (afl.com.au) and through the League's official mobile and tablet apps.

Acknowledgements

I would first like to thank my primary supervisor Denny Meyer for the patience and guidance she showed throughout the completion of this thesis. What was initially planned as a three-year research project eventually stretched across nine years. Stephen Clarke should also be recognised as my original supervisor, whose retirement easily beat me to the finish line. Stephen's link in the early years with Champion Data is the only reason this project was possible through Swinburne, which should also be acknowledged.

Most of the AFL team at Champion Data had strong contributions to this research through validity and 'footy-smarts' testing of models, development of commercial products and collection of raw data.

My parents, Barry and Diane Jackson, also showed great patience and persistence in encouraging completion, even to the point of asking "How is your thesis going?" consistently in the four years that elapsed when I had abandoned the research.

Thank you.

Declaration of Authorship

This thesis is presented to fulfil the requirements of a Doctor of Philosophy at Swinburne University of Technology. I hereby declare that this thesis and the work presented in it is entirely my own. No other person's work has been used without due acknowledgement in this thesis. All references and verbatim extracts have been quoted, and all sources of information, including graphs and data sets, have been specifically acknowledged.

Karl Jackson

April 20, 2016

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Executive Summary

The main outcome of this research was to establish a new method for assessing player performance in the Australian Football League. This assessment takes place in two phases:

1. **Equity Ratings** to measure the performance of players within a game.
2. **AFL Player Ratings** to measure long-range performance of players.

Equity Ratings

Equity Ratings go far beyond any previously-existing player rating systems for the AFL by including the spatial locations of events to measure their impact. Several years of spatial data on AFL matches from Champion Data were used to calculate the 'equity' of possession at the point where possession was taken. This equity is the expected value of the next score in the game and can take on values from +6.0 (team is certain to score a goal) to -6.0 (opposition is certain to score a goal). If both teams are equally likely to score from a given situation, this will have zero equity. At every point on the ground equity is calculated for six possible phases of possession:

1. Set Position
2. Uncontested Possess
3. Looseball Get

4. Hardball Get

5. Marking Contest

6. Ground-level Contest

These equity gradients then form the basis of measuring the impact of each player's recorded contributions to a game, comparing the actual result of his action to the equity before his action.

Change in Equity Rating = Final Equity - Starting Equity

Examples

The following examples show how the outcome and location of events affects a player's score in different situations.

Example 1 - Kick-ins The equity of a kick-in is -0.5 points, meaning the defending team is slightly more likely to be the next team to score. Kicking to a teammate short on the boundary line leaves the team just as far from goal, so there is no change in equity. Kicking 50m to the boundary line and finding a teammate via an uncontested mark results in a final equity of 0.0 points, so the kick-in player is rewarded with +0.5 points towards his Equity Rating. Kicking 50m to the corridor and finding an uncontested mark results in a final equity of 0.8 points, meaning the kick-in player receives +1.3 points.

If the kick-in player can't find an uncontested teammate and decides to kick to a marking contest, he would need to kick the ball 80m down the boundary line or 70m through the corridor in order to break even with his starting -0.5 points equity from the defensive goal square. This takes into account the risk of losing the marking contest and the likelihood that the opposition will score next in that situation.

Example 2 - Shots at Goal After taking a mark 20m from goal, directly in front, the team's equity is roughly 5.0 points. Kicking a goal from this point adds six points to the scoreboard, so the goal kicker receives one point towards his Equity Rating.

Kicking a behind adds one point to the scoreboard and gives the opposition the ball via a kick-in. The equity for the opposition at a kick-in is -0.5, meaning the team kicking the behind essentially gets an average of 1.5 points per behind kicked, rather than just the one point added to the scoreboard. So, despite the team being expected to score 5.0 points on average, they have instead added just 1.5 points, meaning the kicking player loses 3.5 points from his Equity Rating.

Missing altogether and kicking the ball out on the full still gives the opposition the ball in a negative situation, meaning a final equity of +0.5 points, but a loss of 4.5 points from his Equity Rating.

If the shot was taken from 50m out directly in front, this would have an equity of 3.0 points, meaning +3.0 points for kicking a goal, -1.5 for kicking a behind and -2.5 for kicking the ball out on the full.

Example 3 - Hardball Get and Disposal At a centre bounce, both teams have an equal chance of winning possession so the equity is zero for both teams. Winning a hardball get immediately puts the team at a slight advantage, and the player will receive roughly +0.6 points. Handballing to a teammate forward of the contest improves this advantage, gaining the handballing player a further +1.0 points for a total of +1.6 points.

Had he missed the target with his handball and sent the ball back into dispute, this would be a worse position for the team than after his hardball get, losing him roughly 0.4 points for a net return of just +0.2 points.

Kicking forward 40 metres to a marking contest results in a final equity of 1.5 points - similar to a short handball to a teammate. Kicking forward

40 metres and finding a teammate uncontested results in a final equity of 3.5 points - more than double the value of kicking to a marking contest.

Example 4 - Spoils Spoiling the ball out of a marking contests prevents the opposition taking a mark. A marking contest in the defensive goal square means a high likelihood that the opposition will score next, with an equity of -3.0 points. If the defensive player can bring the ball to ground level, this improves the team's equity to -2.0 points, so the player is awarded +1.0 points.

Results

The average score recorded by players is 9.5 points, with 95% of players scoring below 20.0 points. The best game recorded from 2010 to 2015 was 50.5 points for Lance Franklin's 13-goal game in 2012.

Players who use the ball well, especially in the forward half of the ground, are rewarded with high scores. Likewise, winning the ball off the opposition, directing hitouts to a teammate, and winning possession when the ball is in dispute are all well rewarded in Equity Ratings.

Players turning the ball over in dangerous situations and those who have a poor accuracy in front of goal are penalised with low scores. High accumulators of possessions whose disposals are essentially neutral by simply maintaining possession also receive little reward.

AFL Player Ratings

The Official AFL Player Ratings, as hosted on the league's website (AFL.com.au), use a weighted sum of a player's single-game Equity Rating to give a perpetual score that adjusts over time. Each player's most-recent 40 games are included, with a restriction that they were played within the previous two-year period.

The most recent 30 games receive full weight towards a player's overall score, while games 31 through 40 receive 100%, 90%, ..., 10% of weight. As such, there is a buffer of at least four games where a player can miss through injury or suspension without being penalised with a reduced score.

Equity Ratings can be calculated for games from 2010 forward, meaning that AFL Player Ratings can be calculated from the start of 2012, when two seasons of Equity Ratings are available. From the start of 2012 until midway through 2015 Gary Ablett was the No.1 player overall, with two season-ending injuries in successive years contributing to him being overtaken.

The highest score Gary Ablett reached before his first injury was 766.0 points during the 2013 season, the equivalent of 21.6 Equity Rating points per game. The next-highest score achieved by any other player is Scott Pendlebury's 698.7 points during 2014 - equivalent to 19.7 points per game - making Ablett's peak nearly 10% higher than any of his rivals.

Pendlebury was the player to overtake Ablett, but he was subsequently overtaken by Nat Fyfe, who remained No.1 to the end of the 2015 season.

Thesis Outline

- Chapter 1 will introduce the reader to background information relevant to this research. A full list of the contributions to knowledge will be presented. The game of Australian Football will be explained, and existing player rating systems in the sport will be discussed.
- Chapter 2 will review the relevant literature, focusing on the application of maths to Australian football and to player rating systems in the Australian Football League and in other team sports.
- Chapter 3 will give a detailed explanation of the available data and how it is collected by Champion Data.
- Chapter 4 contains exploratory analysis of the data, including a data visualisation tool to be applied to Australian football, and a metric to assess a player's kicking ability.
- Chapter 5 will introduce the concept of Field Equity, which forms the basis of this research. Previous results will be verified against a new data set.
- Chapter 6 contains a pilot rating system using the Field Equity results calculated in Chapter 5.
- Chapter 7 details the calculation of a more robust measure for Field Equity.
- Chapter 8 gives a full breakdown of how Field Equity calculations will be used to measure player performance.

- Chapter 9 investigates the results of the player performance measure, labelled Equity Ratings, with comparisons to other systems.
- Chapter 10 outlines the implementation of the player rating system within industry, combining single-match performance measures into a long-range performance measure called AFL Player Ratings. Case studies will be used to investigate the performance of selected players.
- Chapter 11 documents some potential further uses of the player rating system beyond a singular measure of performance.
- Chapter 12 outlines the contributions of this thesis and provides suggestions for future work.
- Appendix A is a full glossary of terms relevant to the research and the game of Australian football.
- Appendix B has a full list of every rated player at the conclusion of the 2015 Australian Football League season, ordered by their standing in the AFL Player Ratings.

Chapter 1

Introduction

This research was the result of an increase in the depth of data recorded for Australian Football League (AFL) games in 2006. The official statistics provider, Champion Data, began recording the locations of events within games and sought to improve the use of this information and to develop new products.

The initial scope was to create a detailed and accurate player rating system, but data visualisation methods and other metrics were also created.

1.1 Contribution to Knowledge

In performing an exploratory analysis of the data collected on Australian football games, strategic opportunities will be opened up to AFL clubs. Identifying trends of team tactics through spatial data can translate to potential changes in team tactics and training methods to better suit opposition game styles.

Heatmaps will be introduced to Australian football as a data visualisation tool. They will help to identify player and team tendencies, and will have application to coaching and player game plans.

A new measure of kicking ability will be introduced that takes into account the expectation on the kicking player. This will improve on previous measures of a player's kicking ability where only the outcome is used. This will have applications to coaching, knowing how often certain kicks are being attempted in the AFL, and the expectation on the kicking player in each situation.

As its primary focus, this research seeks to create a new method for evaluating player performance in Australian football. This will be done by incorporating spatial information to measure not only what happened, but where it happened. By utilising this spatial information we will have a better understanding of the expectation of player performance in certain situations, placing measurable values on outcomes that were previously ambiguous. This is the first time that spatial data, and information on the pressure applied to players, has been incorporated into a measure of player performance in Australian football.

This new player rating measure will be shown to be significantly better at judging players across playing positions, with less bias towards midfield players. The rating system also shows near-perfect correlation to the scoreboard margin of games, indicating that events have been accurately assessed in terms of contribution to the final result.

1.2 Catalyst for Research

In 2006, Joel Bowden of the Richmond Football Club finished the season as the third-highest scoring player in Champion Data's ranking points formula. He had previously also been the third-highest scoring player in the 2004 season. Though Bowden was a dual best-and-fairest-winner at Richmond (2004-2005) and a dual All-Australian-player (2005-2006), the general consensus within Champion Data was that this placing was too high.

Bowden was a player who played in the defensive half and was known for

a high volume of possession. He led the competition in effective kicks and rebound 50s in 2006. He had the best disposal efficiency of the top-50 ball winners, but just four of his 495 disposals for the season were won in the forward half and he had the 15th-lowest contested possession rate of the same group.

Prior to 2004, most teams employed a long-kicking strategy, meaning the majority of kicks had a high impact on the state of the game. In the 2004 season we started seeing teams kicking short (less than 40m) more often than kicking long, which hadn't been seen in modern times.

From 1999 to 2004, the seven lowest figures observed for percentage of kicks sent long at team level were by 2004 teams, and 10 of the 14 lowest. The premiers from that year (Port Adelaide) had the lowest percentage at 49.1%, which may have helped accelerate the change towards short kicking.

The yearly competition averages for percentage of effective kicks sent long are shown in Figure 1.1, highlighting this increasing in short kicking from 2004. Distances on ineffective and clanger kicks were not recorded until the 2010 season.

From this point forward, raw counts of kicks and disposals became less useful than they had been in the past, with more players looking for short options, and starting to kick backwards as a way of maintaining possession.

In 2006, the AFL's official statisticians Champion Data started recording the location of events. In addition to being able to view maps of a player's involvements or team events, new metrics were introduced to the industry. The two main metrics introduced were:

1. Metres Gained:

    - The distance towards goal gained from possession and disposal of the football.

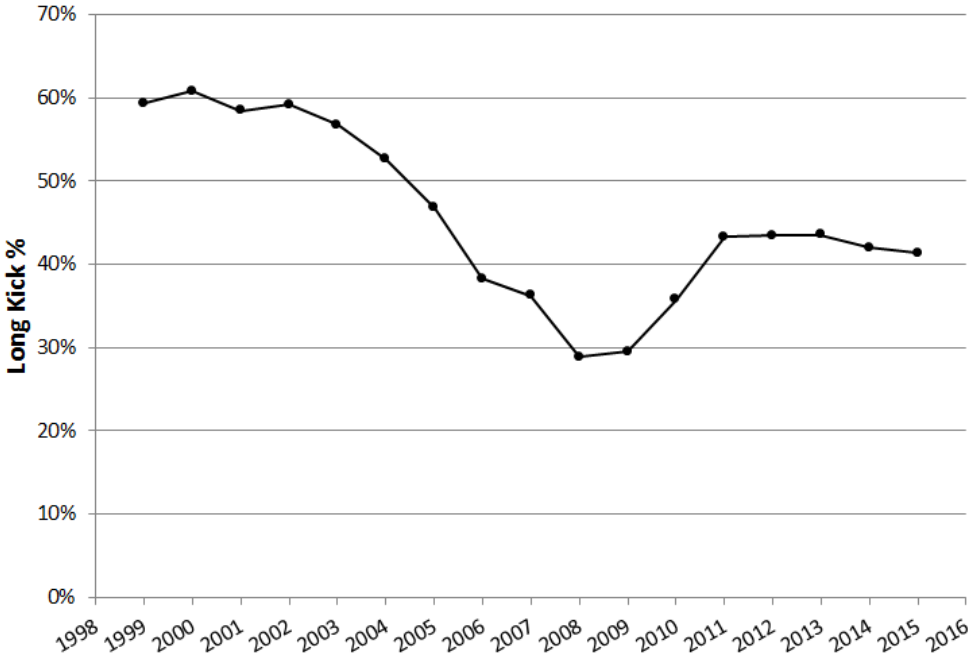


Figure 1.1: Percentage of effective kicks sent long (over 40m) by year.

2. Midfield Ball Movement:

    - Breakdown of midfield possessions into corridor, wing and boundary to give an indication of ball movement patterns.

3. Split Midfield:

    - Increasing the number of field zones from three (forward 50, midfield and defensive 50) to four (forward 50, attacking midfield, defensive midfield, and defensive 50) by splitting the midfield at the halfway line.

More detailed measures and better representations of the spatial information were sought to build on the success of these initial metrics. In particular, a major focus of this project was to leverage the new information to put a spatial context on top of existing statistics.

Due to the counting nature of existing player rating systems, events that put teammates into scoring positions are often treated the same as events that bear little to no impact on the final result.

As such, many players were incorrectly rated, mostly due to:

- Overvaluing neutral contributions, especially in the defensive half.
- Undervaluing positive contributions, especially in the forward half.

By taking into account the location of each event and the subsequent result, we have a better understanding of the impact of that event to the team's position, which we hope will translate to a more accurate measure of the player's performance.

1.3 Australian Football

This section is intended to be a short introduction to the sport of Australian football, starting with the origin and early development of the game before explaining some of the basic rules.

1.3.1 History

Originally developed as a way for Australian cricketers to keep fit during the winter months, Australian football has since grown to become one of the most popular sports in Australia [41].

The first recorded game of Australian football was in 1858 [8], between two Melbourne high schools - Scotch College and Melbourne Grammar School.

After a steady increase in interest around the Melbourne and Geelong areas, the Victorian Football League (VFL) was established in the late 1800s with eight foundation clubs - Carlton, Collingwood, Essendon, Fitzroy, Geelong, Melbourne, St Kilda and South Melbourne.

State leagues were also established in South Australia (SANFL) and Western Australia (WAFL) around the same time.

The VFL competition grew in 1908 with the introduction of Richmond and University (who later withdrew after the 1915 season) and with Footscray (now known as the Western Bulldogs), Hawthorn and North Melbourne being added in 1925.

The game took its first steps towards a national competition in 1982, when VFL foundation club South Melbourne relocated to the Rugby League stronghold of Sydney to become known as the Sydney Swans. In 1987, this expansion continued with two additional non-Victorian clubs - the Brisbane Bears and the West Coast Eagles (based in Perth). Two years later, to better accommodate the nationalisation of the game, the VFL was renamed the Australian Football League (AFL).

By 2012, the national expansion of the game was complete and the competition took on its modern look, with the Fitzroy Lions merging with the Brisbane Bears to become the Brisbane Lions and with additional teams Adelaide (added in 1991), Fremantle (1995), Port Adelaide (1997), Gold Coast (2011) and Greater Western Sydney (2012).

The current competition involves these 18 teams playing 22 games in 23 rounds (with one bye), known as the 'home and away (H&A) season', running from March to August (the Autumn and Winter seasons in Australia). The top 8 teams at the conclusion of the home and away season then compete in the finals series in September-October, which ultimately leads to two teams contesting the AFL grand final where the winner is crowned the season's champion.

1.3.2 Rules and Terminology

Australian football is similar to other invasion sports in that the primary aim is to outscore the opposition by moving the ball through goals placed at the end of the field.

Australian football is played on a oval field (often used for cricket in the summer months) with an oval shaped ball, similar to those used in rugby league, rugby union and in American football.

There is no offside rule, meaning all players can use the entire playing area without restriction, which results in an open and fast-moving contest. Each team contains 22 players, with 18 being allowed on the field at any one time.

The game is split into four quarters, with each consisting of twenty minutes of game time. The clock is stopped when the ball is out of play, so each quarter generally lasts 27-31 minutes in real time.

The playing area is marked with:

Boundary line	Contains the playing area.
Goal Posts	The scoring area.
Centre square	Only four players per team are allowed inside the square at a centre bounce restart.
Centre circles	One player from each team starts within the bigger circle but outside the smaller circle
Goal square	Restarts after opposition minor scores must be taken from inside this area.
50m arc	Acts as a guide for typical scoring range.

Figure 1.2 shows an example of field markings, as displayed in the official Laws of the Game [42].

The area enclosed by the 50m arc and the boundary line is referred to as the 'Forward 50' at the attacking end of the ground and the 'Defensive 50' at the defensive end of the ground. The remaining area between the two arcs is known as the 'Midfield', which can be further split at the halfway line to give two zones - the 'Defensive Midfield' and the 'Attacking Midfield'.

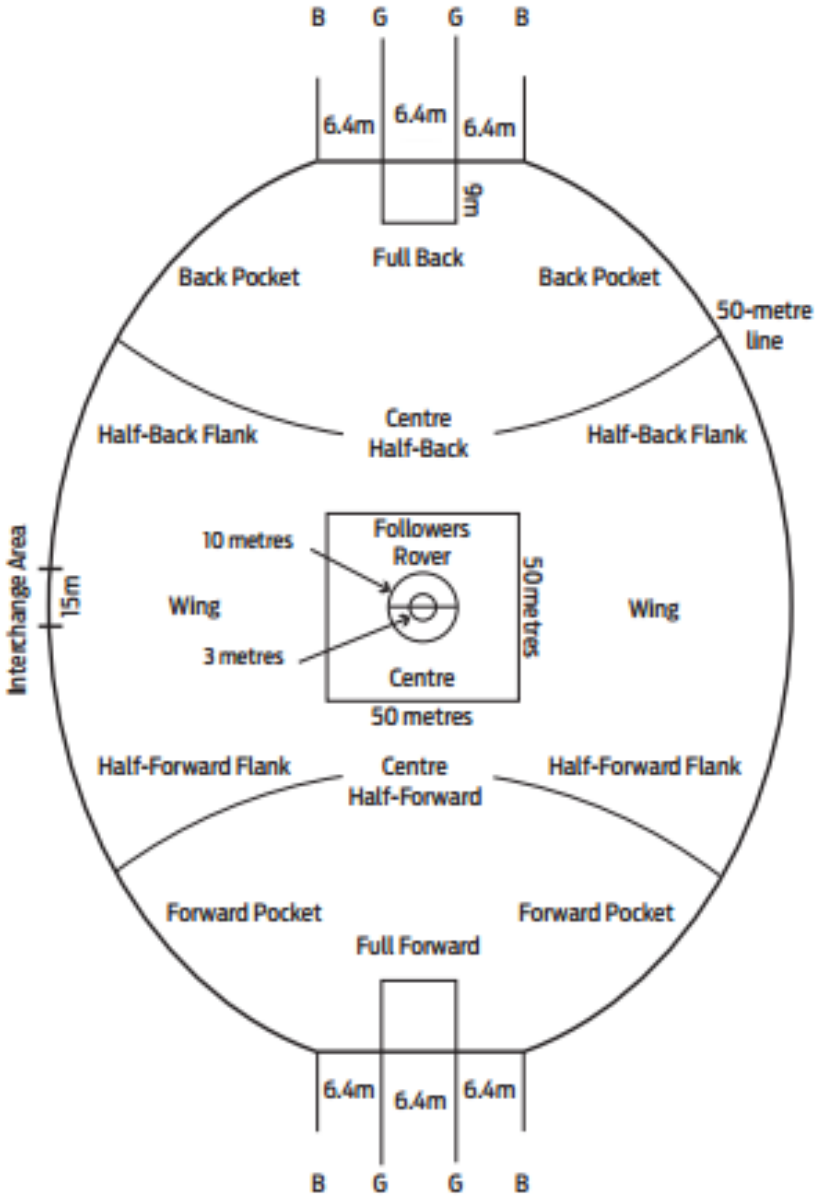


Figure 1.2: The playing area for Australian football

In order to score, the ball must be passed between the posts at the end of the ground. The goal line is defined as the line between the two goal posts (G) and the behind lines are defined as the two lines between either behind post (B) and the adjacent goal post. Scoring then occurs in the following situations:

- Goal (6 Points): The attacking team kicks the ball over the goal line.
- Behind (1 Point):

- The attacking team kicks the ball over one of the behind lines.
- The ball hits or travels directly over either of the goal posts.
- The ball travels over either the goal line or the behind lines, but was touched by another player or last contact with the ball was not made with the foot.
- The defensive team forces the ball over either the goal line or the behind lines (known as a rushed behind).

Unlike most sports, when the ball is out of play in Australian football, it is generally returned to play in a disputed situation. The following list gives some examples of how play is restarted.

1. At the start of each quarter and after a goal is kicked the ball enters play via a **centre bounce** where the umpire bounces or throws the ball in the air similar to a jump-ball in basketball. At this point only one player from each team is allowed to contest the ball from within the centre circle and only three players are allowed inside the centre square.

2. Where the ball is considered dead, usually after a tackle prevents a player from releasing the ball, the ball is returned to play via a **ball-up**. A ball-up is similar to a centre bounces, but the ball is thrown up where it stopped and there is no restriction on player positions.

3. If a team kicks the ball out of bounds on the full, the opposition team gains possession via a free kick where the ball traveled out of bounds, known as a **boundary kick-in**

4. If the ball otherwise travels out of bounds it is returned to play by an umpire **throw-in** and the ball is thrown backwards over the umpires head to ensure there is no bias in the throw.

5. When a team registers a behind (one point), the opposition gains possession via a free kick to be taken from within the defensive goal square, known as a **kick-in**

When a player hits the ball out of the air from a centre bounce, ball-up or throw-in it is called a **hitout**.

A player in possession of the ball can advance the ball by running with the ball or attempt to transfer possession to a teammate.

If a player runs with the ball, it must come in contact with the ground (usually by bouncing) every 15m.

Once in possession of the ball it can be transferred via a kick or fist (known as a **handball**). Throwing the ball is not allowed.

The combination of kicks and handballs is known as **disposals**.

Players in possession of the ball may be tackled by the opposition between the shoulders and the knees. If the ball is not released correctly when a player is tackled, that player may be penalised for holding the ball if they had prior opportunity to move the ball on.

Examples of other instances where a free kick can be awarded are for dangerous tackles (above the shoulders or below the knees) and for pushing a player in the back.

Essentially the same as a free kick, a **mark** is awarded if a player catches a kick (originating from either team) of longer than 15m on the full. Players have the option to play on after a mark has been awarded.

A full glossary of terms can be found in Appendix A.

Chapter 2

Literature Review

This chapter serves as an introduction to relevant literature on applications of mathematics in sport focusing on Australian football and player rating systems.

Nearly all sports are judged by a quantitative scoring mechanism, making links to mathematics, statistics and other quantitative fields a natural fit. Most of the early research in sports analsysis was restricted to sports with a history of data collection like baseball [1]. The rise of computers led to more sports having notational data available through the 1970s, 1980s and 1990s. In more recent times, however, this rise in data collection has been offset by the commercialisation of such data. The data collection process can be labour-intensive, leading to significant costs for data collection companies. These costs are recouped by exclusive licensing agreements for the hosting of statistics by third-party companies, limiting the amount of information that is freely available.

In addition to the restrictions placed on the general public through the commercialisation of data collection, sporting organisations restrict the publication of sensitive intellectual property that may give them a competitive advantage over other organisations. Due to this factor, we must treat any literature reviews in the field of sports with caution, noting that it is highly likely

that research has been undertaken that is not part of the public discourse.

Decisions on team selection, recruiting of players and coaching/managerial positions at sporting organisations are closely tied to team and player performance. Without an objective measure of said performances, any decision-making processes would be highly inefficient. The need for such measures was summarised by Hughes and Franks [28] where they say "Human memory systems have limitations, and it is almost impossible to remember accurately all the meaningful events that take place during an entire competition."

Research by Franks and Miller as far back as 1986 [21] found that novice soccer coaches recalled only 42% of key factors influencing a single match, even when given clear instruction on which factors to focus their attention on. This research was repeated by Laird and Waters in 2008 [30] on qualified coaches and found that though the recall was better than the novice coaches in the earlier research, the rate of recall was still just 59%.

2.1 Maths in Australian Football

Much of the published work in Australian football focused on predicting the results of games. Stefani and Clarke (1992) [55] showed the benefit of including home ground advantage in computer tipping and Clarke (1992) [15] showed that computer tipping comfortably outperformed human tipsters in the 1991 AFL season.

Bailey (2000) [3] showed that player traits, particularly the combined age and experience of players, had a significant role in the outcome of games, which was again shown by Bailey and Clarke (2004) [4] where match predictions were improved by accounting for the players selected in each game.

Live in-game predictions were developed by Forbes (2006) [19] using markov models, and Ryall (2008) [48] assessing the likely next team to score based on

current phases of play.

2.2 Player Rating Systems

A comprehensive overview of official rating systems in sport was written up by Stefani in 1997 [53] and updated in 2011 [54]. It was proposed that rating systems fell in one of three categories - subjective, accumulative, and adjustive. Subjective systems were based on judging of performances, such as in combat sports. Accumulative systems were the result of some weighted sum of individual performances, and adjustive systems were the result of performance above or below expectation based on previous ratings.

In all of the situations introduced, the rating system focused on the result-level of the sport - teams for team sports, and individuals for individual sports. In these cases we have a clear benchmark and test for any rating systems that are derived - match results. No evidence was presented for the rating of individuals within a team sport, where the performance of individuals may be decoupled from the overall match result.

Team sports live on a spectrum from discrete to continuous, depending on the rules and the structure of the games. At one end of the spectrum are discrete sports, where events are able to be isolated and there is a period of rest before the next play occurs. Examples of such sports are cricket and baseball. At the other end of the spectrum are sports with continuous gameplay, low rest time and no isolation of events between scores. Examples are Australian football and hockey. In the middle of the spectrum are sports with continuous play, but isolation of events does occur. Examples of these sports include American football, where each play is continuous but there is a rest period between plays, and rugby league, where after a tackle the defence is forced to retreat until the player in possession puts the ball back into play.

The complexity of measuring the impact of players in team sports depends

on where the sport lies on this spectrum.

On the difficulty in rating players in more continuous sports, Gerrard (2007) [22] suggested that the problem can be broken into three components:

- Tracking: Identification, categorisation and enumeration of events.
- Attribution: Allocation of individual contributions to joint and interdependent actions.
- Weighting: Determination of the significance of each action to the overall match outcome.

In many sports the first two components of the tracking problem are solved by official data collection processes, leaving only the enumeration of events to be researched. The attribution problem is easier in discrete sports, with fewer players contributing to each action. Rating systems focusing on the value of events often avoid the weighting problem by assuming all actions have an equal effect on the match outcome, subject to the values applied in the enumeration of events. Other rating systems treat the weighting problem as the core of the rating system, judging how players changed their team's probability of winning.

2.2.1 Discrete Sports

The ability to identify player performance in discrete sports like baseball was brought into the limelight with the release of Moneyball [31] in 2003. This book told the story of the Oakland A's, who use data analysis to identify players who could be recruited for low wages but still improve team performance.

Another example of the early implementation of a player rating system in baseball was Bennett (1993) [6] who measured each player's contribution to the change in his team's win probability after every play.

In cricket, Lewis (2008) [32] and Stern (2014) [57] have both proposed rating systems for players in limited overs matches based on runs scored per resource (combination of balls faced and wickets lost) consumed for batsmen and resources consumed per run conceded for bowlers.

2.2.2 Continuous Sports

Even in baseball, where there appears to be a high level of separability, the result of a closed situation can still be attributed to multiple players. In Rosales and Spratt [47], strikes were shown to share responsibility between the pitcher, catcher, batter and umpire. This problem was applied to more complex games by Stern [56] in distributing credit for touchdown passes in American football between the passer, receiver and defensive players.

For sports without separability, such as complex invasion sports like football and hockey, attributing outcomes to individuals is less trivial. One method of introducing performance measurement to these sports is to isolate analysis to closed skills, or for specific situations [1]. Examples include field-goal kicking in American football [7] [36], goal-scoring in ice hockey [38] and field goals in basketball [51].

Another method is to attempt to quantify the interactions between players using network analysis, such as the work by Duch [17]. These approaches are more beneficial than situational ratings, but rely on interactions between players, generally in the form of passes. This means that any events not related to maintaining or losing possession, such as tackles, missed tackles or penalties conceded, are not included.

Plus-minus measurements of player performance are another popular measurement of player contribution [18], but these are only relevant for sports with low numbers of active players and high rates of scoring, such as basketball. These methods assign equal value to all players on the court for every score

that is registered. For Australian football, where each team has 18 players on the field and the field can be over 180m long, this method is not applicable.

Two methods that are based on the evaluation of events are implemented by Bracewell (2002) [9] in rugby union and Chatterjee (1999) [14] in basketball. Both methods sought to assign a value for each statistical category recorded at player level to assess a player's contribution.

The most comprehensive player rating system in team sports at the time of publishing is the EPV system in NBA basketball, as introduced by Cervone, et al. (2014) [13]. This system uses player tracking data to assess each player's contribution based on the expected value of the next score in a game, taking into account the player's location, the location of his teammates and the location of defensive players.

2.2.3 AFL Player Rating Systems

In the AFL, two major player rating systems are visible to the general public, both through online fantasy football - the AFL's own official competition AFL Fantasy, and Supercoach, run by Melbourne-based newspaper The Herald Sun.

In these competitions the general public compete against each other by selecting an initial squad of 30 players subject to salary cap and positional restrictions. A limited number of trades are allowed throughout the season to adjust each competitors squad. Before each round, 22 of the 30 players are selected in the 'starting team' and the sum of the individual scores of those 22 players represent the performance of the squad.

Both competitions are highly competitive, with over 200,000 participants and more than $50,000 in total prize money for each competition.

AFL Fantasy

AFL Fantasy is the official online fantasy competition of the AFL and is hosted on the AFL's website (afl.com.au). The point scoring system is simplistic, as outlined in Table 2.1.

Event	Points Awarded
Goal	6 points
Tackle	4 points
Kick	3 points
Mark	3 points
Handball	2 points
Free Kick (For)	1 points
Hitout	1 points
Behind	1 points
Free Kick (Against)	-3 points

Table 2.1: Point allocation in AFL Fantasy.

For each of the above events, a player is awarded points towards his overall total for the game.

Advantages Since the only use of AFL Fantasy points is for the evaluation of players within a fantasy framework, the main advantage is the simplicity of the system. With just nine event types being allocated points, the general public can easily calculate a player's score to work out how their fantasy team is performing.

Disadvantages Although simplicity is the main strength of the system it is also the biggest weakness. With the categories being measured, AFL Fantasy is essentially measuring the quantity of involvements a player has had during a game, with no regard to quality. For example, a short kick directly to an opposition player scores the same as a long kick to an unmarked teammate in scoring range. Likewise, taking a contested mark to prevent an opposition goal scores the same as an uncontested mark from a teammate's backwards

kick under no opposition pressure.

2.2.4 Champion Data Ranking Points

Champion Data's ranking points formula was developed in the early 2000s by using the notational analysis captured in games to measure player impact. Regression analyses were performed to estimate the scoreboard effect of multiple statistics, judging their importance towards the final result. In the middle 2000s it was appropriated by SuperCoach to be used in a fantasy football context.

At the base level it is a system similar to that used in AFL Fantasy in that each event within a game has a fixed value. Similarities between the two systems stop there, however, with more than 50 events being quantified in the Champion Data ranking points system compared to just nine in AFL Fantasy. As was mentioned previously, the point value of each event was determined mathematically - derived from a regression model using the counts of each event type as the regressors and the final margin of the match as the response variable.

Effective kicking and winning the ball from contested situations are the most valuable events, while heavy penalties apply for unforced errors. Due to the proprietary nature of the system, the full points allocation cannot be revealed, but Table 2.2 contains some examples to highlight the improvement from AFL Fantasy.

Unlike AFL Fantasy, where all kicks received equal value, Champion Data ranking points allow six categories for kicks. Long kicks that find a teammate uncontested are the most valuable, followed by effective long and short kicks. Backwards kicks are positive, but worth just one point, while ineffective kicks receive no points and clangers (kicking the ball directly to the opposition) lose points for the player.

Event	Type	Points Awarded
Kick	Long to Advantage	7
Kick	Long Effective	4
Kick	Short Effective	4
Kick	Backwards Effective	1
Kick	Ineffective	0
Kick	Clanger	-4
Mark	Contested from Opposition	8
Mark	Contested from Teammate	6
Mark	On Lead	5
Mark	Uncontested from Opposition	4
Mark	Uncontested from Teammate	2
Mark	Ineffective	0
Hitout	To Advantage	5
Hitout	Neutral	0
Hitout	Sharked	-1

Table 2.2: Subset of point allocation in Champion Data ranking points.

After events have been assigned their base value, further weighting is applied based on the zone of the event and the current game situation.

- Events that happen inside the defensive and forward 50 zones are given an additional weight of roughly 20% above those that happen in the midfield, since they more directly affect scoring plays.
- Events that happen when the game is close are weighted higher than events that happen when the outcome of a game is unlikely to change. This multiplicative factor can result in plays that change the outcome of a match in the dying seconds (such as kicking the winning goal) potentially having four times as much value as events towards the end of a match where the result is beyond doubt (when the margin is very large).

In addition to these weights applied to individual events, there is a standardisation process to fix the total points allocated within a game to 3,300 points. As an example, if only 3,000 points were awarded after the base values and weightings have been applied, each event is increased to (3,300/3,000)=110% of its original value.

Advantages By using nearly all available events within the game and assessing them based on the mathematical value of each event towards team success, a good representation of a player's contribution to his team's performance is obtained.

Disadvantages Champion Data rankings points are deficient in ranking purely defensive players such as key defenders and taggers. These defensive players have limited on-ball activity, which affects the ability of the ranking system to fully capture their involvement. Also, due to increased weighting on defensive 50 events, general defenders often finish with a higher ranking than expected. They generally receive the ball under no pressure from a teammate, then effect a disposal with a higher margin for error than other position types, but are still rewarded with an increased weight relative to midfield players. Effective kicks to a teammate in defence carry the same value as an effective kick through congestion to set up a teammate in scoring range.

2.2.5 Other Systems

In 2013, Sargent [49] attempted to use network analysis to establish a player rating system for AFL players in a method similar to Duch [17]. Interactions between players were used to assess teamwork and a player's contribution to a teammate's performance and the result of the game. This research focused on one team only (Geelong) so a full list of results was not available, nor were the processes reproducable.

2.3 Expectation

The catalyst for this research was the availability of spatial data for Australian football and the initial research by O'Shaughnessy (2006) [37]. In this paper he defines match equity, $E_M(m, t, x, \phi)$, as the probability that a team will

win from the current match situation, dependent on the current score margin (m), the time left in the match (t), the location of the ball (x) and the current phase of possession(ϕ). It is then suggested that the match equity can be decoupled to give two measures - field equity (E_F) and match state, such that $E_M(m, t, x, \phi) = E_M(m + E_F(x, \phi), t)$. Field equity is the expected value of the next score, based on the current location of the ball and the current phase of possession. The match state is essentially the effect that the next score will have on the outcome of the game.

Earlier works that attempted to create similar results for other sports included a 2002 paper by Romer [46], in which he evaluated the value of possession at specific game states and field locations as a decision-making tool for fourth-down situations in American football, and Thomas (2006) [59], who evaluated the effect of posession and puck location on a team's scoring in ice hockey.

Recent years have seen more advances in this area across other sports. Lucey, et al. [34] calculated score probabilities for shots in soccer, based on the location of the ball, the match-context, speed of play and the proximity of defenders. This information was used to measure efficiencies in front of goal at player and team level, though no attempt was made to extend the logic past the shot into general play passes.

Similar logic was applied to field goal attempts in basketball using player tracking data by Shortridge, et al. (2014) [51]. This was extended to a full-court evaluation of scoring likelihoods for the purpose of creating a player rating system by Cervone, et al. (2014) [13].

Chapter 3

Data Overview

Australian football lends itself perfectly to analysis via on-field statistics. There is a combination of high-scoring games, fast-paced play and an even spread of contributions from all players that is unlikely to be matched in any other sport around the world.

Unfortunately, rich data is only available since Champion Data has been the official data collectors - from the 1999 season.

3.1 Collection Methods & Quality Assurance

Champion Data has a team of 10 people involved in the collection of match-day information. All of the data is collected live and games are finalised within 15 minutes of the final siren.

Live information is fed in real-time to clubs and the media. Coaches and commentators have access to dashboards with key performance indicators and detailed statistics. Live statistics are also broadcast online to media clients.

3.1.1 Capture Team

The majority of the captured information comes through the core capture team of four people - Main Capture. Enriched data is also added by three separate teams - Interchange & Matchups, Graphical Capture, and Pressure & Kicking.

Main Capture (Introduced 1999):

1. **Main Caller** - Calls the game like a commentator, registering every on-ball event with an associated player.
2. **At-Ground Support** - Assists with player identification and off-the-ball calls made by umpires.
3. **Back Caller** - Monitors live vision to confirm correct calls and assist with any questionable events.
4. **Keyboarder** - Enters data into a capture system.

Interchange & Match-ups (Introduced 2003, 2004):

1. **Spotter** - Calls interchange moves and on ground match-ups to identify players and their direct opponents.
2. **Interchange Capture** - Enters data on interchange moves
3. **Match-up Operator** - Enters match-ups in accordance with the spotter's instructions.

Graphical Capture (Introduced 2006):

1. **Graphical Capture** - Records the location of events.

Pressure & Kicking (Introduced 2010):

1. **Pressure Caller** - Assigns a pressure level and pressure players to every disposal, and assess intentions for each kick.
2. **Pressure Capture** - Captures pressure and kicking data from the pressure caller

All of the members of the game-day capture team undergo extensive training before being assigned to a live game. Because the jobs are in a highly-sought-after industry there is a low turnover of staff.

A large number of applications for positions are received each year, and before applicants get through to an interview stage they are required to complete a player identification test. Scores of above 80 per cent are expected for game-day staff to show that they are familiar with AFL players.

Interchange and match-up roles are seen as the entry-level positions since they only rely on player identification and little interpretation.

Data capture positions do not require high level knowledge of statistic definitions or football smarts, but due to the high-paced nature of the collection process thorough training is required before being exposed to a live capture environment.

Pressure callers and main callers require a detailed knowledge of Champion Data calling protocols to ensure that definitions remain consistent across multiple games for the sake of comparison. In the majority of cases, callers do several years of capture off recorded vision for state-league and junior football before graduating to AFL-level collection.

For the sake of consistency, the back caller position is generally filled by a full-time member of staff with training to be a main caller who also has a grasp of the full data collection process. Their main role is to maintain the consistency of definitions across games, regardless of which staff were working

on that game.

The pressure capture team works off a live stream of vision, with the ability to rewind footage to ensure accuracy. They act as a layer of quality assurance to the main call, since most statistics run through their capture system for additional information to be added. On average, six to ten events per game (of nearly 1000) are relayed to the back caller for assessment.

The graphical operators also act as a level of quality assurance. They too work off a vision feed, and in the process of recording locations of events may notice errors in player identification, though at AFL level this happens less than once per game on average.

3.1.2 Captured Statistics

Since becoming the official data collectors of the AFL in 1999 Champion Data has expanded on existing content nearly every year.

Nearly every season has seen the introduction of new statistics to the capture, as can be seen in Figure 3.1.

The 1999 season featured just 53 statistical events, which more than doubled to 124 for the 2015 season.

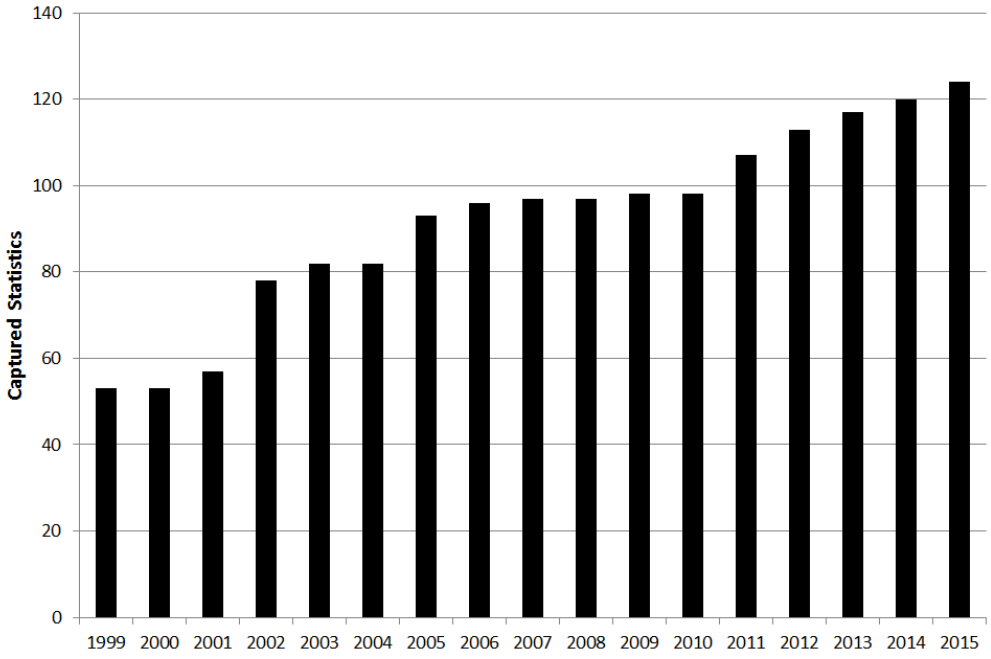


Figure 3.1: Number of recorded statistics by season.

Because of the introduction of multiple capture streams, the increase in the number of derived statistics has shown an even greater growth across years, as can be seen in Figure 3.2.

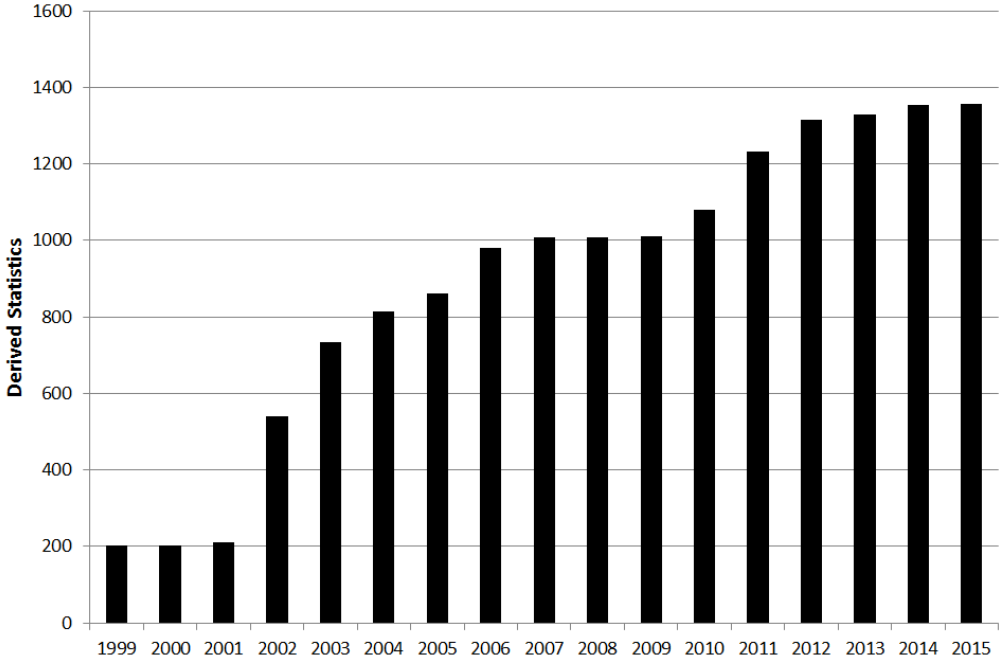


Figure 3.2: Number of derived statistics by season.

An increase of nearly 700% in the number of derived statistics is seen from 1999 to 2015, despite an increase of under 250% in the number of called statistics.

Examples of derived statistics are kicking efficiency (effective kicks divided by total kicks) and hitout to advantage rate (hitouts to advantage divided by total hitouts).

3.2 Data Structure

Champion Data provided XML files containing captured information for each game of the AFL season. This information can be summarised into four parts.

- Match Information
- Possession Chains
- Raw Statistics
- Additional Parameters

3.2.1 Match Information

Match information details where and when the game was played, together with the competing teams and the result.

Metric	Description
Match ID	Unique identifier of each match
Season	The year the game was played
Round	The round during the season
Venue	Where the game was played
Home	Home team
Away	Away team
Home Score	Home team's score
Away Score	Away team's score

Table 3.1: Available match-level information.

This information enables comparisons of performance for players between wins and losses, at certain venues, against certain opponents, and for identifying trends at specific points in time.

3.2.2 Possession Chains

Every streak of possession can be separated into possession chains. Scores, stoppages, changes of possession, and period ends all break possession chains.

Metric	Description
Initial TRX	Identifier of the start point of the chain
Chain Club	The club in possession of the ball
Initial State	How the chain started - out of stoppage, from a turnover, or from a kick-in
Initial Zone	Where the chain started
Launch Player	The player responsible for starting the chain, usually with the first possession
Final State	How the chain ended - with a score, a stoppage, a turnover, or the end of the period
Final Zone	Where the chain ended
Guilty Player	The player responsible for losing possession at the end of the chain
Turnover State	For turnovers, the context of when the ball was lost - at a stoppage or in general play
Turnover Type	For turnovers, how the ball was lost - by kick, handball, or another source
Turnover Creation	For turnovers, the context of how the ball was lost - unforced error, forced error, or the opposition winning a contest.

Table 3.2: Available chain-level information.

Chain information allows context around how a player is involved in the play (around stoppages, or otherwise), as well as the ability to count involvements in scoring chains of possession.

3.2.3 Raw Statistics

For every recorded action during a game, Champion Data has information on when and where the event occurred, and the players involved.

Metric	Description
TRX	Transaction ID for event to preserve sequential order.
Period	Identifier for which quarter of the game the event occurred
Period Seconds	Elapsed time within the period when the even occurred
Statistic Code	Identifier of the event type
Squad	The team in control of the event
Player	The player in control of the event
Opponent	The opposing player related to the event
Zone	A categorical representation of the location based on ground markings
X,Y	Co-ordinates for the location of the event, relative to the centre of the ground

Table 3.3: Available event-level information.

3.2.4 Enhanced Content

For some events, additional information is provided to increase the known detail surrounding the event.

For disposals the level of pressure is recorded. For kicks, the intent of the kick is also recorded, as well as the distance, direction and kicking foot.

Shots at goal are enhanced with the location of the shot and the type of kick that was used.

Event Type	Metric	Description
Disposals	Pressure	The level of pressure the disposal player was under from the opposition
Disposals	Pressure Player	The players applying pressure to the ball carrier
Kicks	Intent	The type of target a player was trying to kick to
Kicks	Distance	Whether the player was trying to kick long (over 40m) or short
Kicks	Direction	Whether the player was kicking forwards, backwards or laterally
Kicks	Foot	Whether the left or right foot was used for the kick
Shots at Goal	Distance	Distance from goal, in roughly 10m bins
Shots at Goal	Angle	Angle from goal line, in roughly 30 degree bins
Shots at Goal	Shot Context	How the player won possession before taking a shot
Shots at Goal	Shot Type	What type of kick was used - normal kick or snap shot
Shots at Goal	Miss Direction	Whether the shot missed to the left or the right
Free Kicks	Context	Where the infringement occurred - in a marking contest, ruck contest, while tackling, or other
Free Kicks	Reason	The infringement that led to a free kick being paid
Kick-in	Direction	Whether the player kicked-in to the left, right, or into the corridor
Inside 50s	Direction	Whether the player went inside 50 from the left, right, or from the corridor
Inside 50s	Type	Whether the inside 50 was sent to a teammate or bombed inside
Interchanges	Reason	Why a player came off the ground - through injury, or as a normal rotation

Table 3.4: Additional information added to event-level capture.

3.3 Data Volume

In the 2015 season, more than 3000 events were logged for each game, with over 50 parameters provided for most events. Figure 3.3 shows a distribution of the number of events per game.

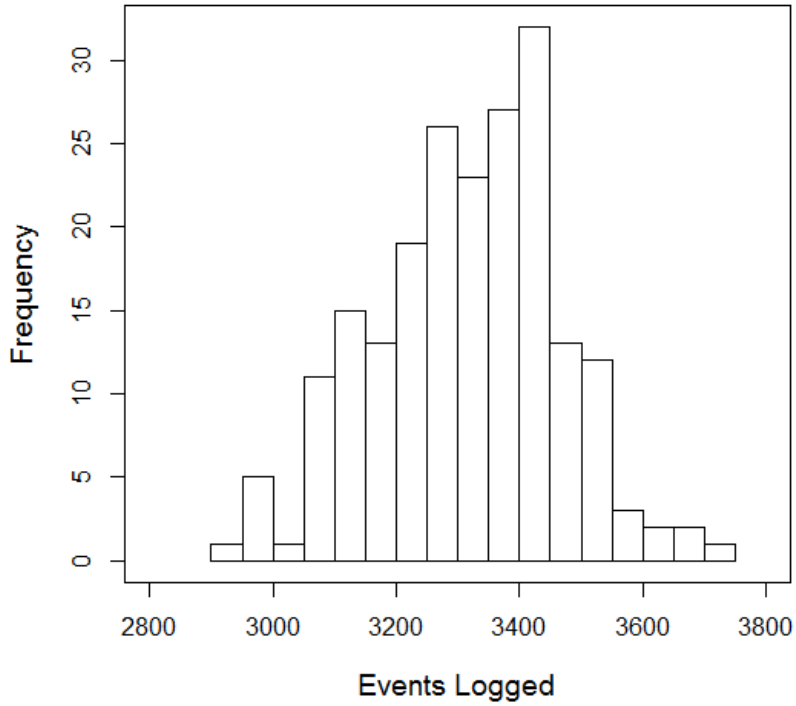


Figure 3.3: Distribution of event count for each game of the 2015 season.

Just over 20% of events logged are related to player possessions, with a similar number of player disposals. Table 3.5 has a full breakdown of the distribution of each event type.

Note that 'Other' is mostly comprised of events that add further detail to previously recorded events. For example, many hitouts are followed by an event to specify whether it was a hitout to advantage or a hitout sharked.

Event Category	Proportion of Total
Possessions	21.9%
Disposals	21.9%
Defensive Acts	6.0%
Stoppages & Restarts	5.5%
Zone Changes	5.3%
Ruck Contests	3.0%
Hitouts	2.6%
First Possessions	2.6%
Clearances	2.3%
Free Kicks	2.2%
Shots at Goal	1.5%
Other	27.8%

Table 3.5: Distribution of event types.

3.4 Accuracy

With the main caller, back caller, pressure caller and graphical capture operator all checking for interpretation and/or player identification errors, it is rare that major mistakes are still present at the completion of the game.

Champion Data has historically claimed an accuracy of 99% accuracy. This has no basis through rigorous testing, however, but it is assumed that it is close to the truth. AFL clubs pay significant monetary fees to Champion Data to subscribe to information and part of this process is to align match statistics to broadcast vision for the sake of player training and development.

Each player receives an edited version of their game, with all of their involvements cut out from the whole game to shorten the process of watching the game replay. Any issues that are spotted in this process by club staff or players are reported back to Champion Data. This occurs less than five times per season, from more than half-a-million records, so the assumption of 99% accuracy appears to be valid.

Aside from the accuracy of major statistics, there is also a potential for

subjectivity to affect the raw statistics, which are outlined below. Between the caller and the back-caller, nearly every decision is reviewed and discussed in live play, meaning checks are in place even before QA layers become involved.

Due to the ambiguity of some definitions, however, there is an element of subjectivity in some statistics. Some examples are outlined below.

3.4.1 Clearances

Clearances are assigned to the player who has the first effective disposal, or first kick, in a possession chain that clears the stoppage area. Two potential factors can be influenced by subjectivity in this definition:

1. What is the stoppage area?
2. When has the ball cleared that area?

The stoppage area is loosely defined as the area enclosed by the players who are attending the stoppage. Though this can also be ambiguous it is generally clear which players are involved in stoppage structures and which are set up outside of these.

The decision as to whether the ball is cleared from the area can also be ambiguous, since a team is generally required to have had control of the ball before a clearance has been paid. Situations do occur where a team fumbles the ball continuously, with the ball leaving the stoppage area, but no clearance is paid, or the clearance is paid to the opposition if the ball is lost and taken away by the opposition.

Because of this ambiguity, all clearances are checked on a weekly basis. Roughly 10 are changed per week as part of this review process, of 700-800 that are called live by the capture team.

3.4.2 Tackles

One of the most common complaints received from the general public around statistics collection is for tackle counts. Regular feedback is received via social media, email and direct phone calls from people wishing to alert Champion Data to a missed tackle (commonly for a player on the fantasy team of the person making the complaint). This is strong evidence of the lack of understanding around the tackle definition.

A tackle is awarded to a player who through physical contact affects the disposal of the player in possession. Knocking a player to the ground as they get an effective handball to a teammate will not be rewarded with a tackle, regardless of the force of the contact. In contrast, a slight touch that puts a player off-balance while kicking can be rewarded by a tackle.

Since the inception of pressure capture in 2010, tackles were able to feed through an additional level of quality assurance. Any physical pressure act on an ineffective or clanger disposal will be paid with a tackle.

The same capture has allowed the calculation of Tackle Attempts, by regarding physical pressure on an effective disposal as an ineffective tackle attempt, and historical tackle counts as effective tackle attempts.

3.4.3 Disposal Efficiency

Marking disposals as effective, ineffective or clangers are also part of the capture process. Effective kicks can be either short (less than 40m) to a teammate's clear advantage, or long (over 40m) to a 50-50 contest or better for the team. Here the interpretation of 'teammate's advantage' and the decision of kicking distance are at the discretion of the main caller, with feedback from the back caller.

3.4.4 Possession Type

Another decision that is made for every possession of the football is the possession type. If a player physically beats an opponent to win a disputed ball, the player will be credited with a hardball get. If the player simply beats his opponent to the ball with no physical contest, it is a looseball get.

Because of the competitive nature of the game, there are often instances where the difference between a hardball get and looseball get can be of the order of fractions of a second.

3.5 Suggestions for Reviewed Quality Control

It was suggested to Champion Data that methods should be put in place to measure the accuracy of statistics.

3.5.1 Accuracy of Recorded Statistics

Current quality control involves a manual process of checking statistics against vision of the events to assess accuracy. This is done for all clearances in the AFL season, and for selected statistics in lower competitions. The primary aim of this process is to detect, and correct errors, rather than to assess accuracy. As such, detailed information on the number of events changed is not systematically recorded.

Two possibilities were identified to measure the accuracy of called statistics.

Random Sampling

Champion Data could expand on the above practices by performing a random sampling of events for review each week.

The benefit of this method of assessment is the ability to calculated accuracies for interpretative statistics, such as pressure levels, disposal quality and possession types.

Since only existing events can be reviewed, this method of assessment fails to identify any events that were missed by the capture team.

Recapture of Games

By recapturing an entire game with different staff, multiple sources can be used to compare the initially recorded information to what was obtained by a secondary capture team.

This could identify missed events and assess the accuracy of recorded events.

Unfortunately, this method of assessment requires a high level of resources - both in terms of staff costs and staff availabilities. Because of this, it is unlikely to be implemented on a large scale.

3.5.2 Caller Bias

Early stages of this method of assessing accuracy has been put in place as of the end of the 2015 season.

Match-level information is to be collated and cross-referenced to the personnel involved in capturing the game.

After controlling for the tendencies of the teams involved, checks for statistical significance of differences associated with the capture personnel will be identified. This will result in the ability to identify potential biases of capture staff, and suggestions for additional training of these staff to improve the accuracy of Champion Data's collected information.

3.6 Future Developments

At the time of writing negotiations were underway for Champion Data to gain access to player tracking information via GPS units and/or RFID chips worn by players. At present, only AFL clubs have access to this information and then, only for their team of 22 players.

This information is used regularly for assessment of player demands [23] [12] [16] and movement patterns [10]. Recent developments have also seen this information compared to player performance measures from Champion Data [26] [25] [5].

If Champion Data is able to integrate its existing data streams with player tracking data, this would give the location of all 44 players involved in a game, and potentially the ball, at sub-second intervals.

Such information would revolutionise data capture in Australian football, adding more depth to available information and reducing the subjectivity of a human call. As an example, Champion Data's pressure levels could be replaced by a measure of player density in the vicinity of the ball-carrier.

Match-ups could be automated so that a player's direct opponent is calculated based on player locations.

This could open up many potential opportunities for analysis of player performance and decision making, and improve the accuracy of collected data.

Chapter 4

Exploratory Data Analysis

4.1 Heatmaps

One of the early outcomes of this project was the development and commercialisation of heatmaps.

With the high number of events recorded it was found that a density plot of points was easier to interpret than a raw plot of the underlying locations.

They were initially used as a means to check the data manipulation process, but quickly became a valuable analysis tool.

4.1.1 Density Estimation

Heatmaps are a graphical representation of the 2-dimensional empirical probability density of the locations of a given data set. Kernel density estimates with a bivariate Gaussian kernel are used to estimate the density function.

The kernel function is applied to all data points over the expanse of the entire playing area, which we will call $\mathcal{G}$.

For a data sample of n points, we let $K_{(x,y)}(x_i, y_i)$ be the kernel function of

data point i calculated at location (x, y), for $(x, y) \in \mathcal{G}$ and $i \in \{1, 2, \ldots, n\}$. The location of data point i is given by (x_i, y_i).

Then, from the definition of the bivariate Gaussian kernel, we have

$$K_{(x,y)}(x_i, y_i) = \frac{1}{2\pi h_x h_y} \exp\left(-\left(\frac{x_i - x}{h_x^2} + \frac{y_i - y}{h_y^2}\right)\right)^2$$

where h_x and h_y are the smoothing bandwidths in the x and y directions, respectively.

Underestimating h will result in a grainy image, which often makes it impossible to extract patterns. Conversely, over-estimation of h will result in loss of information due to oversmoothing of the density function.

Examples of this are shown in 4.1.

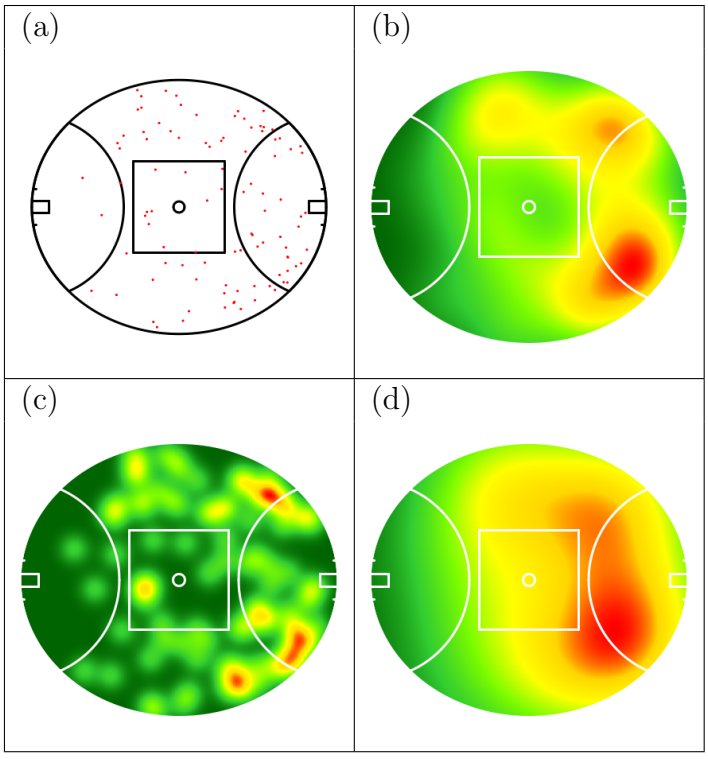


Figure 4.1: Three heatmaps contructed from the same data set.
(a) The original data set.
(b) A heatmap with correct bandwidth estimation.
(c) An underestimated bandwidth.
(d) An overestimated bandwidth.

Fortunately, previous work by Scott [50] enables near optimal estimates of the smoothing bandwidths. For $\mathbf{x} = \{x_1, x_2, \ldots, x_n\}$ and $\mathbf{y} = \{y_1, y_2, \ldots, y_n\}$

$$h'_x = 1.06 \times \min\left(SD(\mathbf{x}), \frac{IQR(\mathbf{x})}{1.34}\right) \times \frac{1}{\sqrt[5]{|\mathbf{x}|}}$$

and

$$h'_y = 1.06 \times \min\left(SD(\mathbf{y}), \frac{IQR(\mathbf{y})}{1.34}\right) \times \frac{1}{\sqrt[5]{|\mathbf{y}|}}.$$

where SD is the standard deviation and IQR is the interquartile range.

Due to the restricted nature of the playing field in Australian football it is reasonably common for situations to arise where data sets have near-zero standard deviation in the x or y directions. To avoid highly skewed calculations of bandwidths in these situations, the two bandwidth calculations are mixed to give the final numbers used in the generation of the plot.

$$h_x = (0.7 \times h'_x) + (0.3 \times h'_y)$$

$$h_y = (0.3 \times h'_x) + (0.7 \times h'_y)$$

Once the contributions of each data point have been calculated the estimate of the density function at point (x, y) is then

$$f(x, y) = \frac{1}{n} \sum_{i=1}^{n} K_{x,y}(x_i, y_i).$$

This is then converted to colour plots where the maximum density estimate is represented by red, high density levels by yellow, low density levels by light green and zero points represented by dark green to mimic the colour of the grass field.

Field markings are overlaid to provide context and for the sake of consistency, all heatmaps are produced such that the applicable player or team has

the attacking goals to the right-side of the plot.

The final product can be seen in (b) of Figure 4.1.

4.1.2 Implementation

Heatmaps were quickly adopted by AFL clubs and the media as a useful analysis tool. Of particular interest were plots of players' possessions to attempt to identify running patterns, especially for forward-line players. Two examples of this being acknowledged in the media are:

- [39] North Melbourne claimed that heatmaps of Lance Franklin's possessions helped their defenders plan for where he would run, which subsequently helped them win the game. A quote from North Melbourne's football manager Donald McDonald in the article reads "...heat maps help your players prepare for the upcoming opponent".
- [58] Possessions for two key Brisbane Lions players - Jonathan Brown and Daniel Bradshaw - were shown to be biased to opposite sides of the ground, enabling them to be compatible when playing in the same forward line.

Heatmaps were included in a premium subscription service that Champion Data provided to AFL clubs. In 2008 just four clubs purchased this subscription, but this grew to eight by 2010 and 15 of 18 clubs in 2015. More than ten unique subsets of recorded data are converted into heatmaps for clubs, which are available for all of the nearly 700 players that play in any given AFL season, as well as combined heatmaps for each team.

As of the 2015 season, AFL Media provided a paid subscriber-only section of the AFL's official mobile app aimed at the general public, which contains heatmaps of all players and team possessions at the completion of the game. The subscriber service is also promoted via the use of a heatmap on the official

league website at the completion of each round in an article title 'After the Siren' [11].

The most common use within the industry is to compare heatmaps of similar event subsets across different time periods to identify changes. Specifically, players who change their role, and teams that change tactics.

Example: Player Role Change

Using the locations of a player's possessions gives a good indication of his playing position. Champion Data has seven categories for positions, which are shown in Figure 4.2.

In these examples, possessions won at centre bounces are excluded. This is due to a high concentration of possessions around the centre of the ground distorting the location of the player's other possessions.

Midfielders and ruckmen essentially follow the ball around the ground, and are sometimes referred to as 'nomadic' players. This high ground coverage can be seen clearly in Figure 4.2.

Key forwards and key defenders are often grouped as 'key position' players. Key forwards have the primary role of kicking goals, so often stay inside the forward 50 area.

Key defenders are responsible for marking key forwards, so are forced to stay in defensive 50 to guard them.

General forwards have more freedom to roam outside the forward 50, which in turn gives more freedom and ground coverage to general defenders.

Players regularly change roles not only between different seasons, but sometimes from week to week. In some instances it can be up to 18 months between two teams playing against each other, so opposition analysis has to be done by teams to help prepare.

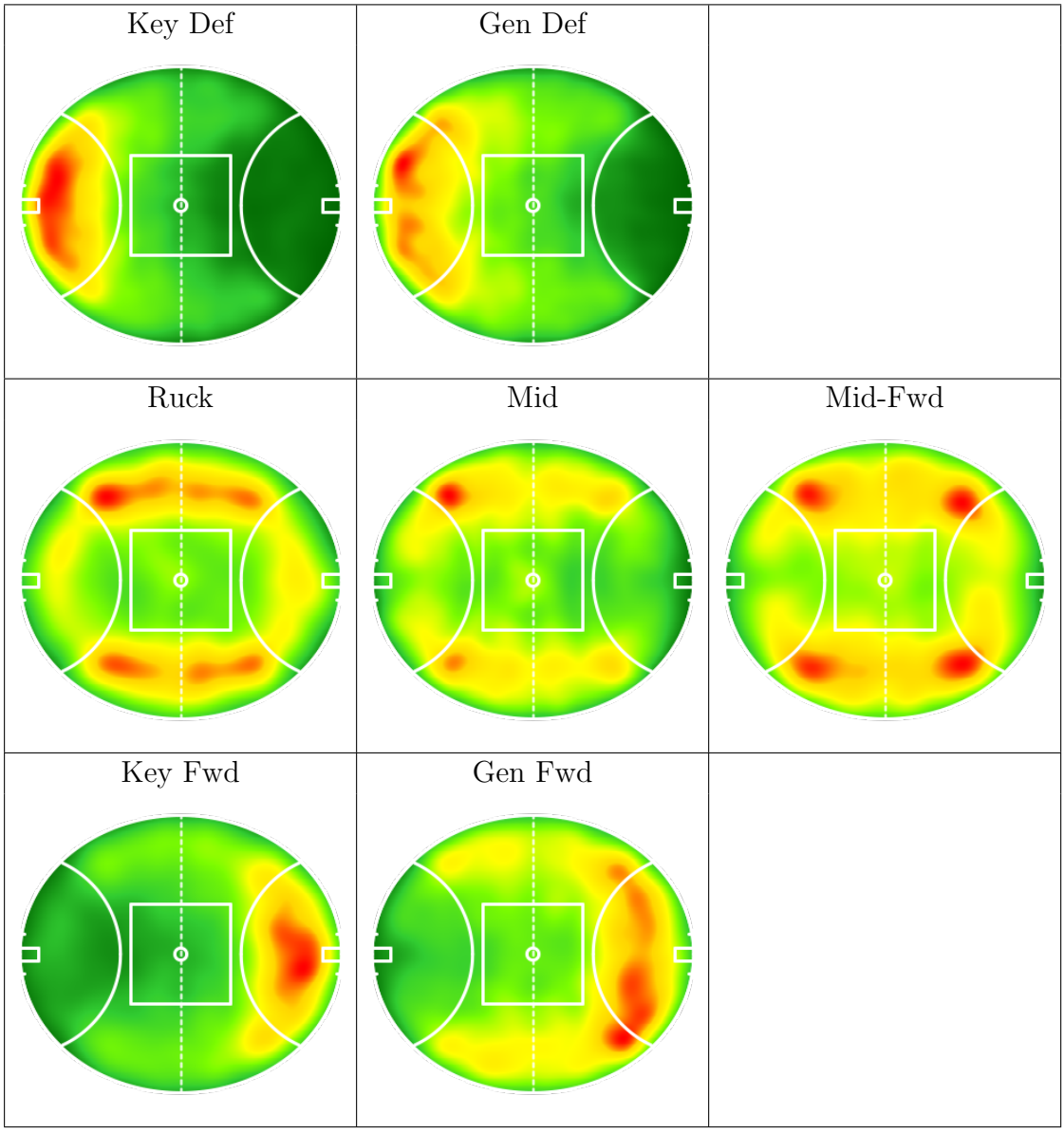


Figure 4.2: Heatmaps of player positions.

Watching vision of past games and interpreting this information internally can be difficult, especially considering that there are 22 players from each team combining for over 400 possessions of the football in a single game.

Relying on memory to extract any meaningful information isn't always reliable, so having a historical record of a player's involvements and having an easily-understood visual representation of this information is invaluable.

Figure 4.3 has heatmaps for Port Adelaide player Robbie Gray's possessions in 2014 compared to the 2015 season. 27% of his possessions were inside the

forward 50m zone in 2014, compared to just 18% in 2015. He had never previously fallen below 26% in his first eight seasons in the AFL.

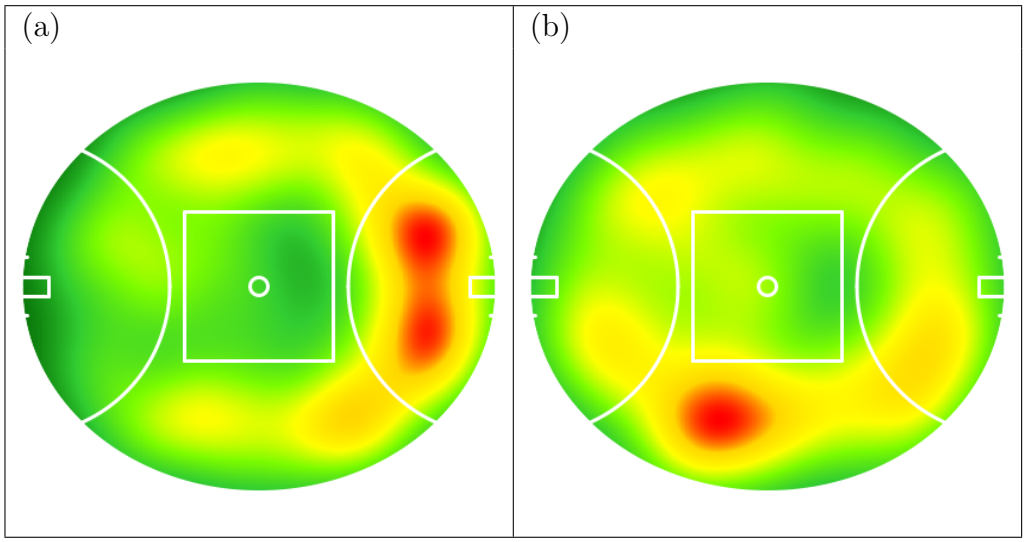


Figure 4.3: Heatmap of Robbie Gray's possessions across seasons:
(a) 2014.
(b) 2015.

Example: Team Tactics

Team tactics can change drastically, especially across different seasons. Coaching changes can accelerate these changes, as new philosophies and game styles are brought to the club.

Figure 4.4 has heatmaps of Fremantle's targets when kicking into the forward 50 for 2008-2011 under coach Mark Harvey and 2013-2015 under coach Ross Lyon - time periods that exclude the coaches' first year at the club.

The Lyon-coached Fremantle team kicked the ball into the centre corridor 54% of the time, compared to just 39% of the time under Mark Harvey.

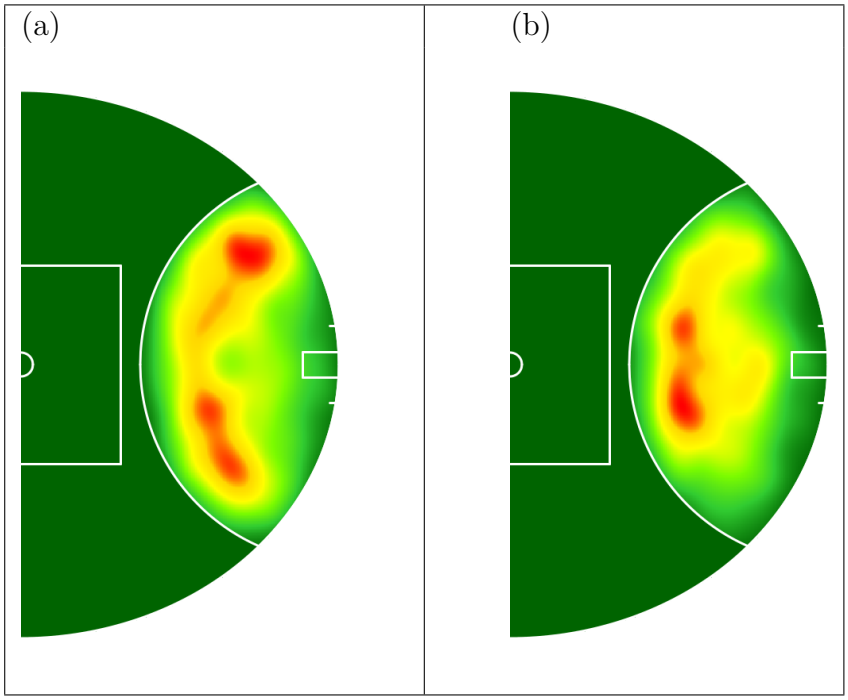


Figure 4.4: Heatmap of Fremantle's targets inside 50:
(a) 2008-2011.
(b) 2013-2015.

Example: Team Strengths

Team strengths and weaknesses can also be highlighted by visual representations of location data. One example is shown below in Figure 4.5 where St Kilda's marks on Lead are plotted for wins and losses separately.

Marks on lead are recorded when the kicker sends the ball to a teammate running into open space who has gained separation from his defender. Based on data from the 2015 season, 85% of these kicks are marked by the target.

From the plots it is clear that in the games St Kilda has won, its players have been able to use leading teammates further up the ground, while in losses this method of ball movement has been restricted to the forward line.

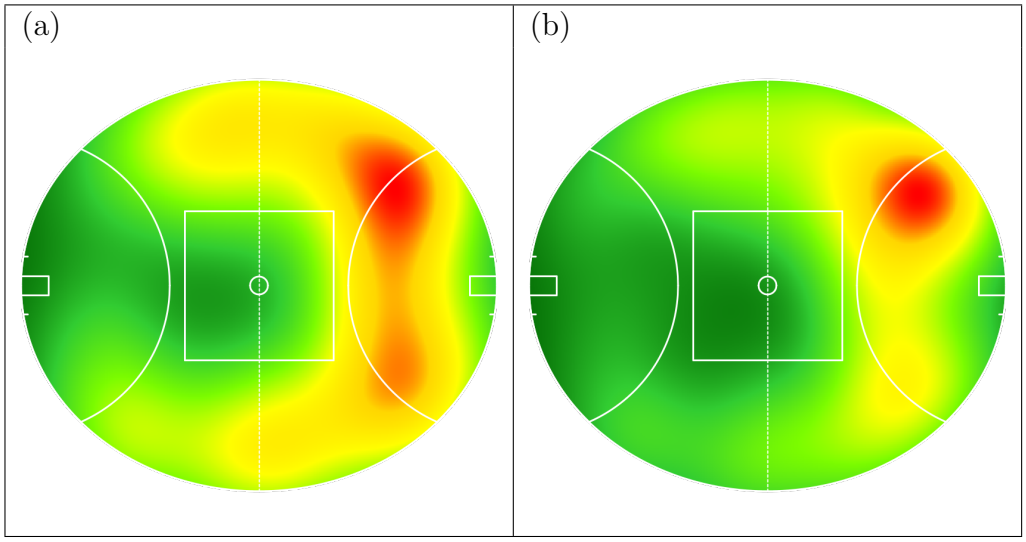


Figure 4.5: St Kilda's marks on a lead by game result - 2015:
(a) Wins.
(b) Losses.

4.2 Spatial Data Traits

Spatial data can also be used to enhance knowledge of how the game is played in certain situations.

4.2.1 Kicking Distance

One area of interest was a breakdown of kicking distance. Figure 4.6 has the distribution of kicking distances split by ground zones - defensive 50, defensive midfield and attacking midfield. Only field kicks (those which are not shots at goal) are included so kicks from the forward 50 were not investigated.

From the defensive 50, kicks of distance between 20m and 50m are essentially uniformly distributed.

From the defensive midfield there is a bias towards shorter kicks, with a mode at 27m.

From the attacking midfield there is a bias towards longer kicks, with a

mode at 45m.

Kicks from all zones show a steep decline in prevalence beyond 50m - identifying the physical limitations of most players.

The steady increase in the number of kicks between 10m and 15m is unexpected, since the threshold for a player being awarded a mark is set at 15m as per the laws of the game, meaning there is little reward for kicking shorter than 15m.

A significant number of kicks below 15m have resulted in marks, which is due to a combination in the error associated with Champion Data's capture of the data points, and the human error involved in umpires deciding whether a kick has travelled 15m.

Kicks travelling less than 15m that are not marked include kicks that are smothered or deflected, meaning they didn't reach their intended kick distance.

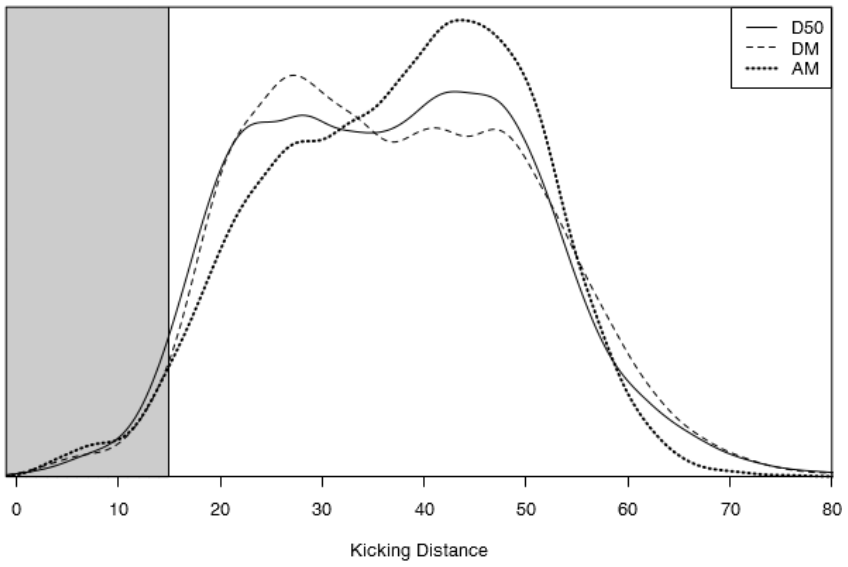


Figure 4.6: Kicking distance based on zone of kick - field kicks only.

The level of pressure applied to the kicker by the opposition also affects kicking distance, as can be seen in Figure 4.7.

In the defensive midfield, 45% of kicks are from set position (after a mark

or free kick), 41% are not pressured and the remaining 14% are under pressure. Kicks under no pressure follow a similar distribution to all kicks, as seen in Figure 4.6.

Kicks from set position have a higher bias towards short kicks. Having the ball in set position allows the kicker time to assess his options and also allows teammates to move into better positions for the kicker, which could explain this bias.

Kicks under pressure are less likely to go long, perhaps due to the kicker not having ample time to go through the full kicking motion, instead just quickly trying to move the ball forward. There is also a significant number of kicks that travel less than the 15m required for the kick to be marked, most likely due to the increased likelihood of the kick being touched in flight when more players are in the vicinity of the kicker.

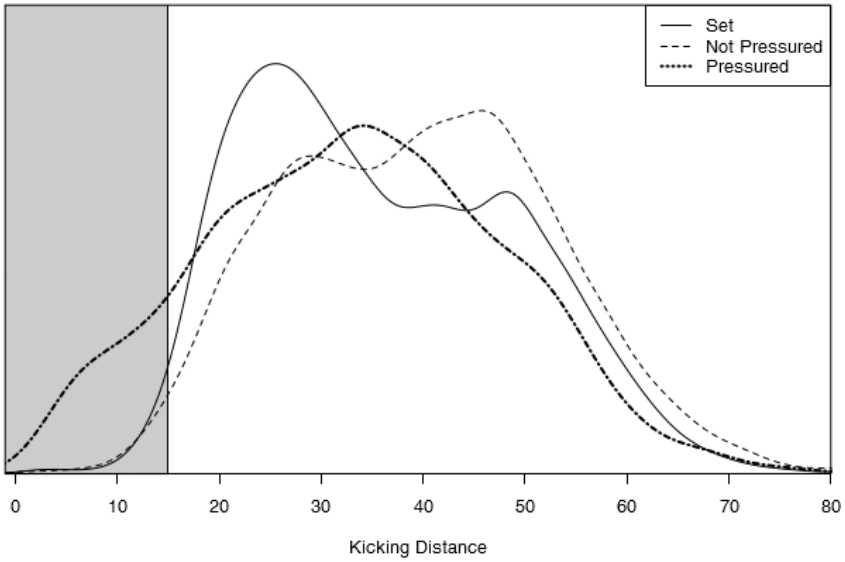


Figure 4.7: Defensive midfield kicking distance based on pressure on kicker.

Field kicks show a different distribution to kick-ins, as can be seen in Figure 4.8. Only kick-ins where the player kicked from within the defensive goal square are included. Kick-ins where the player kicks to himself are excluded. The distribution is clearly bi-modal, with modes at 22m and 52m.

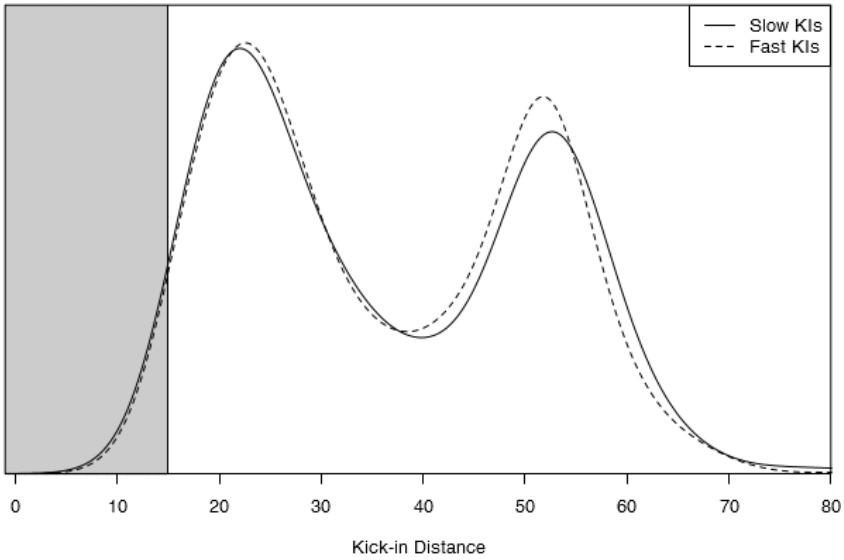


Figure 4.8: Kick-in distance excluding kick-ins to self.
Slow kick-ins are after a set shot by the opposition.
Fast kick-ins are after a shot from general play.

When players are taking a kick-in, the opposition often has time to set a defensive zone. If a teammate breaks out of that zone to present an easy target for the kicker it is likely to be near the boundary line and close to the kicker.

If no teammate is free, the default tactic is to kick long to the boundary line to clear the defensive area and make it difficult for an opposition counter-attack if possession is lost. A heatmap in Figure 4.9 also shows this bimodality, highlighting the areas where short and long kicks are sent.

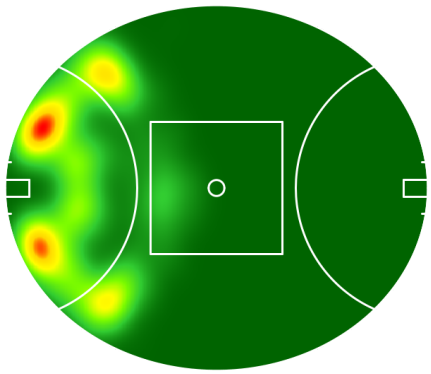


Figure 4.9: Heatmap of kick-in target locations.

Splitting kick-ins by club allows further analysis of club tactics when restarting from the goal square. Figure 4.10 has the distance distributions of three clubs in the 2015 season - Greater Western Sydney, Western Bulldogs and Fremantle.

The GWS Giants rarely go long, instead looking for mid-range targets. The Bulldogs go long more often than the average team and Fremantle goes long much less than the average team.

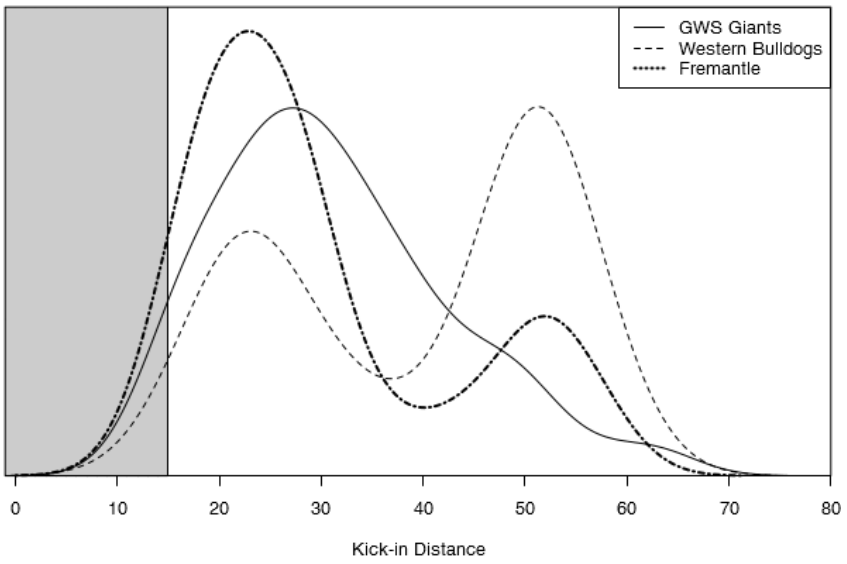


Figure 4.10: Kick-in distance distribution - club example.

4.2.2 Next Scorer

This exploratory data analysis is linked closely to the main tool of this research - Field Equity, which will be introduced in more detail in Chapter 5. For every possession recorded, we calculate whether that team was the next team to score. This gives us the opportunity to understand the value of having the ball in a certain position, and also the relative value of different possession types.

Figure 4.11 has plots of the percentage of times the team in possession was the next team to score, based on field position. The two plots shown are

for marks and groundball gets - where a player has had to beat at least one opponent to win a disputed ball.

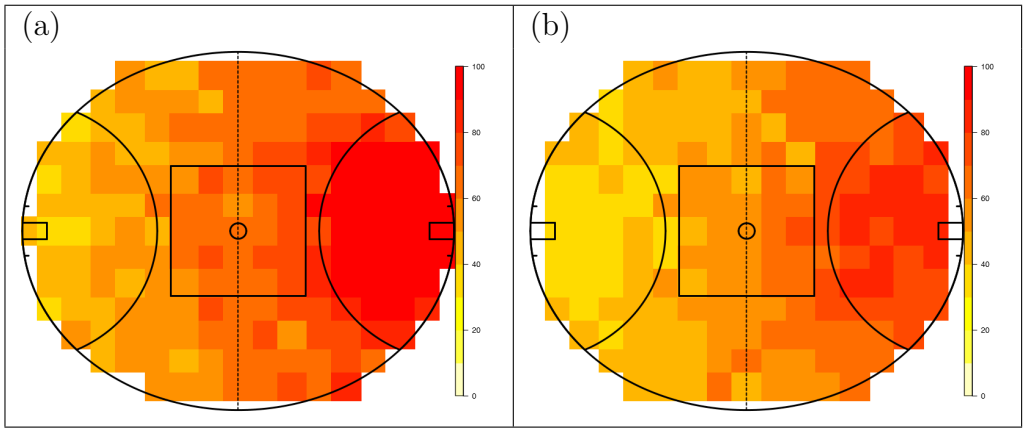


Figure 4.11: Percentage of possessions where the team was next to score:
(a) Marks.
(b) Groundball Gets.

Linking in with the kicking distance investigation earlier, we see that the probability of being the next team to score is consistently above 90% inside the forward 50 - the scoring range of most players.

Outside of this zone there is a steady decline towards the defensive 50. This decline is also present for the groundball gets, but the 90% scoring probability is no longer present. The removal of the luxury of a free kick awarded after a mark means distance is no longer the only main factor affecting scoring likelihood, as congestion and time-pressures are introduced.

4.2.3 Shot at Goal Accuracy

Similar to the next-scorer analysis above, we can look at the likelihood of a shot at goal being accurate based on the location of the shot. Shots directly in front of goals are likely to be more accurate than those taken on wide angles and shots taken from closer to goal are likely to be more accurate than those from long distances.

Figure 4.12 has a summary of all set shots from 2014 and 2015.

Distances from goal are split into 10m blocks, with everything outside 50m from goal grouped together. Angles are split into pre-defined zones of (from the outside in) 'boundary', 'acute angle', 'slight angle', and 'directly in front'.

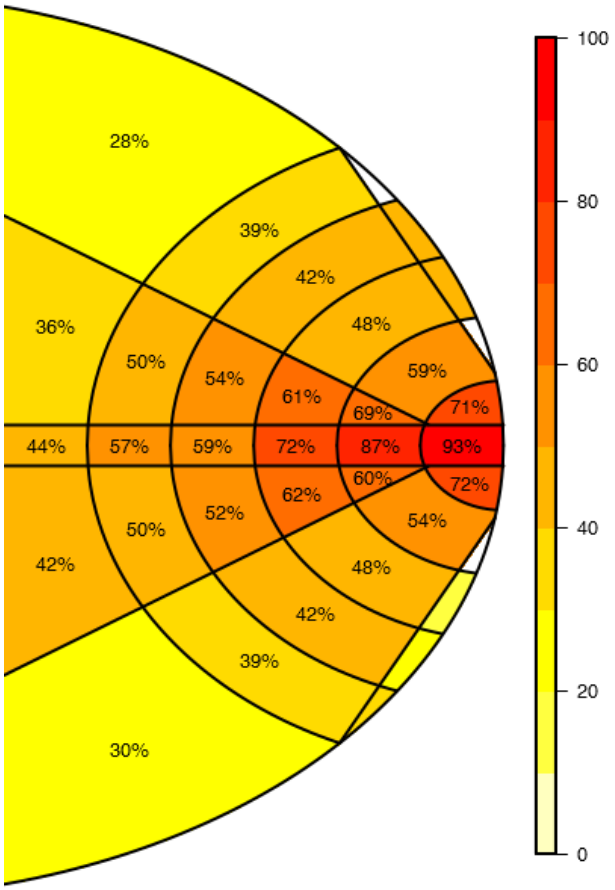


Figure 4.12: Accuracy of shots at goal based on location of shot.

These zones appear to be near enough to symmetrical, but Champion Data has also recorded which foot was used to kick at goal.

Splitting shots into left and right-foot attempts shows a benefit of players using the 'open' side of the ground - to the left of goals for a right-footer and to the right of goals for a left-footer - where the apparent goal width from the player's kicking foot is larger than from the opposite foot.

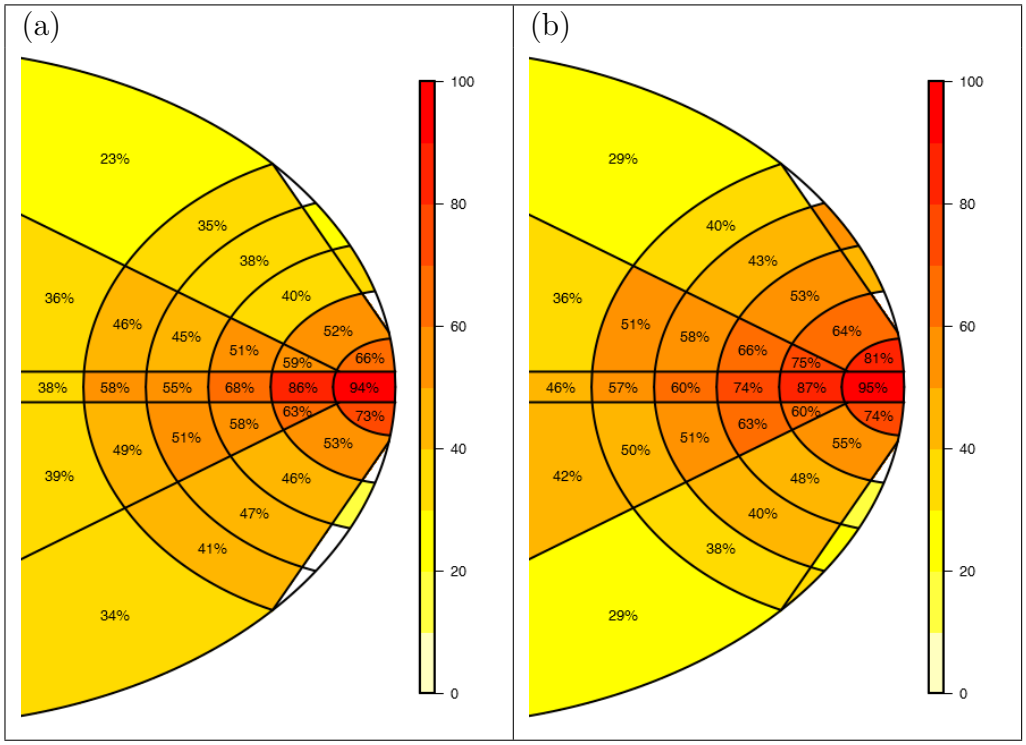


Figure 4.13: Accuracy of shots at goal based on location of shot:
(a) Left-foot shots.
(b) Right-foot shots.

Surprisingly though, there appears to be no significant bias towards players using their preferred side of the ground, as can be seen in Figures 4.14.

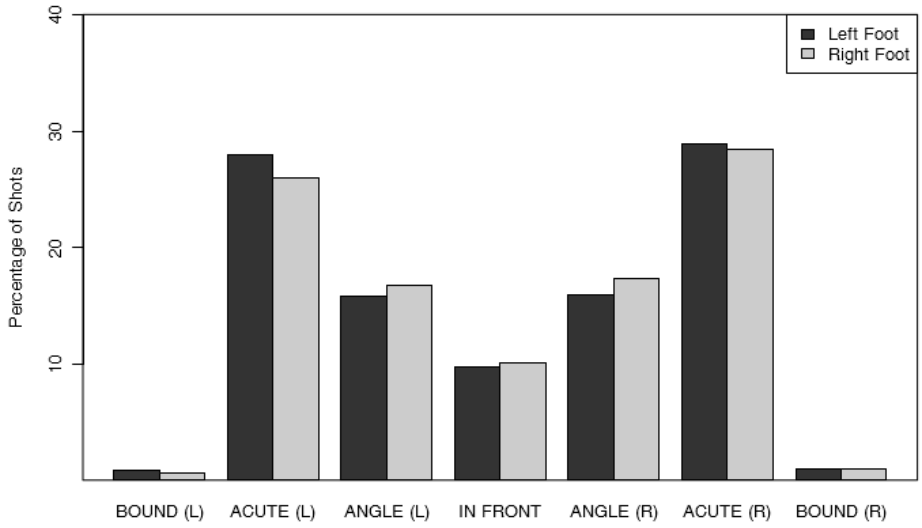


Figure 4.14: Distribution of set shots at goal by kicking foot.

One example is Sydney forward Lance Franklin. As a left-footer, he should

be attempting to take more shots from the right-side of the ground to maximise his chance of kicking a goal. Instead, he has consistently preferred the left-side of the ground throughout his career.

Figure 4.15 is a heatmap of Franklin's shots at goal from 2012 to 2015.

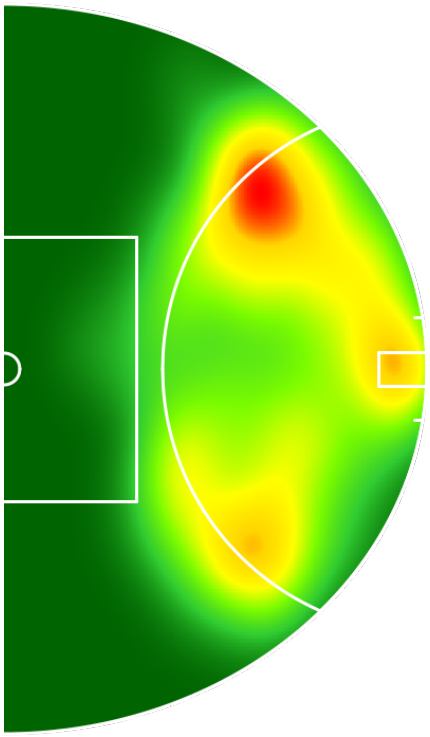


Figure 4.15: Heatmap of Lance Franklin's shots at goal (2012-2015).

Excluding shots taken from within 30 degrees of the centre of the ground, Franklin has taken 192 shots from the left side and just 134 from the right side. This proportion of 62% is highly significant, with a p-value of 0.0016 relative to an even spread in both directions.

4.3 Kicking Outcomes

The primary aim of this thesis was to provide a new player rating system. The rating system to be introduced in later chapters is based around the premise

of performance relative to expectation. Players who perform an action that is more beneficial to the team than the average outcome will be rewarded higher than players who perform on, or below average.

The same logic is applied here to judge a player's kicking ability.

The existing kicking efficiency metric fails to take into account the difficulty of a player's kicks, meaning those taking easier kicks are generally rewarded with a higher kicking efficiency.

Figure 4.16 has examples of the discrepancies between difficulty based on the location and pressure level for kicks.

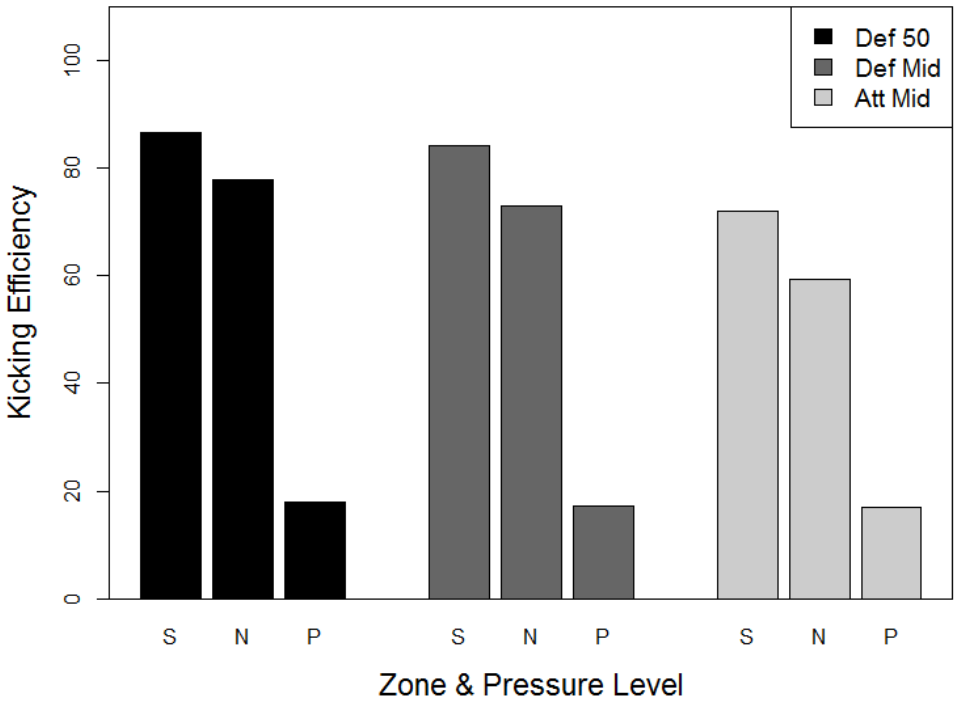


Figure 4.16: Kicking efficiency of short kicks by zone and pressure level.
S = Set Position
N = No Pressure
P = Physical Pressure.

Note that kicks under physical pressure are markedly more difficult than kicks under no pressure and from set position. There is also a slight decrease in kicking efficiency for kicks in the attacking midfield compared to defensive midfield and defensive 50.

By comparing the outcome of a player's kicks to the expected outcome based on the known information about the kick, we get a measure known as 'kick rating', defined as

$$KR = \frac{1}{n}\sum_{i=1}^{n}\Big[H - \mathbb{E}\left(H|D,\omega,KI,P,Z,T\right)\Big] \tag{4.1}$$

where n is the number of kicks attempted, $H \in \{0,1\}$ indicates whether the kick hit the target, D is the kick's distance, ω is the kick's direction, KI is the intent of the kick, P is the pressure level of the kick, Z is the zone of the kick, and T is the zone of the target.

Champion Data's kick capture includes seven distinct kicking intents, three directions, and two distances.

There are four options for kicking zone, four options for the target zone and six pressure levels. Table 4.1 has a list of the available options for each parameter.

Intent	Direction	Distance	Zone	Target	Pressure
Distance	Forward	Long	D50	D50	Set
Open	Lateral	Short	DM	DM	None
Lead	Backward		AM	AM	Corralling
Reverse Lead			F50	F50	Chasing
Covered					Closing
Contest					Physical
Goal					

Table 4.1: Parameter options recorded for each kick.

Kicks for distance are considered to be fast kicks out of congestion where the result doesn't reflect the kicking ability of the player. For this reason they are excluded from analysis. Kicks for distance account for just 2.3% of all field kicks (excluding shots at goal) for the 2015 season.

For shots at goal, alternative parameters are recorded for the distance and

direction, with five options for distance and seven for direction, as listed in Table 4.2.

Direction	Distance	Shot Type
Boundary (Open)	0-15m	Snap
Acute (Open)	15-30m	Off Ground
Angle (Open)	30-40m	Standard
In Front	40-50m	
Angle (Closed)	50+m	
Acute (Closed)		
Boundary (Closed)		

Table 4.2: Parameter options recorded for each shot at goal.

Here (Open) indicates that the player was on the favourable side of the goals for the kicking foot used, while (Closed) indicates that the player was on the non-favourable side, as was shown in Figure 4.13.

From the six parameters listed in Table 4.1 there are 2,880 possible combinations that define a kick, after excluding kicks for distance and shots at goal. Many of these are either not possible, or are rare enough that they were not observed in the 2015 season. The number of observed combinations was 564, with 214 being seen at least 30 times and 125 being seen at least 100 times.

The most commonly seen kick was observed 3,097 times in the 2015 season - a short, forward kick to a covered teammate in the attacking midfield, kicked from the defensive midfield from set position. Of these kicks, 2,513 hit their target - a 'hit rate' of 81.1%.

Any player who attempts this specific kick then gets a score of +18.9% if they hit their target, and -81.1% if they miss. The average of these scores across all kicks attempted is a player's kick rating.

To determine whether a player has hit their target, we must take into account the intent of the kick.

Kicks to a contest are consider low-risk kicks, so there is more leniency on

the kicker. Any kick that reaches the contest is determined to have hit its target, regardless of the result. The only outcomes that will result in a player missing the target when kicking to a contest are uncontested turnovers. This results in a high expected hit rate, which in turn offers little reward for players who consistently take this option, and large penalties if player's do miss a kick to a contest.

Shots at goal that fail to register a goal are considered to have missed the target, even if the kick falls short and possession is retained.

All other kicks are said to have hit their target if they find a teammate by a contested mark, free kick in a marking contest, or by an uncontested possession.

Intent	'Hit' Criteria
Goal	Goal kicked.
Contest	Ball reaches the contest.
Other	Contested mark or uncontested retention by teammate.

Table 4.3: Requirements on hitting the target by kicking intent.

To again demonstrate the effect of the pressure applied to a kicker, and the location of the kicker, we will consider hit rates for kicks to a covered target.

Figure 4.17 has the average hit rate of kicks to a covered target where the kick was from set position or under no pressure. The distance to goal measure is relative, with the 50m arcs being roughly at 30% and 70% of the venue length. We can see that the average hit rate for kicks taken near the attacking 50m mark is roughly 40%, compared to 70% from the defensive 50m mark.

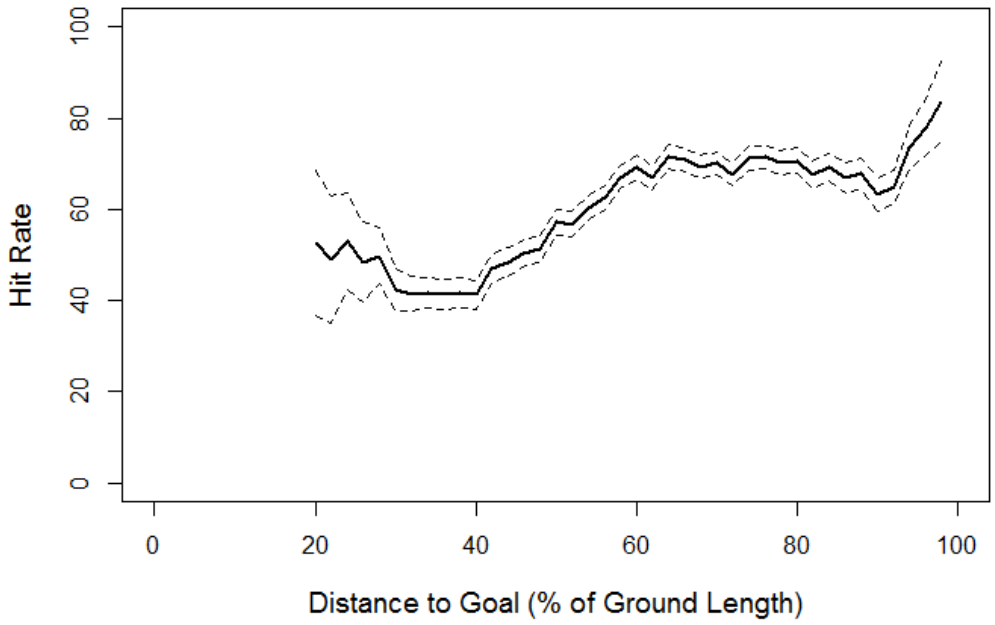


Figure 4.17: The effect of location on hit rate of covered kicks from set position or no pressure, with 95% confidence intervals.

To assess the importance of pressure, we will further restrict our sample to covered kicks that are at least 60% of the ground length away from attacking goal. Results in Figure 4.17 indicate that hit rates relative to location were stable for kicks taken in this range.

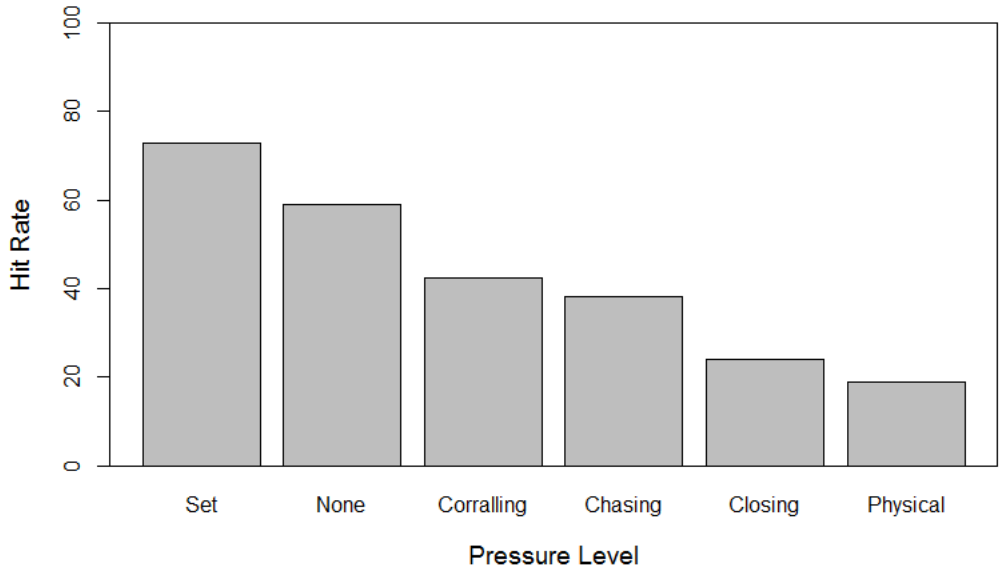


Figure 4.18: The effect of pressure on hit rate for covered kicks more than 60% away from attacking goals.

Kicks from set position hit their target roughly 72% of the time, compared to just 19% when under physical pressure.

The expected hit rate from Equation 4.1 is taken as the average hit rate across the entire competition for kicks with identical parameters. The top-20 most used kicks in 2015 are shown in Table 4.4 as an example, sorted from easiest to hardest.

D	ω	KI	P	Z	T	Count	Hit
Short	Backward	Covered	Set	DM	D50	829	98.3%
Long	Forward	Covered	Set	AM	F50	1277	97.7%
Short	Forward	Contest	Set	D50	D50	2087	90.1%
Short	Forward	Covered	Set	DM	DM	3097	81.1%
Short	Forward	Covered	Set	D50	DM	1547	76.6%
Short	Forward	Covered	Set	DM	AM	2581	75.9%
Short	Forward	Covered	Set	AM	AM	1054	74.8%
Short	Forward	Covered	None	DM	DM	1081	70.1%
Short	Forward	Covered	None	DM	AM	1323	65.1%
Short	Forward	Covered	Corral	DM	DM	1231	56.2%
Short	Forward	Covered	Corral	DM	AM	1374	46.2%
Short	Forward	Covered	Set	AM	F50	1234	43.5%
Short	Forward	Covered	None	AM	F50	1088	43.3%
Short	Forward	Covered	Corral	AM	F50	1497	32.7%
Long	Forward	Covered	Set	DM	AM	1178	17.8%
Long	Forward	Covered	Set	AM	F50	1780	14.8%
Long	Forward	Covered	Set	D50	DM	1059	14.3%
Long	Forward	Covered	None	AM	F50	1512	12.4%
Long	Forward	Covered	Corral	AM	F50	1724	11.9%
Long	Forward	Covered	Corral	DM	AM	866	9.7%

Table 4.4: Expected hit rate of 20 most used kicks in 2015.

To assess the significance of each player's kick rating, every kick for the season was simulated 10,000 times as a Bernoulli variable with p equal to the expected hit rate for that kick.

Of the 341 players who attempted at least 100 kicks for the 2015 season, 36 players had a kick rating significantly better than random, outperforming at least 95% of the simulation runs. There were 23 underperforming players,

who outperformed less than 5% of the simulation runs.

Further, a quantile plot of actual kick ratings for 2015 compared to those observed from random simulation indicates a significant trend of over-performance and under-performance at either end of the leader board, as can be seen in Figure 4.19. This indicates that there is an observable bias in kicking ability at player level across the competition.

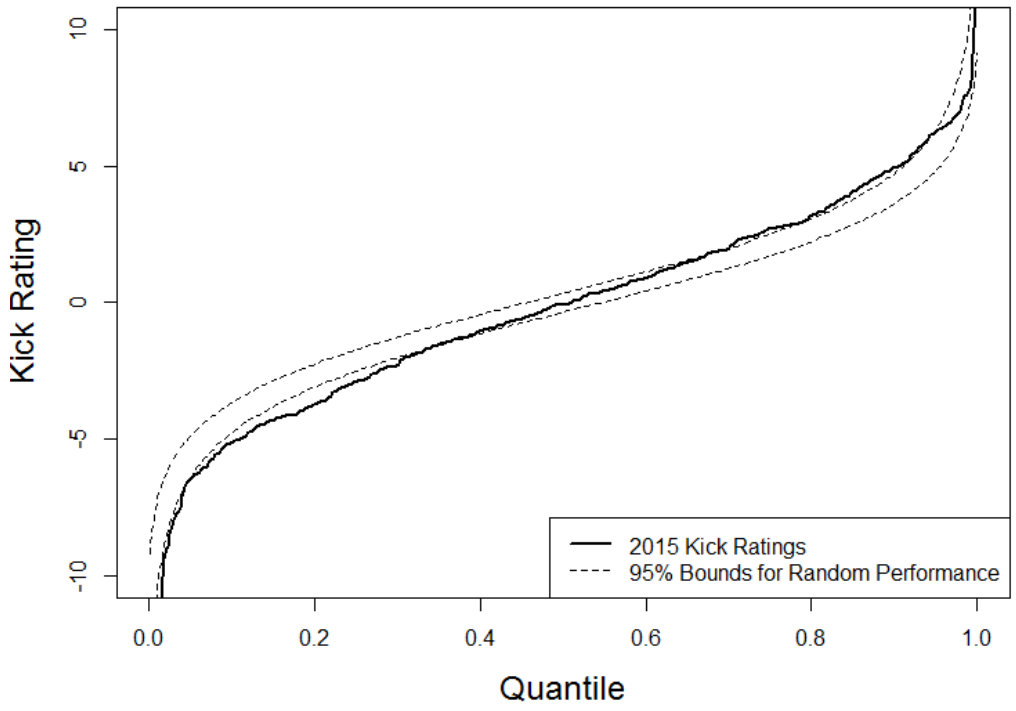


Figure 4.19: Observed quantiles of player kick ratings in 2015.

The best, and worst, players for 2015 are listed in Tables 4.5 and 4.6, respectively.

Note that Michael Walters, 10th overall, has a hit rate of just 56.2% - clearly the lowest of the top-10. He ranked just 150th of the 341 players for hit rate, but was 270th for expected hit rate. This highlights the advantage of rating a player's kicking relative to expectation, rather than just on raw outcomes.

Player	Club	Exp Hit (%)	Hit (%)	Kick Rating (%)
Mitch Duncan	GEEL	60.8	70.9	+10.1
Nathan Krakouer	PORT	55.3	63.1	+7.8
Bradley Hill	HAW	55.3	62.9	+7.6
Cameron Guthrie	GEEL	55.5	62.9	+7.4
Grant Birchall	HAW	63.7	70.7	+7.0
Brent Harvey	NM	51.9	58.7	+6.8
Dylan Roberton	STK	64.6	71.3	+6.7
Robert Murphy	WB	60.8	67.4	+6.5
Cameron Sutcliffe	FREM	63.0	69.5	+6.5
Michael Walters	FREM	49.7	56.2	+6.5

Table 4.5: Top-10 players for kick rating in 2015.

By comparison, Dylan Grimes from Richmond had a hit rate of 71.4% - ranked fifth of the 341 players and more than 15 percentage points above Michael Walters. He ranked just 157th for kick rating because he had the third-easiest kicks of any player (expected hit rate of 70.9%) to give a kick rating of +0.5%, meaning he essentially did what was expected of him.

Player	Club	Exp Hit (%)	Hit (%)	Kick Rating (%)
Nic Naitanui	WCE	42.9	31.5	-11.4
Patrick Cripps	CARL	57.6	48.9	-9.0
Koby Stevens	WB	49.6	41.7	-8.0
Jordan De Goey	COLL	45.0	37.8	-7.1
Bryce Gibbs	CARL	48.1	41.1	-7.0
Stefan Martin	BRIS	50.1	43.3	-6.8
Aaron Vandenberg	MEL	42.5	36.2	-6.3
Jarrod Harbrow	GCS	55.4	49.3	-6.1
Maverick Weller	STK	53.7	47.7	-6.1
Josh Kennedy	SYD	41.4	35.4	-6.0

Table 4.6: Bottom-10 players for kick rating in 2015.

Since kick ratings are compiled on an average-per-kick basis, they are available to be used with any subset of kicks.

Kick ratings can be applied at player level, or team level, to assess kicking

ability.

Kicking ability can also be measured in specific game situations, to assess a player under pressure against the same player under no pressure. Likewise, kick rating can be used to develop capability profiles for players to determine which areas they are competent in, or which areas need development.

This information can then be used by coaches to tailor specific training programs to players to improve on any deficiencies in their games.

Chapter 5

Field Equity

The main outcome of this research will be a player rating system based around the location of events. The basis for the rating system is the concept of field equity - first introduced to Australian football by O'Shaugnessy [37].

In this paper he defines match equity, $E_M(m, t, x, \phi)$, as the probability that a team will win from the current match situation, dependent on the current score margin (m), the time left in the match (t), the location of the ball (x) and the current phase of possession(ϕ). It is then suggested that the match equity can be decoupled to give two measures - field equity (E_F) and match state, such that

$$E_M(m, t, x, \phi) = E_M(m + E_F(x, \phi), t).$$

Field equity is the expected value of the next score, based on the current location of the ball and the current phase of possession. The match state is essentially the effect that next score will have on the outcome of the game.

5.1 Calculation

For each possession of the football we wish to determine the scoreboard value of the team having the ball in that location. From this, we can compare the outcome of a player's involvement with an expectation based on instances where other players have been in a similar position.

The simplest example is after a mark close to goal. From 2002 to 2015, only 14 of nearly 1,800 players (0.8%) have missed after taking a mark within 15m of goal directly in front. The average accuracy from this situation is near enough to 100%, so in terms of expectation the team in possession has essentially already gained the six points associated with kicking a goal before the player takes the kick.

In the previous chapter, we saw that a set shot 40-50m out from goal on a slight angle had an accuracy of 50% (Figure 4.12). Assuming that all non-goals go through as minor scores for a behind, the equity associated with a mark in this area of the ground is then a function of the probability of kicking a goal (p).

$$\begin{aligned} E_F &= 6p + 1(1-p) \\ &= 6 \times 0.5 + 1 \times 0.5 \\ &= 3 + 0.5 \\ &= 3.5 \text{ points.} \end{aligned}$$

From Figure 5.1 below, we can see that the field equity associated with marks inside 50 closely resembles the distribution of accuracies, as expected. A mark in the goal square is worth the above-mentioned six points, while a mark from directly in front between 40 and 50 metres from goal is worth three points. Marks are generally worth more when taken closer to goal and closer to the centre corridor.

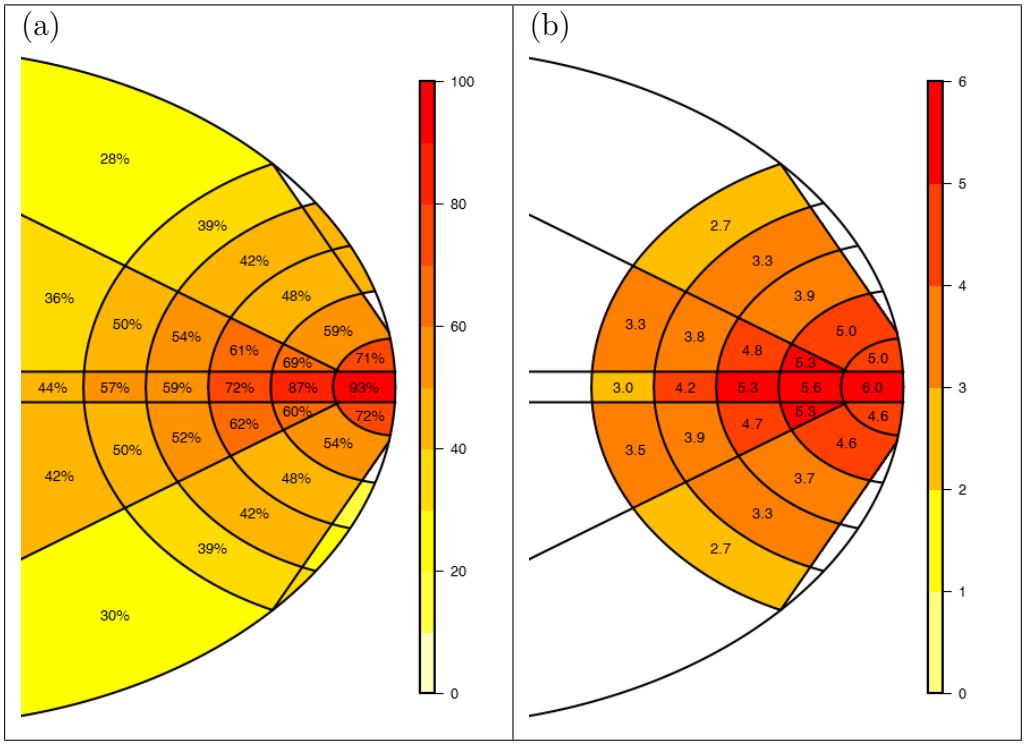


Figure 5.1: A comparison of accuracy and Field Equity for marks:
(a) Accuracy of set shots.
(b) Field Equity of marks.

Extending this methodology beyond shots at goal, where after each play both teams have a chance of being the team to score next, is less trivial. For the purposes of this research, the methodology of estimating field equity will be similar to the methods used in the original O'Shaugnessy paper.

We define, for events $1, \ldots, n$:

$\mathbf{x}_i$ as the observed location of the i^{th} possession

ϕ_i as the phase of possession for the i^{th} possession

S_i as the next score that occurs after the i^{th} possession

We can then estimate the field equity for a particular phase of possession (ϕ) as

$$E_F(x, \phi) = \sum_i I\left(\phi_i = \phi\right) \times I\left(\|x_i - x\| \leq c\right) \times S_i$$

where I is the indicator function and c is a critical distance to determine

which data points are included. This is to account for inherent error in the data collection process by introducing some smoothing across points. For the sake of initial calculation this was arbitrarily set at six metres, meaning any possessions plotted within six metres of a given point will be used to calculate the field equity at that point.

Figure 5.2 below has plots for the field equity of the four phases of possession defined in O'Shaugnessy [37]

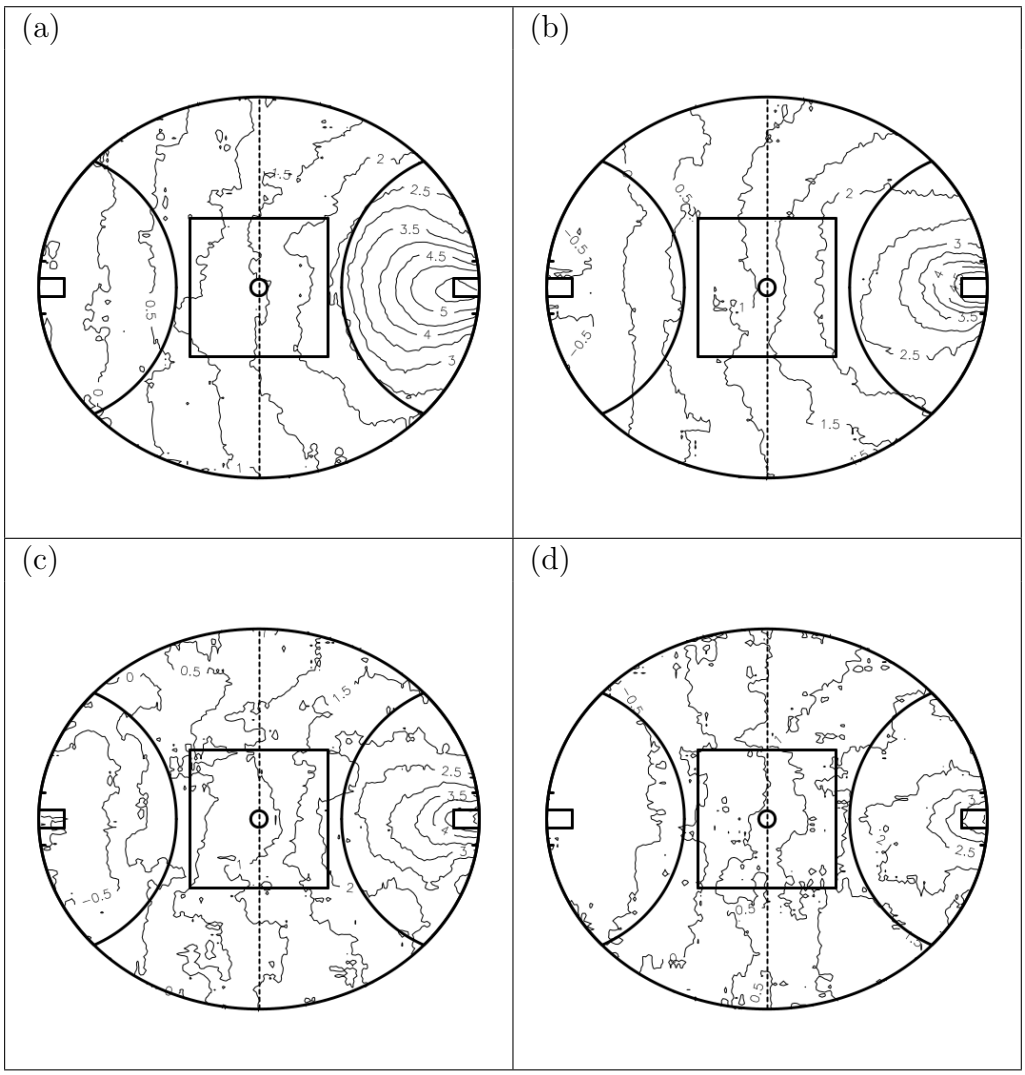


Figure 5.2: Field Equity calculated for four phases of possession:
(a) Set Position.
(b) Directed Possession.
(c) Looseball Get.
(d) Hardball Get.

5.2 Discussion

Despite being taken from distinct data sets to the O'Shaughnessy paper, these equity plots follow a nearly identical distribution on the field across the possession phases, verifying the algorithms used against previous work. Table 5.1 below contains further detail about these equity gradients, with the average calculated field equity, and the range, presented for each combination of zone and possession phase.

Possession Phase	Def 50	Def Mid	Att Mid	Fwd 50
Set Position	0.07 (-0.88,1.09)	0.87 (-0.25,1.79)	1.80 (0.90,2.86)	3.61 (1.74,5.77)
Directed	-0.13 (-0.83,0.74)	0.72 (-0.58,1.48)	1.63 (0.51,2.49)	2.79 (1.45,5.60)
Looseball	-0.34 (-1.09,0.70)	0.49 (-0.64,1.50)	1.43 (0.30,2.52)	2.58 (1.18,5.34)
Hardball	-0.74 (-1.65,0.24)	0.17 (-0.96,1.17)	1.09 (0.05,2.04)	2.02 (0.88,4.36)

Table 5.1: Field Equity summary by zone, with average and range

Note that in all instances, set position is worth more than uncontested possession, which in turn is more valuable than loose and hard possession. This difference becomes more obvious as the ball gets closer to goal. In the defensive 50 set position is worth 0.20, 0.41, and 0.81 points more than uncontested, loose, and hard possession, respectively. In the forward 50, this advantage is 0.82, 1.03, and 1.59 points.

It is also clear from Figure 5.2 that there is a steep gradient inside the forward 50 for all possession types. This is due to the scoring range of most players in the competition being within 40-60m from goal. Outside of this range, multiple possessions are needed for a shot at goal to occur, meaning increased likelihood of the opposition scoring next. Inside of this range, every step closer to goal (assuming the angle doesn't change) makes the shot an easier conversion for the kicker, increasing the likelihood of a goal.

We now consider the following examples of how the above information can be used to assess player contributions, before a more complete overview in Chapter 6. All contours mentioned below refer to those in Figure5.2.

5.2.1 Example 1 - Hardball Get to Teammate's Mark

A player wins a hardball get by beating an opponent in the middle of the ground. He then kicks 30m forward to a teammate who marks on the 50m arc.

Winning possession via a hardball get is worth just under 1.0 points. A mark on the 50m arc is worth 3.0 points, so the disposal after the hardball get added 2.0 points to the club's equity. The adjacent contour lines either side of the 50m arc for set position are approximately 10m away, so a 20m kick would have added just 1.0 points to the club's equity, while a 40m kick would have added 4.0 points.

5.2.2 Example 2 - Hardball Get to Opposition Mark

A player wins a hardball get by beating an opponent in the middle of the ground as in the first example. He then kicks 30m forward to an opposition player who marks on the 50m arc.

To measure the equity change after a turnover we must rotate the equity contours 180 degrees and change the sign of the equity value. Turning the ball over on the right half-forward flank, for example, gives possession to the opposition on its left half-bank flank. Since equity is a zero-sum concept, your equity when the opposition is in possession is the negative of the opposition's equity.

The equity of a mark on the defensive 50m arc is 1.0 points, so in this situation the ball has moved from +1.0 points to -1.0 points - a change of -2.0

points. If the ball was kicked deeper into the forward 50 - to the zero point contour - the change would be from +1.0 points to 0.0 points - a change of -1.0 points.

More case studies and a description of equity changes will follow in Chapter 6.

Chapter 6

Pilot Study - Equity Ratings

Once a replica of Field Equity values had been obtained, the next step was to test the viability of creating a player rating system. This pilot study was published in Jackson [29] and also used in Meyer & Jackson [35] to evaluate players.

6.1 Points Allocation

In an effort to develop a player rating system that is unbiased with respect to player position, it was decided that information about a player's disposal and possession needed to be taken into account.

As was seen in Figure 5.2, there is a much higher rate of change for Equity in the forward half than in the defensive half. Defensive half players then have less opportunity to gain equity from their disposals.

By taking into account the ball's location prior to a player winning possession it was hoped to add some value to the defensive aspect of the game - winning possession when the ball is in a valuable position for the opposition.

The outcome of the player's possession was then considered to be the next

possession-like event - a possession to either team, a stoppage called or a score to either team. The value assigned to that possession is then the difference between the outcome and the previous equity to the player's possession.

$$\Delta E_F(i) = E_F(x_{i+1}, \phi_{i+1}) - E_F(x_{i-1}, \phi_{i-1})$$

where $i \in 1, \ldots, n$ identifies each of the n possessions that happen in the game, x_i is the location of the i^{th} possession and ϕ_i is the phase of the i^{th} possession.

A player's performance is calculated as the combined change in equity during a game that occurred as a result of a player's possessions.

$$E_R(j) = \sum_{k=1}^{n_j} \Delta E_F(j, k)$$

where $j \in 1, \ldots, 44$ identifies each player in the game, n_j is the number of possessions for player j and $\Delta E_F(j, k)$ is the change in equity associated with player j's k^{th} possession.

6.1.1 Special Cases

For the non-possession states that were included in the study, the equity value was fixed.

Goal	6.0 points	Scoreboard value of the score.
Behind	1.0 points	Scoreboard value of the score.
Stoppage	$\frac{E_F(x, L) - E_F(-x, L)}{2}$	Equal chance of both teams winning a looseball get.
Kick-in	0.0 points	As suggested in the O'Shaughnessy paper.

6.2 Results

Table 6.1 below is a summary of the results by playing position of player ratings for games in 2007, sorted by median rating per game. The correlations presented are between the individual game and Champion Data's ranking points system. The positions used were Champion Data's classifications of players for the 2007 season.

- Key Fwd - Tall players whose main role is as a marking target.
- Gen Fwd - Non-key forward line players.
- Midfielder - Players who spend the most time around the ball.
- Gen Def - Players who often have a dual defensive and attacking role.
- Key Def - Taller defensive players whose main role is to stop key forwards.
- Ruckman - Tall players that compete for the ball in the air at a stoppage.
- Gen Util - Player who rotates between Mid, Gen Fwd and/or Gen Def.
- Tall Util - Players who rotate between Key Def, Key Fwd and Ruckman.

Position	Games	Mean	SD	95% CI For $\bar{x}$	Corr	Med	Max
Key Fwd	676	12.1	8.9	(11.5,12.8)	0.91	11.2	54.9
Gen Fwd	836	11.3	7.8	(10.7,11.8)	0.80	10.3	50.2
Midfielder	2945	10.2	7.1	(9.9,10.5)	0.85	9.6	43.8
Gen Util	293	9.3	6.8	(8.5,10.1)	0.88	8.4	33.8
Gen Def	1214	8.9	6.1	(8.5,9.2)	0.77	8.4	31.8
Tall Util	366	8.9	6.8	(8.2,9.7)	0.87	8.2	32.3
Key Def	795	8.2	5.4	(7.8,8.6)	0.77	7.8	32.6
Ruckman	619	6.6	5.4	(6.2,7.1)	0.83	5.9	30.2
All	7744	9.7	7.0	(9.5,9.9)	0.81	8.8	54.9

Table 6.1: Pilot Equity Rating system - summary of scores by player position

6.3 Discussion

One of the main aims of this pilot study was to produce a rating system that was unbiased with respect to player position. However, due to the steep equity gradient in the forward 50 and the relatively flat gradient in the defensive 50, as seen in Figure 5.2, players that spend the majority of their time in the forward half are likely to get higher ratings under this first model.

Table 6.1 contains strong evidence of this, with forwards having a significantly higher rating than midfielders, who in turn rated higher than defenders and ruckmen.

By examining the role of players and how this is affected in the ratings, the source of this inequality can be seen more easily. For example, a player that kicks a goal gets a positive increase to their rating of 4.31 points on average, but a missed shot on goal that results in a behind only decreases the player's Equity value by 0.34 points.

It is worth noting that the season's maximum rating in a game, Jonathan Brown's 54.9 points in round 16, was the result of kicking 10 goals and 1 behind.

In Round 21, Lance Franklin kicked 2 goals and 11 behinds but still managed an above average rating of 16.0 points. Currently, a missed goal from the goal square has the same negative effect to a player's rating as a missed goal from outside the 50m arc, as long as the previous possessions had come from the same location and phase. Further penalising missed goals will reduce much of the positive bias towards players in the forward line.

In order to even out the inequalities between forwards and defenders, more thought and planning will need to go into the definition of the equity value for each involvement. The current system only takes into account where the ball came from, not where the actual possession was taken. Using information about the location of the possession could help to even out the ratings by

removing the reward for players on the end of a long run from their teammates, for example.

Key and general defenders should also benefit from using the location of the possession. One possibility is to take into account what might have happened if the player did not get that possession. For example, taking a mark in the defensive goal square not only gives your team possession of the ball, but it prevents the opposition winning possession.

Introducing spoils will also benefit defenders, especially key defenders. Spoiling the ball in a marking contest does not necessarily lead to possession for the team, but it does prevent an opposition mark.

Since no information was used about their presence at stoppages, ruckmen did not fare well with this ratings system. Their primary role in the game is to direct the ball to a teammate via a hitout, with general play involvements becoming secondary. If however, stoppage information could be incorporated, this would result in an increase to ruckmen ratings.

Champion data have a pre-existing statistic called 'hit-out to advantage', which occurs when the ruckman knocks the ball from the stoppage to an unopposed team mate. By combining this information with the location of stoppages and the ensuing possessions, ratings for ruckmen should get closer to the average.

6.4 Conclusion

Despite the obvious inequities between various playing positions, the strong correlation with Champion Data ranking points at least suggests that the rating system is still viable.

Subsequent chapters will refine this rating system by including more match events, some of which were highlighted above.

Possessions and disposals will also be treated differently in an attempt to better reflect a player's contribution.

Chapter 7

Field Equity - Part Two

In [37], the Field Equity was estimated using a similar method to that used in Chapter 5. The estimate of Field Equity at any point on the ground for a specific phase of possession was just the average observed equity within some set critical distance from that point. Even with the critical distance set at six metres, the equity gradients in Figure 5.2 are still grainy due to the discrete nature of the data being investigated.

Increasing the critical distance would go some ways to improving the smoothness of the gradients, but it is feared this will result in a loss of information related to the shapes of the gradients.

In this chapter, we will recalculate the equity gradients in a more robust manner, using smoothing techniques to establish more realistic results.

7.1 Smoothed Equity

The first stage in establishing robust equity gradients was to smooth the raw equity gradients. This was done through parametrisation after converting the two-dimensional X-Y co-ordinates into three-dimensions - distance from attacking goals (D_F), apparent width of the attacking goals (ω_F), and distance

from defensive goals (D_D), such that:

$$D_F = \sqrt{(80 - x)^2 + y^2}$$
$$D_D = \sqrt{(-80 - x)^2 + y^2}$$
$$\omega_F = 6.4 \times \sin\left(\arctan\left(\frac{80 - x}{|y| + 3.2}\right)\right)$$

where the centre of the attacking goal line is at (80,0), the centre of the defensive goal line is at (-80,0), and the goal posts are at ($\pm$80,$\pm$3.2).

By using the apparent goal width, we are introducing a proxy for angle from goal that is more sensitive to movement in the Y direction close to attacking goal and less sensitive further away. This also introduces left-right symmetry on the ground. Whilst this may not be observed, the assumption is that any assymetry is introduced by the footedness of players and not the characteristics of the ground. Accurate testing of this assumption will be the subject of future research, and will need to be done on a diluted data set, since equity will need to be estimated for left-footers on the left and right sides of the ground, and right-footers on the left and right sides of the ground.

To further increase the fitting power of the model, regression splines were used. The number of degrees of freedom on the spline terms was chosen via a standard F-test. Define, for a null model (M_0) and a nested comparison model (M_1)

$$F = \frac{(RSS_0 - RSS_1) / (p_1 - p_0)}{RSS_1 / (n - p_1)} \tag{7.1}$$

where RSS is the sum of squared residuals from the null model, p is the number of degrees of freedom and n is the number of data points. Under the null hypothesis that the model M_1 is no better at explaining the source data than M_0, F will follow an F-distribution with degrees of freedom (p_1-p_0,n-p_1).

The number of degrees of freedom chosen for the smoothed model were cho-

sen by iteratively increasing the number of degrees of freedom in the regression splines and calculating the p-value associated with the results from (7.1).

Five degrees of freedom was chosen as the most appropriate model for estimating equity gradients. Three of the four possession phases had stabilised by the fifth degree of freedom added to the regression spline, with no significant improvements observed by increasing the number of degrees of freedom. Results can be seen in Table 7.1.

Degrees of Freedom	Set Position	Uncontested	Looseball	Hardball
1				
2	2e-16	1e-4	1e-4	0.14
3	2e-9	5e-4	0.079	0.089
4	0.004	0.006	0.142*	0.063
5	0.097	0.017	0.152	0.067
6	0.217*	0.038	0.199	0.107*
7	0.294	0.069	0.263	0.176

Table 7.1: p-value of $F-Ratio$ test for degrees of freedom on regression splines for equity gradient calculation.
* Indicates the first stage where no significant benefit was seen by increasing the degrees of freedom.

7.2 Results & Discussion

From Figure 7.1 below it can clearly be seen that these smoothed equity gradients are more realistic than the raw figures presented in Figure 5.2.

The underlying shapes of the equity distributions from Figure 5.2 have been preserved.

By comparing the set position phase to the uncontested possession phase, it can be seen that in the defensive half the value of possession is comparable. For possessions in the forward half, and particularly inside the forward 50, there is a steeper increase in the value of set position relative to uncontested possessions.

This was explained earlier as being the effect of a set position kick within scoring range giving the player a chance to take his time while attempting a shot. From an uncontested possession a player doesn't have the luxury of extra time.

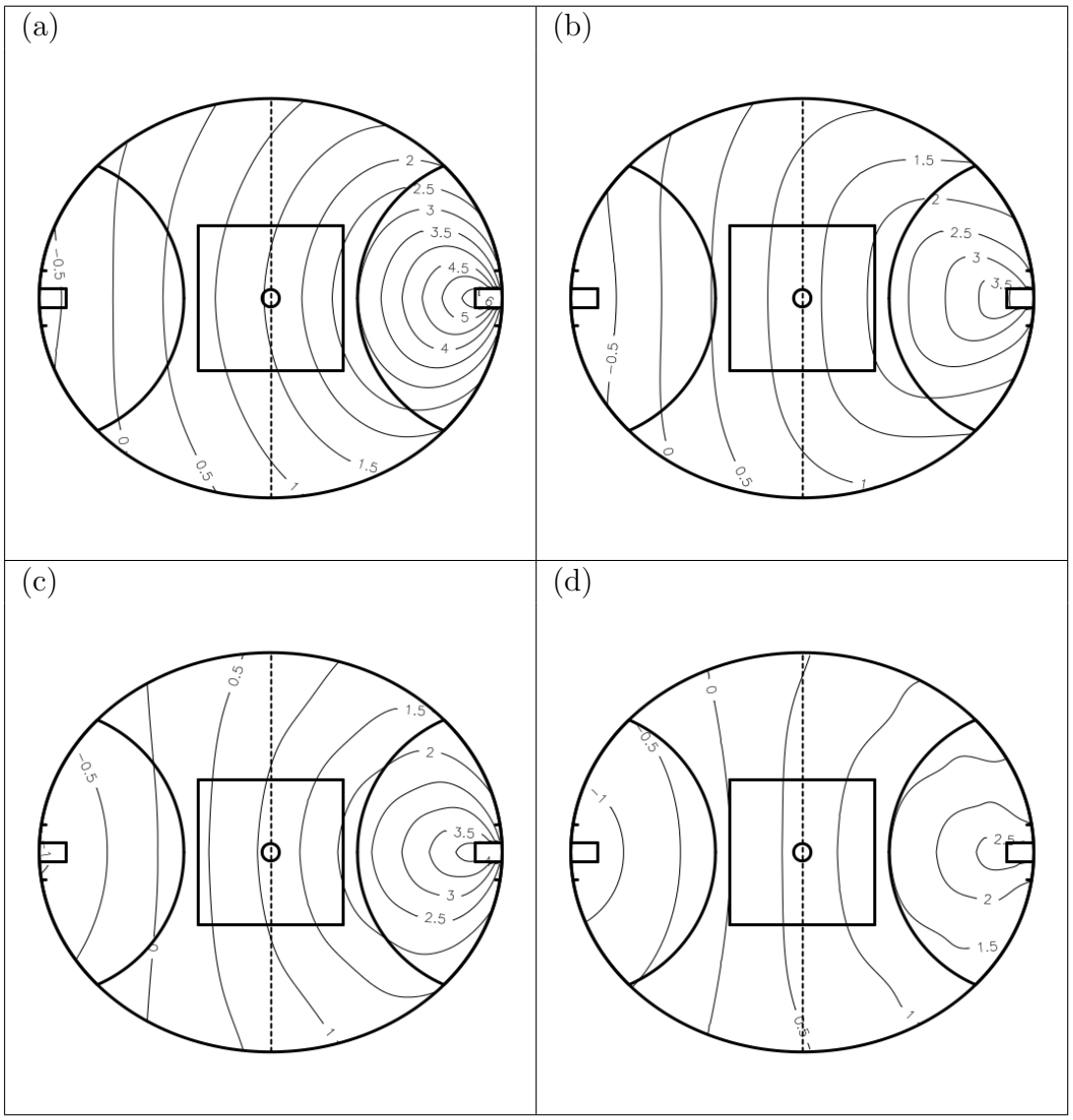


Figure 7.1: Field Equity smoothed for four phases of possession:
(a) Set Position (S).
(b) Uncontested Possession (U).
(c) Looseball Get (L).
(d) Hardball Get (H).

By comparing uncontested possession and looseball gets we see very little difference in the equity values. This may be due to a large proportion of uncontested possessions being handball receives (88% in 2015). Disposals after

a handball receive are under physical pressure more often than disposals after a looseball get.

After winning possession from a handball receive, the next disposal was under closing pressure 17% of the time in 2015, and under physical pressure 10% of the time. After a looseball get the next disposal was under closing pressure 27% of the time and physical pressure 7%. Hardball gets, though, are significantly lower than all other phases of possession across the entire ground. Disposals after a hardball get are under closing pressure 27% of the time, and under physical pressure 52% of the time.

As part of our player rating system in Chapter 9 we also wish to define two additional possession phases - marking contests and ground-level contests.

Marking contests are assumed to give each team a 50% chance of taking a mark. The equity gradient is then calculated as

$$E_F(x, M) = 0.5 \times E_F(x, S) - 0.5 \times E_F(-x, S) \tag{7.2}$$

Ground-level contests are assumed to give each team a 50% chance of winning a looseball get. The equity gradient is then calculated as

$$E_F(x, G) = 0.5 \times E_F(x, L) - 0.5 \times E_F(-x, L) \tag{7.3}$$

Figure 7.2 has the results of (7.2) and (7.3) in the form of equity gradients. Note that they are both symmetrical around the halfway line.

A marking contest in the offensive goal square is worth 3.0 points to the attacking team and -3.0 points to the defensive team.

A ground-level contest in the offensive goal square is worth 2.5 points to the attacking team and -2.5 points to the defensive team.

One other phase that is present in games is the kick-in. In the pilot rating

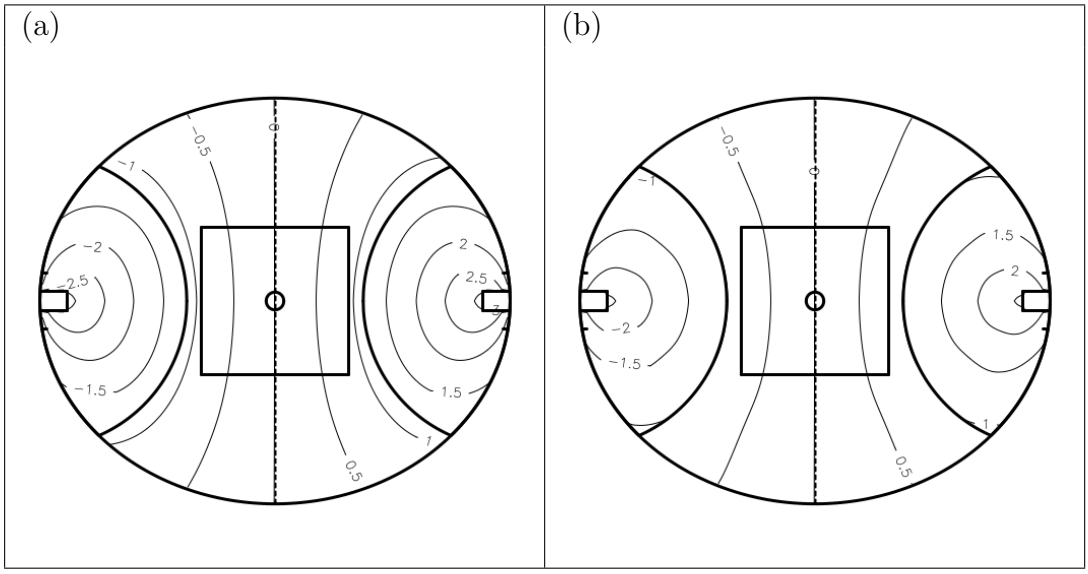


Figure 7.2: Field Equity for two contest phases:
(a) Marking Contest.
(b) Ground-level Contest.

system kick-ins were assigned zero equity. After further investigation, the equity of kick-ins was calculated at -0.48 points. For the sake of simplicity this was rounded to -0.5 points.

7.3 Conclusion & Future Developments

In this chapter smoothed equity gradients were calculated to enable the compilation of a player rating system.

All possession-like events are classified into four possession phases and two contest phases.

In the near future, player tracking data will enable a more rigorous classification of events. Knowing where all 44 players are standing, how fast they are moving and in which direction will enable more levels of pressure and congestion to be calculated, and thus making equity gradients more specific to the given situation.

Suggestions for future study include investigations into the effect of differ-

ent playing venues, and whether equity gradients remain stable across multiple seasons.

Chapter 8

Player Rating System - Points Allocation

With a robust measure of field equity having been established in Chapter 7, a rating system can now be constructed that accurately reflects player contribution. The pilot study in Chapter 6 gave a good starting point, but radical changes were made between then and the final product.

8.1 Included Statistics

In the pilot system, only possessions were counted towards a player's score. By extending to a more comprehensive system, more statistics are included, and each will be assessed as to its importance on the game outcome.

Players can gain or lose points in the following ways:

Possessions	Winning possession of the ball.
Disposals	Moving the ball on.
Hitout	Tapping the ball out of a ruck contest.
Spoil	Hitting the ball out of a marking contest to prevent an opposition mark.
Pressure	Attacking the ball carrier to make his disposal more difficult.
Free Kick	Committing an offence and giving control of the ball to the opposition.
Defensive Acts	Events such as spoils, tackles, and smothers that disrupt opposition ball movement.
Errors	Fumbling the ball or otherwise increasing the level of pressure you are under.

It is hoped that by considering more actions that the rating system will be a closer fit to the reality of player contribution.

Since equity is being assigned specifically to each action, careful consideration is needed as to how we allocate the points.

These decisions are the biggest source of subjectivity within the system, but after consulting with analysts at AFL clubs and internal Champion Data staff, it is felt that these allocations meet the desired criteria of reflecting the contribution of actions.

8.2 Points Allocation

In the pilot system, each change in equity was essentially double-counted by including both where the ball had come from, and where it finished, for each involvement.

The biggest change will be to move away from this method and to instead

assign each change in equity to a single action.

This will result in a final rating system where the difference in player points combined for each team will be a close representation of the final margin in the game.

In all of the sections below X_i is the location of the i^{th} event and ϕ_i is the possession phase of the i^{th} event.

8.2.1 Hitouts

When players are awarded with a hitout at a stoppage it can fall in one of three categories - to advantage, sharked, or neutral.

Hitouts to advantage direct the ball straight to a teammate, hitouts sharked direct the ball to an opposition player and neutral hitouts result in a ball that is still in dispute.

At each stoppage it is assumed that both teams have an equal chance of winning possession. For this reason, the ground-level contest phase is used to grade the equity for each team at the stoppage. Neutral hitouts are given no value since the possession phase has not changed.

In the case of other hitouts, the change in equity is shared between the ruckman and the midfield.

- For hitouts to advantage, two-thirds of the change in equity is given to the ruckman and one-third to the midfielder. See Equations 8.1 and 8.2.

$$\Delta E_F\left(\text{Hitout to Advantage}\right) = \frac{2}{3} \times \Big[E_F\left(X_{i+1}, L\right) - E_F\left(X_i, G\right)\Big] \quad (8.1)$$

$$\Delta E_F\left(\text{Gather from Hitout}\right) = \frac{1}{3} \times \Big[E_F\left(X_i, L\right) - E_F\left(X_{i-1}, G\right)\Big] \quad (8.2)$$

- For hitouts sharked, this is reversed, with two-thirds of the change given

to the midfielder (positive value) and one-third to the ruckman (negative value). See Equation 8.3 and 8.4.

$$\Delta E_F\left(\text{Hitout Sharked}\right) = \frac{1}{3} \times \Big[- E_F\left(-X_{i+1}, \phi_{i+1}\right) - E_F\left(X_i, G\right) \Big] \quad (8.3)$$

$$\Delta E_F\left(\text{Hitout Shark}\right) = \frac{2}{3} \times \Big[E_F\left(X_i, \phi_i\right) - E_F\left(X_{i-1}, G\right) \Big] \quad (8.4)$$

This two-thirds allocation is arbitrary, but it was felt that the ruckman deserves more credit than the midfielder for hitouts to advantage. Likewise, the midfielder sharking a ruckman's hitout is given more credit than the sharked ruckman receives as a penalty.

8.2.2 Possessions

When a player takes possession of the ball, this possession is classified as either contested or uncontested. These two are treated differently.

Contested Possessions (excluding Free Kicks)

Free kicks are generally considered to be a subset of contested possessions, but these will be dealt with as a separate category later.

When a player wins possession of a disputed ball, the player is credited with the change in equity from the disputed situation to the possession phase. Two disputed possession phases are possible - marking contests and ground-level contests.

- A contested mark is valued as the difference between the equity of a marking contest and the value of set position. See Equation 8.5.

$$\Delta E_F\left(\text{Contested Mark}\right) = E_F\left(X_i, S\right) - E_F\left(X_i, M\right) \quad (8.5)$$

- Ground level contested possessions are similarly valued as the difference between the equity of a ground-level contest at point x and the resulting possession phase (looseball or hardball) at point x. See Equation 8.6.

$$\Delta E_F\left(\text{Groundball Get}\right) = E_F\left(X_i, \phi_i\right) - E_F\left(X_i, G\right) \tag{8.6}$$

Exceptions to these rules exist for groundball gets:

- after a hitout to advantage the possession only gains one-third of the equity change. See Equation 8.2.
- after a hitout sharked the possession only gains two-thirds of the equity change. See Equation 8.4.
- after a teammate's spoil gaining possession the possession only gains half the equity change. See Equation 8.22.

Uncontested Possessions

Uncontested possessions occur when possession of the ball has essentially been given to the player, rather than the player having to actually win possession yourself. For this reason, uncontested possessions are generally assigned no value.

$$\Delta E_F\left(\text{Uncontested Possession}\right) = 0 \tag{8.7}$$

It has been argued that players should be rewarded for being able to find space, but the counter-argument is that finding space does not imply possession. Many situations occur where a player has found space, and may be in the best possible position for the team, but is not utilised by the ball-carrier.

The previous player with possession of the ball is in full control of whether you win possession.

Two exceptions exist for uncontested possessions - those won from an opposition disposal, and marks on a lead.

- If the ball was won off an opposition disposal, the change in equity is shared equally between the player winning possession (positive value) and the opposition player disposing of the ball (negative value). See Equation 8.8.

$$\Delta E_F\left(\text{Uncontested Intercept}\right) = \frac{1}{2} \times \Big[E_F\left(X_i, \phi_i\right) - -E_F\left(-X_{i-1}, \phi_{i-1}\right) \Big] \quad (8.8)$$

- When a mark on lead has been awarded, the main capture crew has determined that the player winning possession had to outsprint an opposition player in order to be a viable target. In this instance, the kicking player and the marking player are each given an equal share of the change in equity. See Equation 8.9.

$$\Delta E_F\left(\text{Mark on Lead}\right) = \frac{1}{2} \times \Big[E_F\left(X_i, S\right) - E_F\left(X_{i-1}, \phi_{i-1}\right) \Big] \quad (8.9)$$

8.2.3 Disposals

Disposals are graded based on the equity at the point of the disposal and the equity at the result. The starting equity is dependent on the assigned pressure level of the disposal. Pressure on a disposal is classified into one of the following categories:

- Set Position — After a mark or free kick. (Assigned to Set Position phase).
- No Pressure — No opponent is close enough to affect decision making. (Assigned to Uncontested phase).
- Corralling — Opponent guarding space, but not closing in on ball-carrier. (Assigned to Looseball phase).
- Chasing — Opponent closing in from behind a running player. (Assigned to Uncontested phase).
- Closing — Opponent in the area and approaching the ball-carrier. (Assigned to Looseball phase).
- Physical — Opponent has physical contact on player. (Assigned to Hardball phase).

The location of kicks are plotted, but handballs are not. For handballs, they are assumed to occur at the same location as the previous possession.

The endpoint of the disposal is treated as the next identified event in the game. There are nine possible outcomes, as listed below. The rules for evaluating disposals that result in each of these outcomes are also listed.

Marking Contest

Kicks that result in a free kick in a marking contest, contested mark, spoil, or one-on-one contest.

$$\Delta E_F = E_F\left(X_{i+1}, M\right) - E_F\left(X_i, \phi_i\right) \tag{8.10}$$

Ground-level Contest

Kicks that result in a groundball get, free kick at ground level, stoppage, knock-on or ground kick.

$$\Delta E_F = E_F\left(X_{i+1}, G\right) - E_F\left(X_i, \phi_i\right) \tag{8.11}$$

Teammate Uncontested Mark

Kicks that result in a teammate's uncontested mark or dropped mark.

$$\Delta E_F = E_F\left(X_{i+1}, S\right) - E_F\left(X_i, \phi_i\right) \tag{8.12}$$

Teammate Mark on Lead

Kicks that result in a teammate's mark on lead.

$$\Delta E_F = \frac{1}{2} \times \Big[E_F\left(X_{i+1}, S\right) - E_F\left(X_i, \phi_i\right) \Big] \tag{8.13}$$

Teammate Uncontested Gather

Kicks that result in a teammate's uncontested gather or a no-pressure error.

$$\Delta E_F = E_F\left(X_{i+1}, U\right) - E_F\left(X_i, \phi_i\right) \tag{8.14}$$

Opposition Uncontested Mark

Kicks that result in an opponent's unconstested mark or dropped mark, or out on the full.

$$\Delta E_F = \frac{1}{2} \times \Big[- E_F\left(-X_{i+1}, S\right) - E_F\left(X_i, \phi_i\right) \Big] \tag{8.15}$$

Opposition Uncontested Gather

Kicks that result in a opponent's uncontested gather or no-pressure error.

$$\Delta E_F = \frac{1}{2} \times \Big[- E_F\left(-X_{i+1}, U\right) - E_F\left(X_i, \phi_i\right) \Big] \tag{8.16}$$

Goal

Kicks that result in a goal.

$$\Delta E_F = 6 - E_F\left(X_i, \phi_i\right) \tag{8.17}$$

Behind

Kicks that result in a behind or rushed behind.

$$\Delta E_F = 1.5 - E_F\left(X_i, \phi_i\right) \tag{8.18}$$

Notes:

- Where the ball is sent to a contest the result of the disposal is considered to be the contest itself, ignoring any effect of a teammate's ability to win the contest. This may disadvantage players who are skillful enough to kick the ball to a teammate's advantage in contests, but since no information is available to measure this, it is not considered.
- When a behind is kicked, the final equity is 1.5 points. This takes into account the one point scoreboard value of a behind plus the negative 0.5 equity assigned to the kick-in phase for the opposition, essentially giving the scoring team a +0.5 equity.
- After the first year of the system it was decided to force effective handballs to be non-negative. Many players were taking uncontested marks and handballing to an open teammate. Under the strict rules of assessment this would lead to a negative rating, which was deemed to be unfair to these players. Thus, any effective handball that results in a negative score was set to zero points.

8.2.4 Run Equity

In the case where a player runs with the ball, this change in equity is added to the change in equity of the possession. If the same player eventually disposes of the football, the change in equity from running will be cancelled out by any gains or losses from the disposal.

Consider a full involvement for a player who wins possession, runs with

the ball and then disposes of it. We can define four events that make up this passage of play as: Prior to possession (P), after winning possession (O), at the end of a run (R) and after the disposal (D).

The change in equity for the full passage of play can be expressed as a function of the field equity of each of these four events. By extension, it can be shown that this overall change in equity is only dependent on the state prior to the possession (P) and the state after disposal (D).

$$\begin{aligned}
\Delta E_F &= \Delta E_F(\text{Possession}) + \Delta E_F(\text{Run}) + \Delta E_F(\text{Disposal}) \\
&= \Big[E_F(\text{O}) \text{ - } E_F(\text{P})\Big] + \Big[E_F(\text{R}) \text{ - } E_F(\text{O})\Big] + \Big[E_F(\text{D}) \text{ - } E_F(\text{R})\Big] \\
&= E_F(\text{D}) \text{ - } E_F(\text{P})
\end{aligned}$$

Also included in the run is a possible change in phase between the possession and the disposal.

For example, if a player wins a hardball get and then breaks a tackle to dispose of the ball in space, the difference in equity between the hardball get and the disposal being under no pressure will be assigned to the possession via the run equity.

Similarly, if a player wins the ball uncontested but runs into congestion, the disposal could be under more pressure with a lower equity, resulting in a negative run equity assigned to the possession.

In situations where the player in possession did not dispose of the ball, this run equity becomes important in evaluating the player's involvement.

An extreme example is if a player wins possession in the defensive 50, runs 100m downfield and is dispossessed by an opponent. In moving the ball that distance, he has contributed significantly more than just his original possession, even if he is dispossessed at the end of his run.

8.2.5 Free Kicks

Without exception, all free kicks are split into

- 'for' - the player awarded possession; and
- 'against' - the offending player.

The change in equity associated with the free kick is split evenly between the two players, such that:

$$\Delta E_F(\text{Free For}) = \frac{1}{2} \times \Big[E_F\left(X_i, S\right) - E_F\left(X_i, \phi\right) \Big] \tag{8.19}$$

$$\Delta E_F(\text{Free Against}) = \frac{1}{2} \times \Big[-E_F\left(-X_i, S\right) - E_F\left(X_i, \phi\right) \Big] \tag{8.20}$$

Free kicks given away in marking contests will have the marking contest phase as the source equity (ϕ above). All other free kicks use the ground contest phase.

8.2.6 Spoils

Spoiling a marking contest prevents an opposition player an opportunity to take a mark. The starting point of a spoil is considered to be a marking contest. Effective spoils are paid to players who direct a defensive spoil to a teammate to help win possession off the opposition. In this instance the spoiling player and the possession-winning player equally share the change in equity from the marking contest to the looseball get. All other spoils are paid to the next result.

$$\Delta E_F\left(\text{Effective Spoil}\right) = \frac{1}{2} \times \Big[E_F\left(X_{i+1}, L\right) - E_F\left(X_i, M\right) \Big] \tag{8.21}$$

$$\Delta E_F\left(\text{Poss after Eff Spoil}\right) = \frac{1}{2} \times \Big[E_F\left(X_i, L\right) - E_F\left(X_{i-1}, M\right) \Big] \tag{8.22}$$

$$\Delta E_F\left(\text{Other Spoils}\right) = E_F\left(X_{i+1}, \phi_{i+1}\right) - E_F\left(X_i, M\right) \tag{8.23}$$

In the 2015 season 96% of spoils resulted in a ground-level contest, with 37% leading to a teammate's contested possession, 32% to an opposition contested possession and 27% leading to a stoppage (21% out of bounds and 6% ball-up).

8.2.7 Pressure

Players can apply defensive pressure to opposition players to affect the field equity.

Pressure on Disposals

In cases where 'Run Equity' is negative, the player(s) who applied pressure to that disposal is credited with half of the change in equity from the original possession to the disposal.

$$\Delta E_F\,(\text{Pressure}) = \frac{1}{2} \times \Big[-E_F\,(-X_i, \phi_i) - -E_F\,(-X_{i-1}, \phi_{i-1}) \Big] \qquad (8.24)$$

Tackles

Tackles can be recorded by preventing a player in possession from getting a disposal away (including winning a free kick as a result of the tackle), forcing a non-effective disposal, or preventing a player with hands on the ball being credited with a possession.

If a player gets an ineffective disposal away then these tackles will be treated as pressure on disposals as in Equation 8.24.

If a free kick is won in the act of tackling then Equation 8.19 is used to evaluate the tackle.

If the tackle prevents an opponent being credited with a possession no value

is assigned. This is because the phase of possession hasn't changed, as it was already in dispute before the tackle was laid.

Where the player in possession is unable to get a disposal away the tackling player is rewarded with the change in equity from a hardball get to a ground-level contest.

$$\Delta E_F = E_F\left(X_{i+1}, G\right) - -E_F\left(-X_{i+1}, H\right) \tag{8.25}$$

8.2.8 Errors

Players who make an error in attempting to take an uncontested possession are punished with the difference between the ensuing possession and what should have occurred without the error.

$$\Delta E_F = E_F\left(X_{i+1}, \phi_{i+1}\right) - E_F\left(X_i, \phi\right) \tag{8.26}$$

where ϕ is set position for a dropped mark or uncontested possession for a fumbled handball receive.

8.3 Results

With the rules set in the previous section we can now investigate the application of these rules to actual games. From the 2014 and 2015 AFL seasons, rating point allocations were averaged across different event types to see their impact.

The values of actions are highly dependent on location. By grouping by the zone where the action occurred (defensive 50, defensive midfield, attacking midfield or forward 50), this will enable sensible comparisons but won't completely account for the location on the ground, meaning the following numbers are to be used as a guide only.

8.3.1 Hitouts

On average, a hitout was worth 0.1 points. Centre bounce hitouts were the most valuable, at +0.16 points, followed by Ball Up Hitouts (+0.09 points) and Throw In Hitouts (+0.07 points). Note that all neutral hitouts are assigned zero equity value so only hitouts to advantage and hitouts sharked are shown in Table 8.1.

As expected from the rules of assigning equity in Equations 8.1 & 8.3, the value of hitouts to advantage is roughly double the penalty for a hitout sharked.

	Def 50		Def Mid		Att Mid		Fwd 50	
Stoppage	Adv	Shark	Adv	Shark	Adv	Shark	Adv	Shark
CB			+0.77	-0.38				
BU	+0.74	-0.39	+0.48	-0.33	+0.45	-0.33	+0.55	-0.40
TI	+0.37	-0.19	+0.40	-0.21	+0.40	-0.21	+0.35	-0.19

Table 8.1: Equity value of hitouts by stoppage type and hitout result

It is worth noting that the average equity value of hitouts (ignoring result) is positive in all zones. When looking at just third-man hitouts, where the player winning the hitout wasn't one of the two ruckmen in the contest, the average equity in each zone is negative. This tells us that across the competition third-man hitouts are more likely to benefit the opposition than the player's own team.

8.3.2 Run Equity

Since zero equity is assigned to uncontested possessions from teammates we can use these situations to assess the contribution of run equity. On average, the run equity from ground level uncontested possessions is positive. From uncontested marks it is negative. The most likely explanation is that at ground level a player doesn't have the option to take a free kick, meaning he is more

likely to move towards goal if under no pressure. Players taking an uncontested mark have the option to take a free kick, which puts them further from opposition goal.

Excluding the forward 50, where most players are within range of goal, players take the option of the free kick roughly 60% of the time, only playing on 40% of the time. Inside the forward 50 roughly 90% of uncontested marks from a teammate's kick result in a player taking the option of the free kick.

In the 2015 season 99.4% of uncontested possessions led to a disposal to that player, meaning any negative value for run equity is consumed by the value of the following disposal, as was mentioned in Section 8.2.4.

Possession Type	Def 50	Def Mid	Att Mid	Fwd 50
Gather	+0.03	+0.02	+0.04	+0.08
Handball Receive	+0.02	+0.03	+0.05	+0.09
Uncontested Mark	-0.07	-0.07	-0.11	-0.41

Table 8.2: Run equity for uncontested possessions by possession type.

8.3.3 Contested Possessions

As mentioned in the previous section, the run equity is linked to the value of the possession, which needs to be considered in the following results. Table 8.2 above contained summary information of run equity after an uncontested possession, which was calculated as less than 0.1 points per possession in most situations.

Table 8.3 below contains a summary of points awarded for contested possessions.

Contested possessions after a sharked opposition hitout receive two-thirds of the value of normal contested possessions at that point, with the balance being made up by a negative rating for the opposing ruckman.

Looseball gets after a teammate's effective spoil gain half the points as the

change is shared with the spoiling player.

Possession	Def 50	Def Mid	Att Mid	Fwd 50
Contested Mark	+1.51	+1.13	+1.08	+1.51
Gather from Hitout to Advantage	+0.40	+0.41	+0.45	+0.58
Looseball Get (Sharked Hitout)	+0.81	+0.72	+0.69	+0.74
Looseball Get (Teammate Spoil)	+0.67	+0.52	+0.49	+0.64
Looseball Get (Other)	+1.17	+0.98	+1.00	+1.23
Hardball Get (Sharked Hitout)	+0.68	+0.59	+0.55	+0.49
Hardball Get (Teammate Spoil)	+1.04	+0.75	+0.65	+0.67
Hardball Get (Other)	+1.02	+0.74	+0.81	+0.70

Table 8.3: Equity value of contested possessions by zone.

8.3.4 Disposals

Kicks by Effectiveness

We start by investigating Champion Data's subjective categories for kicks. These are 'effective', 'ineffective', and 'clanger'. Effective kicks are further split into short kicks (less than 40m) and long kicks (over 40m).

In all zones outside the forward 50, short effective kicks were worth more than long effective kicks. Once inside the forward 50, more than three-quarters of effective kicks result in a goal, and long kicks being further out means a greater gain in equity.

Kick Category	Def 50	Def Mid	Att Mid	Fwd 50
Short Effective	+0.26	+0.29	+0.58	+1.81
Long Effective	-0.09	+0.18	+0.55	+2.79
Ineffective	-0.61	-0.43	-0.29	-1.22
Clanger	-0.97	-0.83	-0.89	-1.83

Table 8.4: Equity value of set or no pressure kicks by Champion Data category.

In all four zones effective kicks are worth more than ineffective kicks, which are in turn worth more than clanger kicks, as expected.

Note that long effective kicks from the defensive 50 have a negative overall value. This suggests that Champion Data's definition of 'effective' in this situation is misleading. Long kicks to a marking contest will be recorded as effective, but if the kick was under no pressure it is likely that this result is worse than the starting equity.

Kicks by Pressure Level

Pressure on the ball carrier significantly affects the outcome of kicks, as can be seen in Table 8.5 below.

Set position kicks are unexpectedly worth less than no pressure kicks, though this can easily be explained by noting that set position kicks imply a slow play, where opposition defenders have more time to reduce the number of viable options available to the kicker.

Pressure Level	Def 50	Def Mid	Att Mid	Fwd 50
Set Position	-0.01	+0.08	+0.20	+0.57
No Pressure	+0.10	+0.19	+0.47	+1.24
Chasing	+0.10	+0.27	+0.51	+0.91
Corralling	+0.05	+0.20	+0.40	+0.69
Closing	-0.16	-0.07	+0.12	+0.16
Physical	-0.10	-0.08	+0.16	+0.25

Table 8.5: Equity value of kicks by zone and pressure level.

Kicks by Intent

The outcome of kicks is also highly dependent on the intent of the kicker, as can be seen in Table 8.6 below. To control for pressure, only set position and no pressure kicks are included.

Note that the only decisions leading to a negative average outcome are kicks to a pack and kicks to clear congestion from the defensive 50. These kicks are often used as a last resort where a player has no open teammate to

kick to.

The most valuable kick in each zone is to a leading teammate, despite 85% resulting in a lead mark and thus receiving just half the change in equity. Kicks to a lead are only possible when a teammate is able to break free from an opponent, meaning it is an unlikely option in many situations, but an easy way to move the ball forward when the option does present itself.

Kicking Intent	Def 50	Def Mid	Att Mid	Fwd 50
Open Teammate	+0.10	+0.06	+0.37	+1.64
Leading Teammate	+0.21	+0.26	+0.48	+0.43
Pack	-0.26	+0.04	+0.32	+0.13
Covered Teammate	+0.03	+0.11	+0.24	+0.43
Clearing Congestion	-0.23	+0.01	+0.34	+0.11

Table 8.6: Equity value of set or no pressure kicks by zone and intent.

Kicks by Direction

Kicking direction affects the value of kicks as expected. Forwards kicks have a net positive value, lateral kicks are close to zero and backwards kicks carry negative value.

Direction	Def 50	Def Mid	Att Mid
Forwards	+0.04	+0.17	+0.33
Lateral	-0.01	+0.02	+0.15
Backwards	-0.22	-0.20	-0.09

Table 8.7: Equity value of set or no pressure kicks by zone and direction.

Kicks by Distance

As a further investigation into the effect of kicking distance, the following figures contain a distribution of equity ratings for kicks by zone. To control for kicking intent and pressure levels, only set position kicks that were kicked forwards towards attacking goals were included.

Figure 8.1 has a density plot of equity values for kicks in defensive 50, defensive midfield and attacking midfield, split by kicking distance.

In each of these three zones, kicking short is worth more than kicking long, though this bias lessens as the kicker gets closer to attacking goal. This is likely due to the high proportion of long kicks being sent to a disputed situation, whereas short kicks more easily retain possession.

A small local maximum at +0.8 points exists for long kicks from the defensive 50, for kicks that find an uncontested teammate. These kicks are less likely from the midfield, so they are not detectable in these plots.

Handballs by Pressure Level

The level of detail captured for kicks is not available for handballs, with no measure of intent, distance or direction.

Pressure plays a similar role to handballs as it does for kicks. A full list of average equity ratings can be seen in Table 8.8.

Pressure Level	Def 50	Def Mid	Att Mid	Fwd 50
Set Position	+0.01	+0.02	-0.01	-0.06
No Pressure	+0.05	+0.07	+0.04	+0.07
Corralling	+0.14	+0.18	+0.08	-0.04
Chasing	+0.19	+0.24	+0.13	+0.05
Closing	-0.07	-0.02	-0.08	-0.27
Physical	+0.07	+0.10	+0.15	+0.21

Table 8.8: Equity value of handballs by zone and pressure level.

Handballs from set position and no pressure have a lower average outcome than from higher levels of pressure. This is due to handballs at best resulting in an uncontested possession phase to the receiver, compared to kicks which have a chance of resulting set position. As such, only handballs that travel a long distance forwards (including the run prior to the handball) will result in a large positive gain.

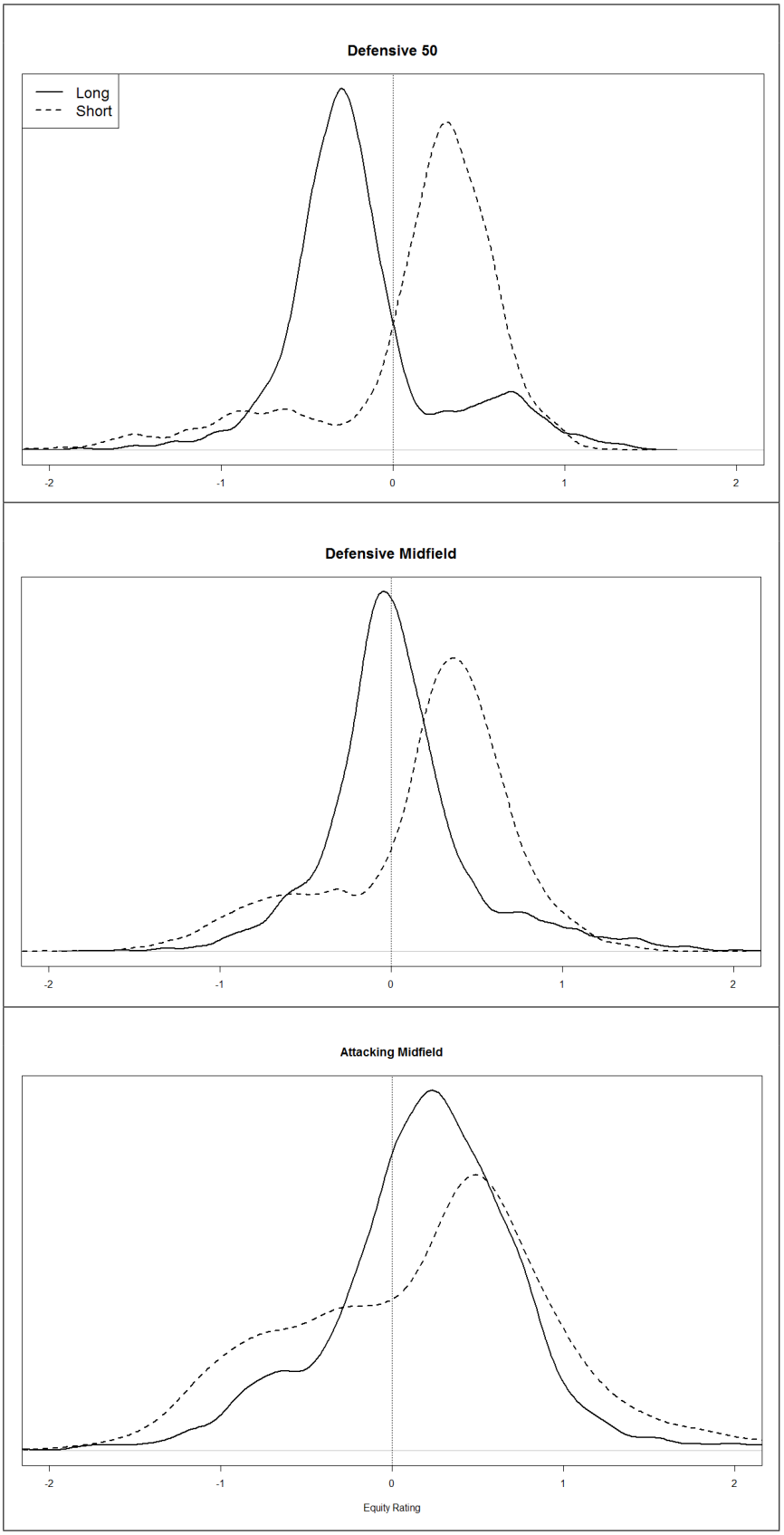


Figure 8.1: A comparison of Equity Rating by kicking distance for set position kicks sent forwards.

Also interesting is that handballs under closing pressure are worth less than handballs under physical pressure. This may be explained in three ways.

Firstly, the original equity of physical pressure is lower than closing pressure, so similar handballs will naturally value the ones under most pressure higher.

Secondly, since we are measuring the value of handballs, it doesn't include situations where a player intended to handball, but physical pressure prevented the handball from being released. If these situations could be measured and attributed to the player in possession they would likely result in a negative value similar to that which is obtained by handballing to a contest.

Finally, physical pressure implies that the defender is in contact with the handballer, and thus reducing the number of defenders around the play and opening up more space. 60% of handballs under physical pressure were judged as effective by Champion Data in 2015, meaning they got to their intended target.

Negative Handballs

Effective handballs with a negative value are set at zero points. The prevalence of these events can be seen in Table 8.9 below. Note that this is most common for set position, where a short handball puts the team in a worse position on average than the prior mark. Next-most common is from no pressure, where a lateral or backwards handball would not improve the position of the team.

Because of the steep equity gradients in the forward 50, any backwards handball is likely to result in a negative value, regardless of the original pressure level.

Pressure Level	Def 50	Def Mid	Att Mid	Fwd 50
Set Position	77%	69%	89%	96%
No Pressure	53%	49%	54%	62%
Corralling	15%	10%	25%	54%
Chasing	13%	8.9%	21%	41%
Closing	12%	9.0%	20%	46%
Physical	1.2%	1.2%	1.2%	1.3%

Table 8.9: Percentage of Effective Handballs assigned zero equity.

8.3.5 Pressure

Applying pressure to the ball carrier gains players roughly 0.06 points per event, or 1.2 points per 20 events. The 90th percentile for pressure acts on disposals in a game in 2015 was 20 events, so it is unlikely that pressure applied will have a significant contribution to a player's game. The most pressure acts on disposals recorded by a player in a game in 2015 was 39.

Affecting the disposal of the ball carrier by either tackling or smothering brings heavier rewards, with roughly 0.24 points per tackle and 0.96 points per smother. The increased value for smothers compared to tackles is due to two factors in the rules.

- Smothers assume the phase of the ball carrier is a looseball get, while tackles assume the phase is a hardball get. The difference between hardball gets and looseball gets can be up to 0.60 points, depending on the location on the ground.
- Tackles are also currently unrewarded if the starting phase was a ground-level contest, which affects 20% of tackles.

Also of note is the large negative value assigned to missed tackles. Missed tackles are only recorded when a player under physical pressure is able to beat the tackler and get into space, meaning an increase from the physical pressure state to the uncontested pressure state.

Pressure Level	Def 50	Def Mid	Att Mid	Fwd 50
Corralling	+0.01	+0.04	+0.06	+0.05
Chasing	+0.01	+0.03	+0.06	+0.05
Closing	+0.06	+0.06	+0.08	+0.08
Physical (on Disposal)	+0.16	+0.13	+0.13	+0.12
Tackle (Prevent Disposal)	+0.13	+0.21	+0.25	+0.31
Tackle (Rundown)	+0.17	+0.25	+0.32	+0.44
Tackle (Dispossessing)	+0.18	+0.25	+0.33	+0.42
Missed Tackle	-0.74	-0.46	-0.34	-0.36
Smother	+1.09	+0.93	+0.88	+1.00

Table 8.10: Equity value of pressure applied by zone.

8.3.6 Summary

Tables 8.11-8.14 below list the best and worst statistics in each zone, based on average equity gained per event.

The three zones excluding forward 50 all have the same five statistics as the most valuable - contested marks, contested knock-ons, effective ground kicks, looseball gets, and hardball gets. By definition, ground kicks and contested knock-ons treat the previous phase as a contest and as such, are essentially graded the same as a contested possession and kick, or handball, respectively.

In the forward 50 effective kicks move into the top-five most valuable stats, due to the vast majority (roughly 77%) resulting in a goal and the maximum possible six equity points as the final phase.

From a negative viewpoint, three events appear in the bottom-five for all four zones - dropped marks, no pressure errors and free kicks against. The first two of these are essentially the negative of contested possessions - converting near-certain possessions into disputed situations. Free kicks give your opponent the ball in a set position, which is the most valuable possession phase.

Others to appear in the top-five worst events are ineffective handballs,

clanger handballs, clanger kicks and ineffective kicks. By definition, these situations have either turned the ball directly over (clangers) or have put the ball into dispute at a location not advantageous to your team, so this result is not unexpected.

Statistic	Equity		Statistic	Equity
Contested Mark	+1.90		Dropped Mark	-1.43
Contested Knock-on	+1.90		No Pressure Error	-1.28
Effective Ground Kick	+1.27		Free Kick Against	-1.03
Looseball Get	+1.06		Clanger Handball	-0.84
Hardball Get	+1.00		Clanger Kick	-0.76

Table 8.11: Best and worst statistics by equity gain/loss in Defensive 50.

Statistic	Equity		Statistic	Equity
Effective Ground Kick	+1.27		No Pressure Error	-1.12
Contested Knock-on	+1.14		Dropped Mark	-1.07
Contested Mark	+1.12		Ineffective Handball	-0.72
Looseball Get	+0.91		Clanger Handball	-0.69
Hardball Get	+0.78		Free Kick Against	-0.68

Table 8.12: Best and worst statistics by equity gain/loss in Defensive Midfield.

Statistic	Equity		Statistic	Equity
Effective Ground Kick	+1.47		Dropped Mark	-1.30
Contested Mark	+1.08		No Pressure Error	-1.04
Contested Knock-on	+1.02		Clanger Kick	-0.73
Looseball Get	+0.90		Ineffective Handball	-0.67
Hardball Get	+0.71		Free Kick Against	-0.63

Table 8.13: Best and worst statistics by equity gain/loss in Attacking Midfield.

Statistic	Equity		Statistic	Equity
Effective Ground Kick	+3.41		Dropped Mark	-2.10
Effective Kick	+2.70		Clanger Kick	-1.29
Contested Mark	+1.53		No Pressure Error	-1.16
Looseball Get	+1.12		Ineffective Kick	-0.88
Contested Knock-on	+1.07		Free Kick Against	-0.82

Table 8.14: Best and worst statistics by equity gain/loss in Forward 50.

8.4 Discussion and Future Developments

The results above were considered to assess the contribution of single actions accurately enough to be the basis for a player rating system.

The most contentious assessment criterion from within the industry was the decision to assign zero points for uncontested possessions. Those who disagreed with this decision felt that the player winning possession should be rewarded for finding enough space to be used as an easier target for the disposal player than sending the ball to a contest. Many agreed with this decision, however, under the logic that a player finding space does not imply he will be used as a target for the ball-carrier, nor does an uncontested possession imply that a player was in the correct position.

With the inclusion of player tracking data, player movements should be able to be assessed and measured. Knowing how a player got in a position to receive an uncontested possession could allow a system where the uncontested possession is rewarded with some part of the change in equity. Likewise, it may be possible to reward players for off-the-ball running where they have created space without necessarily gaining possession.

One change that was implemented after the release of the initial system was to restrict effective handballs to be non-negative. This was done due to many players taking uncontested marks and handballing to players running past. Since no information is currently known about the locations of all players it is impossible to assess one handball receive differently from another based on the perceived pressure of the receiver. At all locations an uncontested mark is worth more than a handball receive in the equity gradients, meaning these handballs were resulting in negative value to the handballer, which was deemed to be unfair.

Two more potential changes are being considered in the near future:

1. Awarding all successful tackles with positive points, rather than just the

first in a string of consecutive tackles. The original logic was that the first tackle put the ball into a ground-level contest phase, which wasn't changed by subsequent tackles. After reviewing the practical application of this, however, it is clear that follow-up tackles can be as valuable as the first tackle in a sequence.

2. Rewarding defenders who neutralise one-on-one contests by treating these events as equivalent to spoiling a marking contest. By definition, a one-on-one contest implies that the ball is in a marking contest, so a defender can potentially bring the ball to ground level (prevent an opposition mark) by wrestling with the forward rather than by effecting a spoil.

In the medium-to-long term, considerations will need to be made about how to incorporate player-tracking data, when information is known not only about on-ball events and their locations, but also the positioning of all 44 players involved in the game. The most logical extension will be to recalculate equity gradients based on congestion and player movement. As an example, winning possession of the ball via a mark on halfway would be worth more to the team if the player had a clear run to goal, with no opponents ahead of him than if the player was the last line of defence and 22 opponents were in front of him. Currently these two situations are treated as equal.

Extensions will also be possible to better assess the equity gradients at the point of disposal. By knowing how much congestion a player is in and what options are available to him, the execution of his disposal can be better rewarded.

Chapter 9

Player Rating System

In Chapter 8 the rules for assigning points to each event were defined in terms of an equity value for that contribution, denoted by $E_F(i)$. A player's full-game rating can then be defined as the total contribution from each of that player's recorded events, which we will call **Equity Ratings**.

$$E_R(j) = \sum_{i=1}^{n_j} E_F(i) \tag{9.1}$$

where $j \in (1, 2, 3, \ldots, 44)$ represents an individual player and $i \in (1, \ldots, n_j)$ is a single event, with player j being involved in n_j events within the game.

9.1 Distribution of Equity Rating Points

A full record of included events in the player rating system is available from 2010. From then until the end of the 2015 season, a total of 1209 AFL games have been captured by Champion Data, totalling 53,196 individual player games.

The best game recorded was 50.5 points by Lance Franklin of Hawthorn in

Round 10 of 2012 against North Melbourne. In this game he kicked 13 goals, 11 of which were outside 30m from goal.

The worst game recorded was -8.4 points by Brandon Jack of Sydney in Round 16 of 2013 against GWS Giants. From seven kicks just two were effective, with the others resulting in two turnovers and three behinds. He also gave away two free kicks, dropped an uncontested mark and made a no-pressure error.

The average game recorded is roughly 9.5 points, while the median is 9.0.

Count	Minimum	Maximum	Mean	Median	Std Dev	Skewness
53,196	-8.4	50.5	9.5	9.0	5.6	+0.58

Table 9.1: Summary of single game Equity Rating points

Nearly 98% of games are above zero points and more than 95% are below 20 points, so $(0, 20)$ acts as a natural bound for expected performance. There is an average of nearly two players per game (1.95) reaching 20 points, compared to one every 11.6 games reaching 30 points. A full breakdown of points into 10-point bins can be seen in Table 9.2.

Range (points)	Count	% Total
< 0	1164	2.2%
[0,10)	29,198	54.9%
[10,20)	20,482	38.5%
[20,30)	2,248	4.2%
[30,40)	100	0.19%
[40,50)	3	0.006%
≥ 50	1	0.002%

Table 9.2: Equity Rating points in 10-point bins.

The distribution of all scores on record has a small positive skew (+0.58), as can be seen in Figure 9.1.

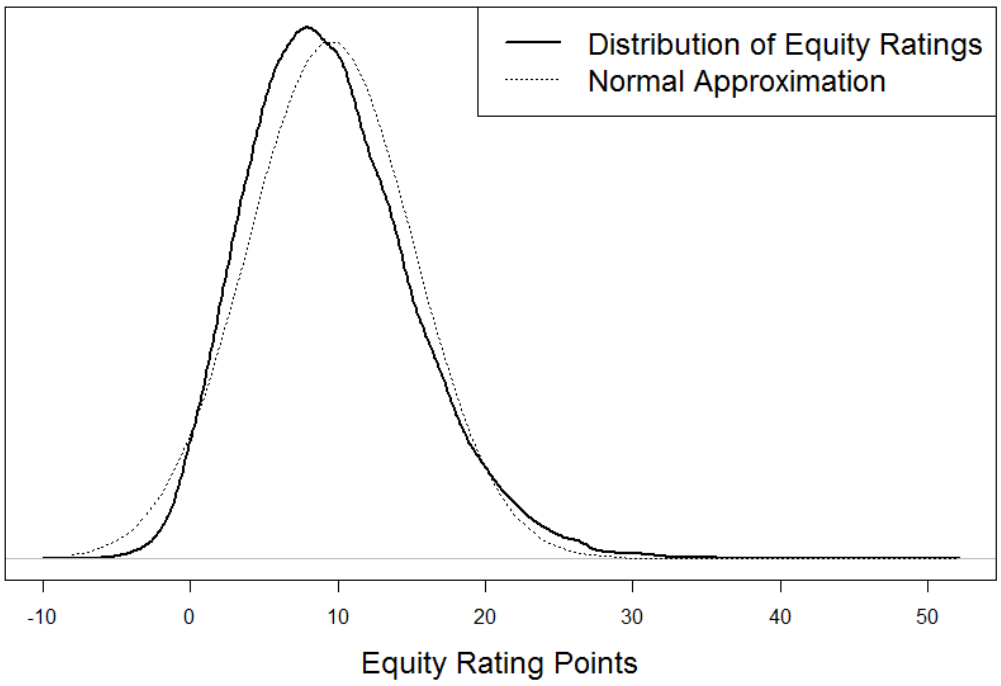


Figure 9.1: Distribution of Equity Rating points.

9.1.1 Rank Order

Within the full list of individual games 1,121 players are represented, of which 873 played 10 or more games, 451 played 50 or more and 186 played 100 or more.

Because of the potential large differences in player quality, it is worth investigating the distribution of points within playing ability. More detailed investigations into player quality will be done in later sections, but for now we will look at the distribution of points based on rank order within a match.

Figure 9.2 has the median score and a 95% confidence interval summarised by rank order within a match.

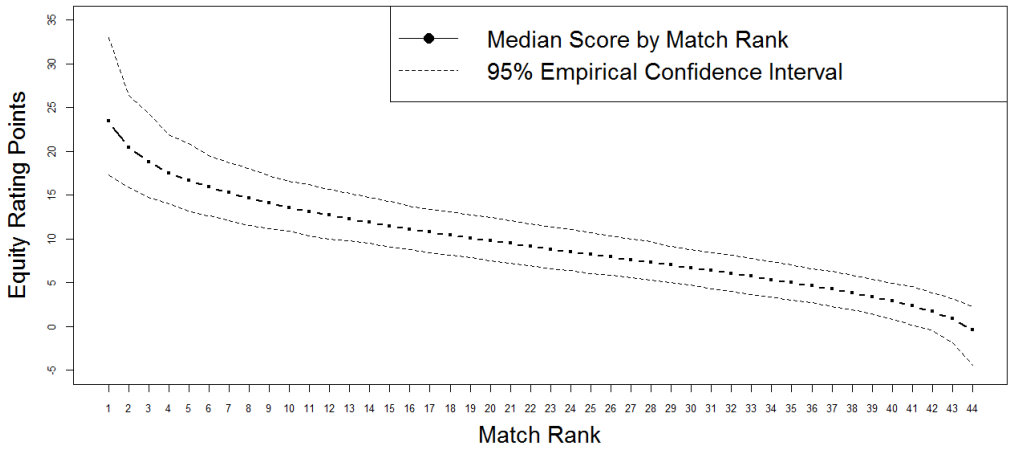


Figure 9.2: Distribution of Equity Rating points based on rank order within game.

The median score for the 'best' player in a game is 23.4 points, with 95% scoring between 17.3 points and 33.0 points.

The 10th-best player in a game has a median score of 13.6, with 95% scoring between 10.9 points and 16.6 points.

The worst player in a game has a median score of -0.4 points, with 95% scoring between -4.4 and 2.2 points.

9.1.2 Match Result

Also of interest is how points are distributed between winning and losing teams. For all players by rank order, the winning team outscores the losing team, on average. This can be seen in Figure 9.3.

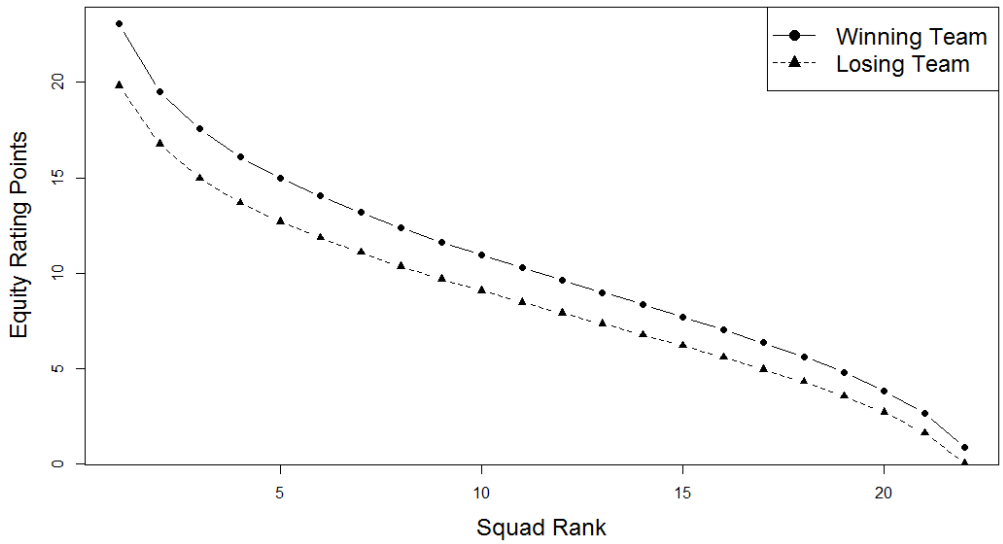


Figure 9.3: Average Equity Rating points by squad rank and squad result.

The biggest discrepancy between the two teams is the top-scoring player, with an average difference of 3.2 points in favour of the winning team. This advantage drops for each subsequent rank order, but the advantage remains positive, with an advantage of 0.9 points for the lowest-scoring player in the game for each team.

From Figure 9.4 below we can see that the range of differences for the top-scoring player for each team is much larger compared to the other squad ranks.

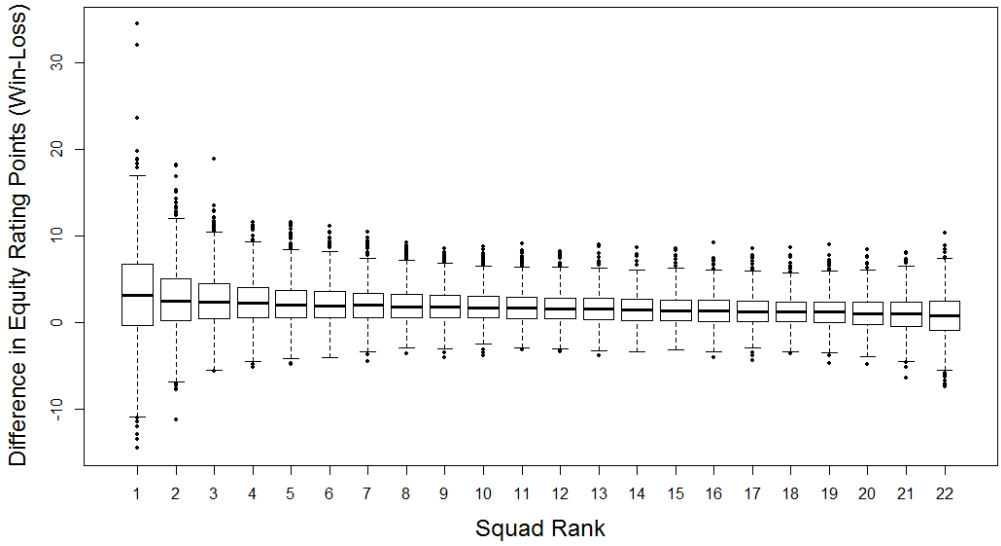


Figure 9.4: Average Equity Rating points difference between squads, by squad rank.

Despite having the largest difference between average scores of winners and losers, in just 73.5% of games the top-scoring player on the winning team outscored the top-scoring player on the losing team. Only the bottom-three scoring players on each team have a lower proportion of winners outscoring losers. A full breakdown by squad rank can be seen in Figure 9.5.

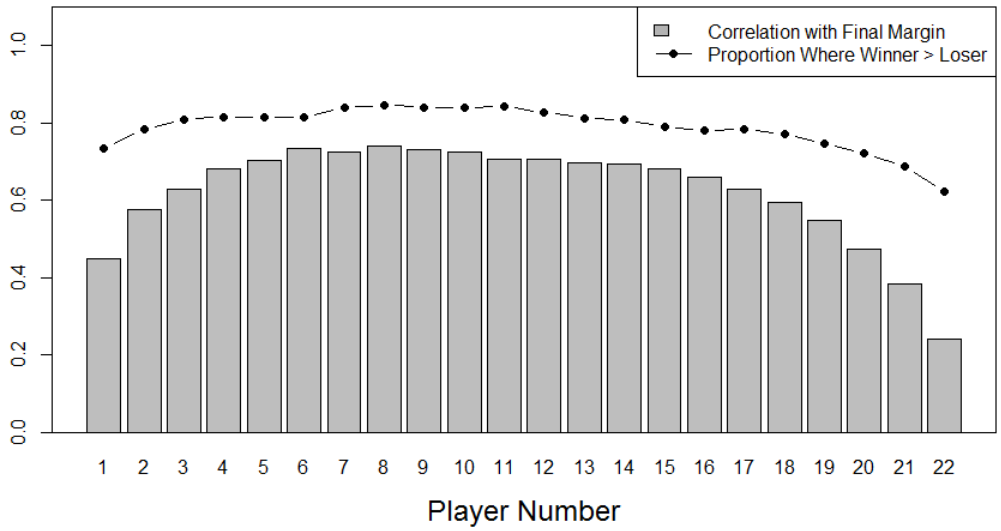


Figure 9.5: Correlation of win-loss differences by squad rank.

The plot also contains a correlation between the win-loss difference of each squad rank and the final margin. This correlation peaks at the eighth player,

though all players between the fifth and 13th have a correlation above 0.70. As with the proportion with positive differences, the top-scoring player has a lower expected correlation of 0.45.

9.1.3 Player Position

Also underlying the single game points is the bias created by player position. Table 9.3 below contains a summary of Equity Rating points by position, with the maximum value in bold and the minimum in italics. A more thorough assessment of rating points by position will be conducted in following sections.

The highest-scoring position is midfield, with an average of 10.7 points per game.

The lowest scoring position is key defender, with an average of just 8.5 points per game. Key defenders also show the lowest variation in scores, with a standard deviation of just 4.6 points, compared to the population value of 5.6 points.

The most volatile position is key forward, with a standard deviation of 6.2 points. Key forwards have a 95th-percentile of 20.4 points - the third-highest of any position - and a fifth-percentile of 0.3 points - the lowest of any position.

Position	5%	25%	Median	Mean	75%	95%	Std Dev	CV
Mid	**1.8**	**6.4**	**10.3**	**10.7**	**14.4**	**21.3**	5.9	55.3%
Mid-Fwd	1.4	5.9	9.6	10.2	14.0	20.9	5.9	58.3%
Ruck	1.3	5.4	8.8	9.3	12.8	18.7	5.4	58.0
Gen Fwd	0.8	5.0	8.7	9.2	12.9	19.6	5.8	63.0%
Key Fwd	*0.3*	*4.7*	8.5	9.2	12.9	20.4	**6.2**	**68.0**%
Gen Def	1.4	5.2	8.3	8.7	11.8	17.3	4.9	56.4%
Key Def	1.6	5.2	*8.1*	*8.5*	*11.3*	*16.6*	*4.6*	*53.8*%
All	1.3	5.5	9.0	9.5	13.0	19.6	5.6	59.0%

Table 9.3: Summary of Equity Rating points by player position.

9.1.4 Player Experience

Initial investigations showed trends of player performance relative to experience, in terms of career games played. Figure 9.6 contains a plot of the average Rating Points gained for each match number of a player's career. A debutant is playing game No.1, his second game is game number two, and so on.

There appears to be a significant improvement through a player's first 50 games, reduced improvement through the next 100 games and then a plateau after 150 games.

The lines in Figure 9.6 represent a basic linear fit through average performances split into 50-game blocks.

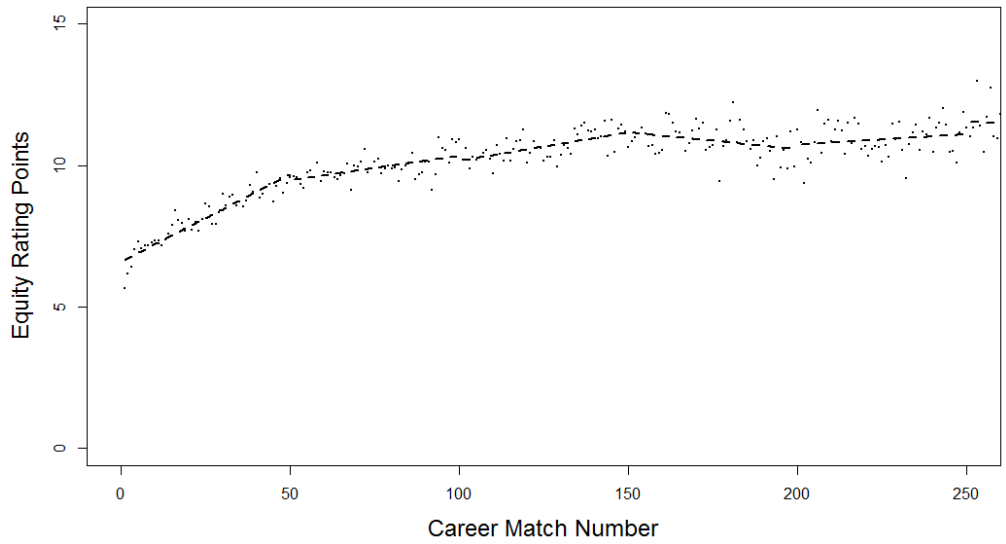


Figure 9.6: Equity Rating points by career experience

Further investigations, however, suggested that a factor in the improvement by career match number was survivorship bias. Players performing poorly early in their careers are unlikely to have extended careers, and thus drag down the averages of early match numbers while not affecting later match numbers.

Due to only having six seasons of Equity Rating Points available (2010-2015) a full investigation into the effect of experience is not possible. Just 25

of 608 players to have debuted since 2010 have gone on to play 100 or more games in that time, with 131 being the most games played by a single player.

As a starting point, we can consider the 147 players to have played 50 or more games. Figure 9.7 contains career trajectories for players who debuted since 2010, showing results for all players and for those who have played 50 or more career games.

Though the results are far from conclusive, they seem to suggest that players who eventually reach 50 or more games start their careers better and have more gradual improvement.

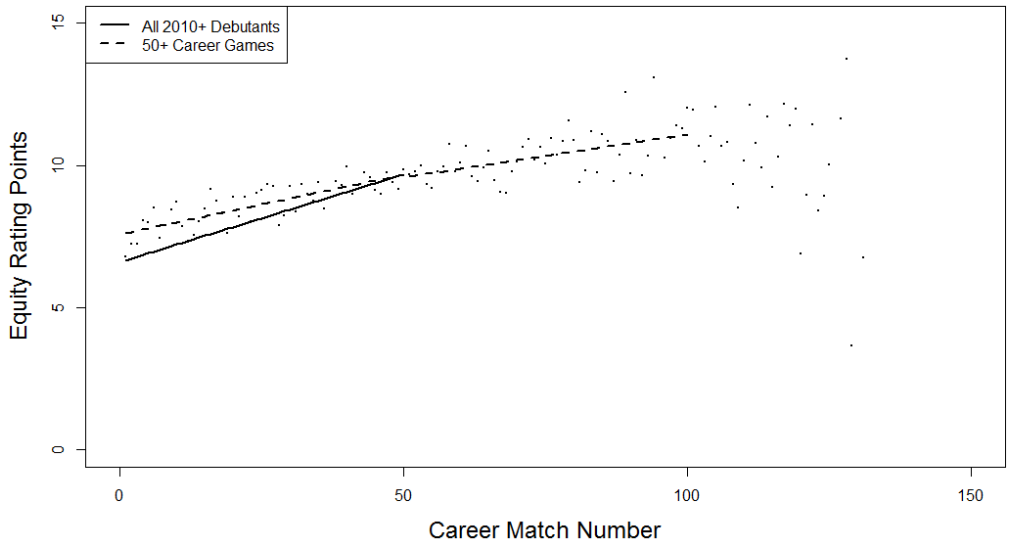


Figure 9.7: Equity Rating points by career experience (Debutants since 2010)

9.2 Equity Rating Source

In Chapter 8 we outlined the method for assigning Equity Rating points to events. With the system now compiled we can investigate which players excel in certain aspects of the game. The average breakdown of points from the 2015 season across all players is shown in Table 9.4.

Point Source	Points per Player Game	Percentage of Total
Possession	5.8	62.3%
Disposal	2.6	28.5%
Hitout	0.2	2.3%
Defensive	1.6	16.9%
Free Against	-0.6	-6.7%
Other	-0.3	-3.3%
Total	9.3	

Table 9.4: Points breakdown of Equity Ratings in 2015.

These position distributions change by player position, which is shown in Table 9.5.

Point Source	Key Def	Gen Def	Ruck	Mid	Mid-Fwd	Gen Fwd	Key Fwd
Possession	63%	61%	60%	66 %	66%	55%	60%
Disposal	14%	28%	6%	27%	26%	40%	40%
Hitout	0%	0%	29%	0%	0%	0%	2%
Defensive	33%	19%	2%	15%	17%	15%	12%
Free Against	-8%	-6%	-9%	-6%	-7%	-6%	-7%
Other	-2%	-2%	-2%	-2%	-2%	-3%	-5%

Table 9.5: Points breakdown of Equity Ratings in 2015 by player position.

Note that points from hitouts make up 29% of points for ruckmen, with all other positions being close to zero.

General forwards and key forwards gain the most points from their disposal. This is due to the large gains possible for effective ball use in the forward half of the ground, as a result of steep equity gradients. Ruckmen and key defenders gain the least from their disposal of all positions.

Key defenders gain one-third of their points from defensive acts (spoils, smothers, tackles, and pressure applied) while no other position gains more than 20%.

Points lost from free kicks is relatively stable across all positions. Points lost from other acts (mostly dropped marks and no-pressure errors) are consistent

across most positions, with key forwards losing more than others. This is again due to the steep equity gradients in the forward half, resulting in increased penalties for these skill errors.

9.2.1 Possession

As we saw in Table 9.4 above, the average player earns 5.8 points per game from winning possession of the ball - 62% of their total score. Table 9.6 has a list of the top-five players for total points per game from possessions, and the top-five for percentage of total points, from the 2015 season.

Player	Club	Pos	Points
Nat Fyfe	FREM	Mid	14.4
Patrick Dangerfield	ADEL	Mid	12.4
Josh Kennedy	SYD	Mid	12.4
Robbie Gray	PORT	Mid	11.4
Joel Selwood	GEEL	Mid	11.0
Player	**Club**	**Pos**	**% Total**
Nakia Cockatoo	GEEL	Gen Fwd	118%
Matt Taberner	FREM	Key Fwd	101%
Jesse Lonergan	GCS	Mid	97%
Patrick Cripps	CARL	Mid	96%
Matt Crouch	ADEL	Mid	91%

Table 9.6: Top-five players for Equity Rating points from possessions - average per game and percentage of total.

Nat Fyfe was the top-scoring player overall for the 2015 season, and also led the competition in points from possessions. He gained 77% of his points from winning the ball and just 22% from his ball use. This is compared to the AFL averages for a midfielder of 66% and 27%.

Nakia Cockatoo and Matt Taberner won more points from possession than their total points per game.

Cockatoo won 3.7 points per game from possession and lost 1.0 per game from his disposal. Other categories added up to 0.5 points to give him an

average of 3.2 points per game.

Taberner won 4.0 points per game from possessions and 1.0 per game from his disposal, but lost 0.9 per game from free kicks and 0.7 per game from errors. He averaged 4.0 points per game.

9.2.2 Disposal

Players who gain more points from disposals than average are generally good users of the ball, and good users in valuable situations. Table 9.7 contains the top-five players from 2015 for average points per game from disposals, and the top-five players for percentage of total points.

Player	Club	Pos	Points
Chad Wingard	PORT	Gen Fwd	7.5
Brent Harvey	NM	Gen Fwd	7.0
Jake Stringer	WB	Gen Fwd	6.9
Dylan Shiel	GWS	Mid	6.7
Scott Pendlebury	COLL	Mid	6.7
Player	Club	Pos	% Total
Taylor Walker	ADEL	Key Fwd	61%
Cam McCarthy	GWS	Key Fwd	61%
Lindsay Thomas	NM	Gen Fwd	58%
Bradley Hill	HAW	Mid	58%
Jake Stringer	WB	Gen Def	55%

Table 9.7: Top-five players for Equity Rating points from disposals - average per game and percentage of total.

Chad Wingard led the competition for points from disposals in 2015, followed by Brent Harvey. Harvey will be used as a case study for player value in Section 10.4.2.

9.2.3 Hitout

Ruckmen win nearly 30% of their points from hitouts, on average. Table 9.8 contains the top-five players from 2015 for average points per game from hitouts, and the top-five players for percentage of total points.

Player	Club	Pos	Points
Todd Goldstein	NM	Ruck	6.7
Aaron Sandilands	FREM	Ruck	6.4
Sam Jacobs	ADEL	Ruck	6.0
Nic Naitanui	WCE	Ruck	5.6
Max Gawn	MELB	Ruck	5.4
Player	**Club**	**Pos**	**% Total**
Tom Bellchambers	ESS	Ruck	49%
Mike Pyke	SYD	Ruck	45%
Sam Jacobs	ADEL	Ruck	43%
Max Gawn	MELB	Ruck	41%
Aaron Sandilands	FREM	Ruck	41%

Table 9.8: Top-five players for Equity Rating points from hitouts - average per game and percentage of total.

Todd Goldstein led the competition in Hitouts to Advantage in 2015 and won the most points per game from his hitouts.

9.2.4 Defensive

Key defenders won roughly one-third of their points from defensive acts, and they dominate the top-scoring players from this source in 2015. Table 9.9 contains the top-five players from 2015 for average points per game from defensive acts, and the top-five players for percentage of total points.

Player	Club	Pos	Points
Steven May	GCS	Key Def	5.1
Alex Rance	RICH	Key Def	4.6
Phil Davis	GWS	Key Def	4.5
Tom McDonald	MELB	Key Def	3.8
Daniel Merrett	BRIS	Key Def	3.8
Player	Club	Pos	% Total
Luke Delaney	STK	Key Def	63%
Rory Thompson	GCS	Key Def	51%
Joel Hamling	WB	Key Def	49%
Nathan Brown	COLL	Key Def	48%
Alex Pearce	FREM	Key Def	45%

Table 9.9: Top-five players for Equity Rating points from defensive acts - average per game and percentage of total.

Steven May led the competition in defensive points in 2015, thanks mostly to his 8.4 spoils per game - the most in the AFL. He was also sixth for percentage of points from defensive acts.

Second to May was Alex Rance, who was just 41st for percentage of points from defensive acts. Rance was fourth in the AFL for intercept possessions in 2015, compared to May who was just 24th.

9.3 Assessment of Rating System

The proposed system had two main aims:

1. To be less biased by player position than previous systems.
2. To better measure player performance than previous systems.

The bias amongst positions will be calculated by comparing each position type to the midfield category.

Rating systems in team sports and individual sports can use match results as an objective measure to assess the rating system. When rating players in a team environment though, no objective measure exists, so alternative methods of assessment must be used. In this section we will compare Equity Rating points to existing methods of player ratings, using subjective industry awards as a guide.

We will also compare the outcomes of the rating systems against the observed match results to assess how closely they represent what occured in the game.

9.3.1 Comparison of Systems - Match Points

Firstly, we will compare the outputs of the three main rating systems - AFL Fantasy, Champion Data ranking points and Equity Ratings. Table 9.10 below shows the correlations between each of the three rating systems. Equity Ratings is closest to Ranking Points, but Ranking Points and AFL Fantasy are closer to each other than to Equity Ratings.

Note that perfect correlation is not desirable, since that would imply that the new system hasn't introduced any new information. Strong, positive correlations indicate that traditional 'good' games are still being rewarded under the new system.

	Ranking Points	AFL Fantasy
Equity Rating	0.78	0.63
Ranking Points		0.89

Table 9.10: Correlation between rating systems.

Figure 9.8 shows a full plot of all player games to illustrate the above correlations. In general, higher games in both previous systems lead to higher games in Equity Ratings. The highest-scoring ranking points game was also the highest-scoring game in Equity Ratings - Lance Franklin's 13-goal game.

The sixth-best ranking points game, however, was just 2,454th in Equity Ratings. In Round 15, 2012, Dean Cox reached 215 ranking points, thanks mainly to the increased weight attached to points late in close games. The final margin was just two points and Cox contributed with a goal, a score assist and two contested marks in the final 10 minutes. Half of Cox's 24 hitouts were neutral, which still carried points in the ranking points system but are worth no points in Equity Ratings. Cox was considered the fourth-best player on the ground by Equity Ratings.

Likewise, the second-best game recorded in AFL Fantasy received just 11.3 Equity Rating points - just 20th on the ground for the game and 18,157th overall. Brent Stanton in Round 6, 2012 had 39 disposals, but just five of 41 possessions were contested, he gained just 492 metres with the ball and he failed to convert any of his three shots at goal.

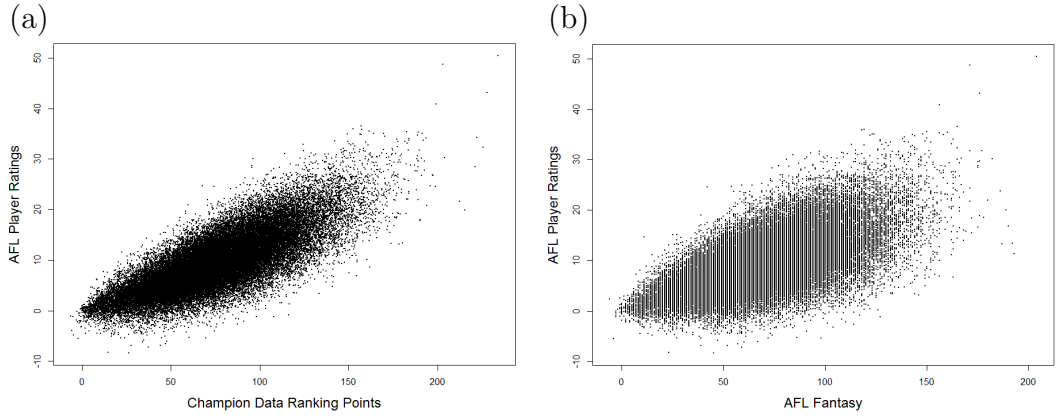


Figure 9.8: Comparison of player rating systems.

9.3.2 Comparison of Systems - Event Points

To gain a better understanding of the workings of the system, and how it compares to existing systems we will consider several scenarios and how they are valued in each system. In each scenario we will present the raw change in points for the ratings systems, as well as a relative number where the raw value is divided by the average game by a player.

From the 2015 seasons, these were 9.3 points for Equity Ratings, 98.7 points for Champion Data ranking points and 70.7 points for AFL Fantasy.

Note that the average for Champion Data ranking points, and all numbers presented below, use only the raw value of statistics and the zone weight applied. Game-state weighting (used to reward events late in close games) and the game standardisation (applied so every game adds up to 3300 points) have been removed from the calculation.

Kicks by Direction

The first scenario we will consider is a kick after taking a mark at half-forward - 10m wider than the front corner of the centre square (65m from goal). From this point, consider that a player has three teammates who are open and he is certain of reaching each of them via an uncontested mark if he chooses to kick it to them. One is 35m from goals directly in front (forwards), one is 57m from goals on the boundary line (lateral), and one is 50m behind him (backwards).

Kicking the ball to the player 35m out is the best option to take, since the player will be in scoring range. The player 57m out is closer to goal but on a wider angle. The player behind him is 45m further from goal, making him an undesirable option.

Based on these three options we will now assess how the three player rating systems award points if that option was taken and executed. The results are in Table 9.11.

	AFL Fantasy		Ranking Points		Equity Ratings	
Scenario	Pts	%	Pts	%	Pts	%
Forwards	3.0	4.2	3.7	3.8	1.9	20.4
Lateral	3.0	4.2	3.7	3.8	-0.2	-2.2
Backwards	3.0	4.2	0.9	0.9	-1.4	-15.1

Table 9.11: Comparison of points for kicks by direction.

We can see that Equity Ratings places a large value on the forwards kick, treats the lateral kick as a slight negative, and the backwards kick as a large negative.

The ranking points system treats the forwards kick and the lateral kick the same, while giving a positive but smaller reward for the backwards kick.

The AFL Fantasy system treats all three kicks as identical.

Kicks by Outcome

The next scenario considers the forwards kick from the above scenario, but assesses how the outcome of the kick affects its value. Three possible outcomes are considered - a kick to a teammate's uncontested mark (considered effective by Champion Data), a kick to a marking contest (considered ineffective by Champion Data), and a kick to an opposition player's uncontested mark (considered a clanger by Champion Data). The results of these three outcomes are in Table 9.12.

	AFL Fantasy		Ranking Points		Equity Ratings	
Scenario	Pts	%	Pts	%	Pts	%
Teammate Unc. Mark	3.0	4.2	3.7	3.8	1.9	20.4
Marking Contest	3.0	4.2	0.0	0.0	-0.2	-2.6
Opposition Unc. Mark	3.0	4.2	-3.7	-3.8	-1.2	-12.7

Table 9.12: Comparison of points for kicks by outcome.

Here we can see that AFL Fantasy again treats all three kicks as the same. Champion Data's ranking points are adjusted based on the quality of the kick, but the size of the difference between the best and worst kicks are much smaller than the difference as calculated for Equity Ratings.

Shots at Goal

If a teammate marked the kick in question above, they would have a shot at goal from 35m out, directly in front of goal. Assuming the player then took a shot at goal, we can assume that one of three outcomes is possible - a goal, a behind, or a missed shot with the ball going out on the full. Players from this position kicked at 75% accuracy in 2015. The results of these three outcomes are in Table 9.13.

	AFL Fantasy		Ranking Points		Equity Ratings	
Scenario	Pts	%	Pts	%	Pts	%
Goal	9.0	12.7	13.4	13.5	2.0	21.8
Behind	4.0	5.7	1.1	1.1	-2.5	-26.6
Out on Full	3.0	4.2	-4.5	-4.5	-3.5	-37.3

Table 9.13: Comparison of points for shots at goal - 35m out.

AFL Fantasy treats each of the outcomes as a positive contribution. Champion Data ranking points treats the goal and the behind as positives, but the missed shot as a negative. Equity Ratings treats only the goal as a positive contribution and the other two as larger negatives.

In the above situation it may be hard to see the deficiency of the Champion Data ranking points system in assessing shots at goal, but this becomes more apparent by changing the location of the shot. If the shot was taken from 15m out rather than 35m out, this shot now has an expected accuracy of 95%, but the ranking points method still treats the outcomes as the same as the 35m shot.

In Equity Ratings, a goal from this situation is now worth just 0.6 points, a behind loses 3.9 points and a missed shot loses 4.9 points.

If the shot is moved to 50m out near the boundary line the expected accuracy drops to 31% and again AFL Fantasy and Champion Data ranking points assign the same number of points as for other shots. In Equity Ratings, a goal is worth 3.9 points, a behind is -0.6 and a missed shot is -1.6 points.

Run and Handball

The next scenario is a player who wins the ball on the half-back flank via a looseball get, then handballs to a teammate. The three options are to run backwards and handball to a teammate in defensive 50, handball immediately to a teammate, or run forwards and handball to a teammate. The results are in Table 9.14.

	AFL Fantasy		Ranking Points		Equity Ratings	
Scenario	Pts	%	Pts	%	Pts	%
Backward	2.0	2.8	1.4	1.4	0.0	0.0
Immediate	2.0	2.8	1.4	1.4	0.3	3.2
Forward	2.0	2.8	1.4	1.4	1.4	15.1

Table 9.14: Comparison of points for handballing to a teammate.

In each situation, AFL Fantasy and ranking points assigns the same number of points. Equity Ratings treats the backwards handball as having no value, the immediate handball with a low value and the handball after running forwards with a larger positive value. This takes into account that the team is now 25m closer to goal than the immediate handball and 50m closer to goal than the backwards handball.

Intercept Marks

For the final comparison we will consider a defensive player intercepting an opposition kick that came from 60m out in the centre of the ground. Four situations will be considered - a contested mark 40m from defensive goals, an uncontested mark at the same location, a contested mark 10m from defensive goals and an uncontested mark at this location. The results are in Table 9.15.

	AFL Fantasy		Ranking Points		Equity Ratings	
Scenario	Pts	%	Pts	%	Pts	%
Contested Mark (40m)	3.0	2.8	8.9	9.0	2.0	21.8
Uncontested Mark (40m)	3.0	2.8	4.5	4.5	1.4	15.3
Contested Mark (10m)	3.0	2.8	8.9	9.0	2.7	28.6
Uncontested Mark (10m)	3.0	2.8	4.5	4.5	1.0	10.8

Table 9.15: Comparison of points for an intercept mark.

AFL Fantasy treats each of these situations the same. Champion Data ranking points has double the reward for the contested mark relative to the uncontested mark but does not take into account the location of events.

In Equity Ratings the contested mark is also worth more than the uncontested mark, but the location also affects the value. For contested marks, being closer to goal is worth more, since in winning the mark you are also preventing an opposition mark. For the uncontested mark, there is less value in being closer to defensive goal. The lower offensive capabilies from taking an uncontested mark close to defensive goals aren't offset by preventing an opponent getting the ball in a dangerous situation, so it carries less weight.

9.3.3 Position Bias

One of the primary aims of this new rating system was to provide a measure of performance that was less biased by player position. In section 9.1.3 we saw a summary of Equity Rating points by player position. We will now extend that to the other rating systems for the sake of comparison.

Reliable position information for players is available back to 2012. Because of the different scales of measurement for the three system we will normalise numbers relative to the midfield position. Figure 9.9 below shows a quantile plot of each of the three systems for positions relative to midfielders. The

measure on the plot is a relative percentile (P_R), defined as:

$$P_R^i(\mathrm{k}) = 100\% - P^i(k)/P^i(M)$$

where $P^i(k)$ is the i^{th} percentile of position type k and $P^i(M)$ is the i^{th} percentile of midfielders. As an example, the 90th percentile of performances by key defenders was 17.8 points and the 90th percentile for midfielders was 18.5 points, giving a relative percentile of 100%-(17.8/18.5) = 3.8%.

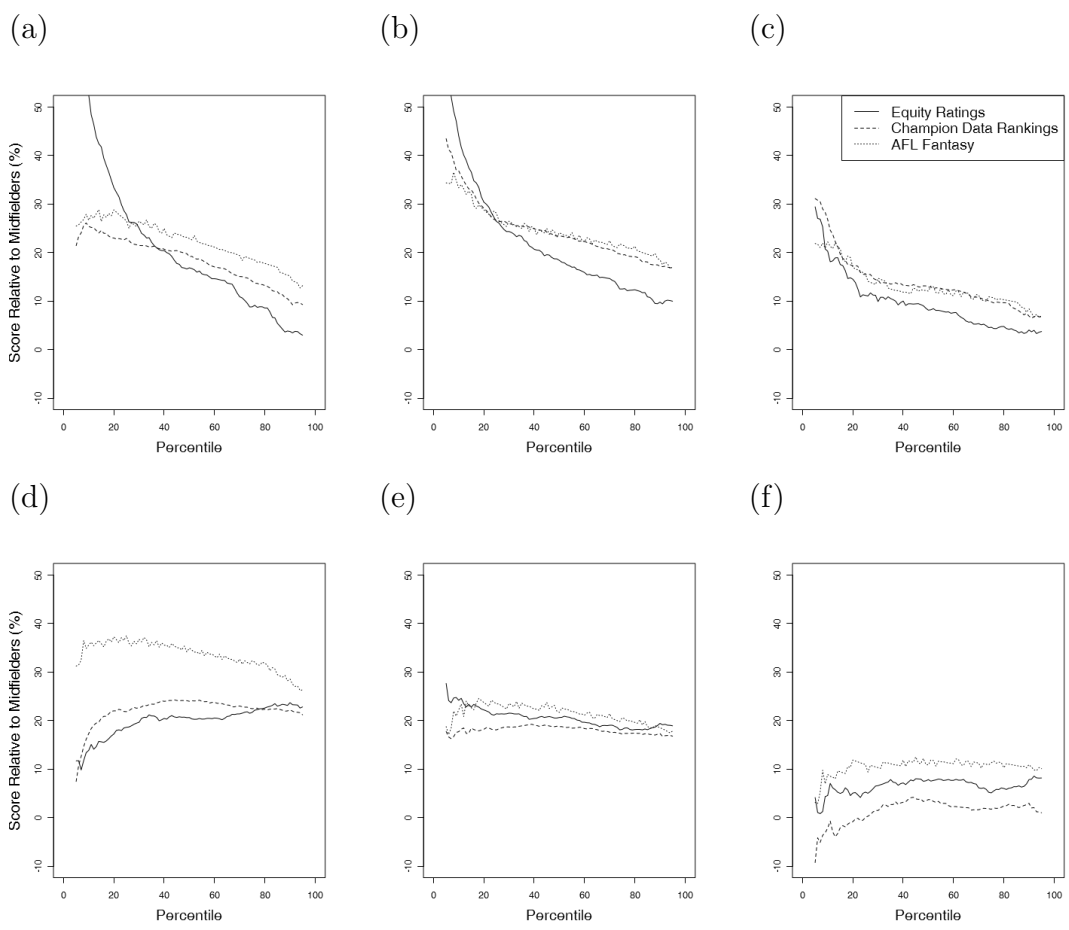


Figure 9.9: Percentiles of player performance for three rating systems relative to midfielders. (a) Key Forwards, (b) General Forwards, (c) Mid-Forwards, (d) Key Defenders, (e) General Defenders, and (f) Ruckmen.

Firstly looking at key forwards, we can see that the relative percentiles for Equity Ratings are above those for ranking points for the 37th percentile and above. This indicates that good performances by key forwards are better rewarded by Equity Ratings than ranking points. The lower percentiles see a

steep decline in relative performance for key forwards.

This is due to the nature of the two rating systems and how they deal with missed shots at goal. In the ranking points model, the player will get no points for his kick, but is given positive points for adding to the scoreboard with a behind. In the Equity Ratings system, any behind kicked where a player had a better than a projected 50% chance of kicking a goal will receive negative points. Of 803 games by key forwards with five or more shots at goal since 2012, 77 had an accuracy of 20% or below (9.6% of all players), 130 had an accuracy of 33% or below (16% of players) and 270 had an accuracy below 50% (34% of players).

A similar pattern, though less pronounced, can be seen in general forwards. They are closer to midfielders in Equity Ratings than in ranking points from the 25th percentile and above. There is also a steep decline in relative percentiles at the low end, also likely to be due to games with poor accuracy in front of goal.

Mid-forwards follow a similar distribution to the other two forward positions, but the relative percentiles are above those of ranking points for all percentiles.

Key defenders are closer to Midfielders in Equity Ratings than in ranking points for all percentiles between the seventh and 77th, inclusive. Both of these systems significantly outperform AFL Fantasy in this regard, with the main reason being that spoils are given no points in AFL Fantasy, but are rewarded in the other two systems. Likewise, marking the ball off an opposition kick is seen as equal to marking a teammate's kick in AFL Fantasy, while both of the other systems reward these higher.

General defenders are further from midfielders in Equity Ratings than in ranking points. Though this does go against the aim of the system to provide an unbiased measure of player performance across positions, these players were identified in Section 1.2 as the main positional category that was currently

being over-valued in existing systems.

Similar to general defenders, ruckmen are further from midfielders in Equity Ratings than in ranking points. For the 2015 season Champion Data adjusted the value of statistics in the ranking points formula to better account for ruckmen. Previously, all hitouts gained positive points, unless they were sharked by the opposition, with hitouts to advantage gaining more points than neutral hitouts. This was adjusted such that only hitouts to advantage gained positive points, and hitouts sharked lost points for the ruckman.

Figure 9.10 below shows the relative percentiles for Ruckmen in 2015 with the new ranking points formula in place. Note that Ruckmen are now closer to midfielders in Equity Ratings than in ranking points.

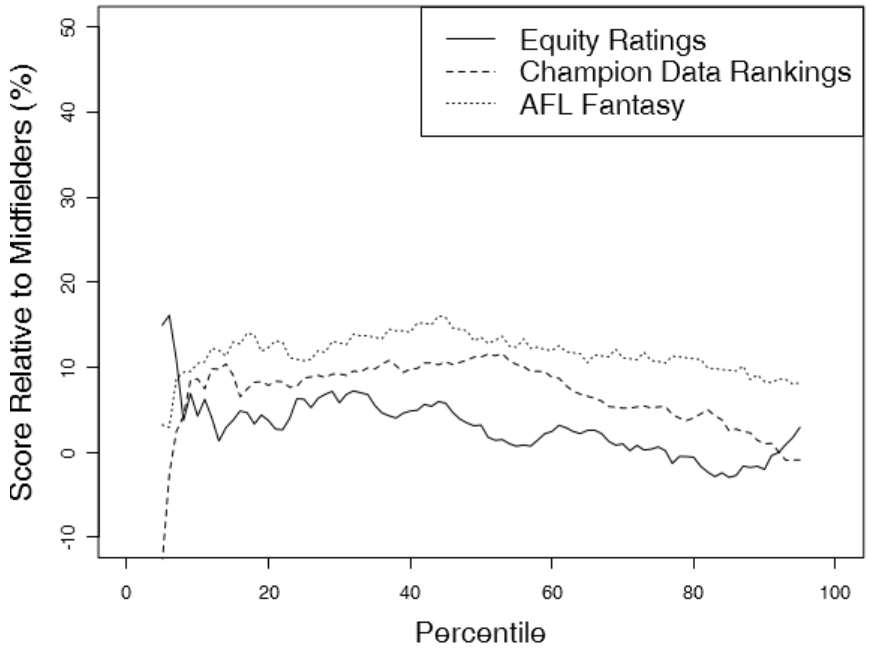


Figure 9.10: Relative percentiles of Ruckman performance in 2015.

9.3.4 Brownlow Medal

The Brownlow Medal is considered the most prestigious individual award in Australian Football. At the completion of each game during the Home & Away season, the umpires submit votes that represent their opinion of who the best-performed players were. Three players receive votes, with the highest-placed given three votes, the second-highest given two votes and the third-highest given one vote. There are no dead heats allowed within games.

These votes are kept confidential until the conclusion of the season, where the votes are tallied live at an equally-prestigious awards ceremony. Typical tallies result in the leading player receiving between 25 and 30 votes for the season.

Previous research by Bailey and Clarke [2] has shown that the result of the game plays a strong part in the assignment of votes, with 92% of players receiving three votes being on the winning team, along with 83% of those receiving two votes and 76% of those receiving one vote. Using a distinct data set to Bailey and Clarke [2] from more than a decade later in time, siimilar results were observed.

Votes	Winners	1-6	7-12	13-18	19-24	25-30	31-36	37+
3	91%	76%	77%	91%	90%	91%	94%	98%
2	79%	50%	59%	64%	69%	81%	82%	94%
1	75%	56%	64%	48%	66%	66%	67%	78%

Table 9.16: Brownlow votes awarded to the winning team, by winning margin (2007-2015).

From 2007 to 2015, 91% of players receiving three votes were from the winning team. For games decided by one goal or less, just 76% of three-votes were given to a player on the winning team, similar to games won by seven to 12 points. For games decided by more than two goals at least 90% of three-votes were given to a player on the winning team.

In Figure 9.11 we show the effect of the result and a player's Equity Rating

rank on a player's chance of polling votes.

Nearly 60% of top-scoring players on the winning team were assigned Brownlow Medal votes by the umpires, compared to just 22% of top-scoring players on losing teams.

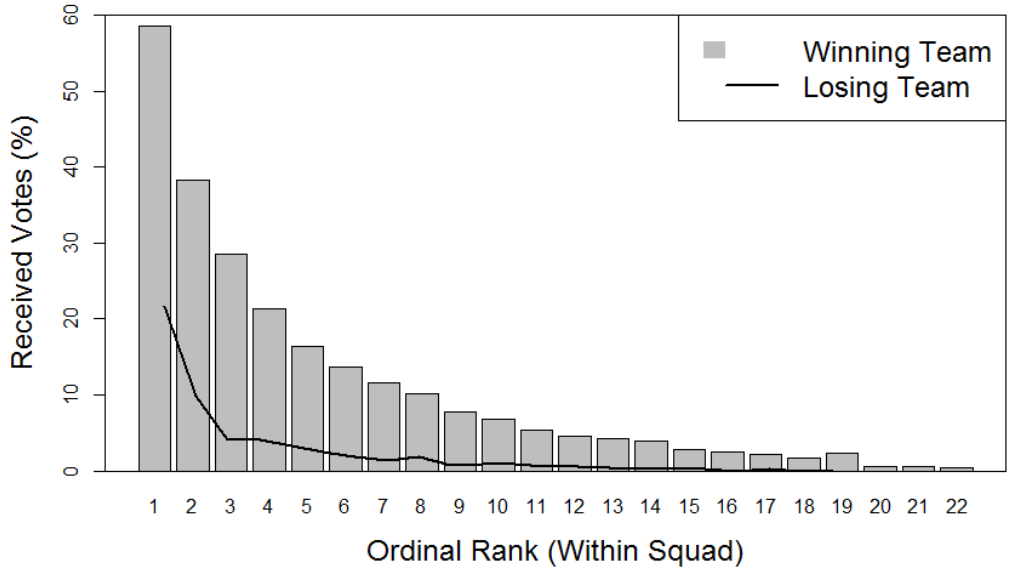


Figure 9.11: Prevalence of receiving Brownlow Medal votes relative to match result and Equity Ratings.

It is clear from this plot that there is also a strong relationship between Equity Rating points received in a game and votes awarded.

The final margin also plays a significant role on a player's chances of polling votes in a given game.

Figure 9.12 contains information from each team's top-scoring player, and the proportion that were awarded votes based on the final margin.

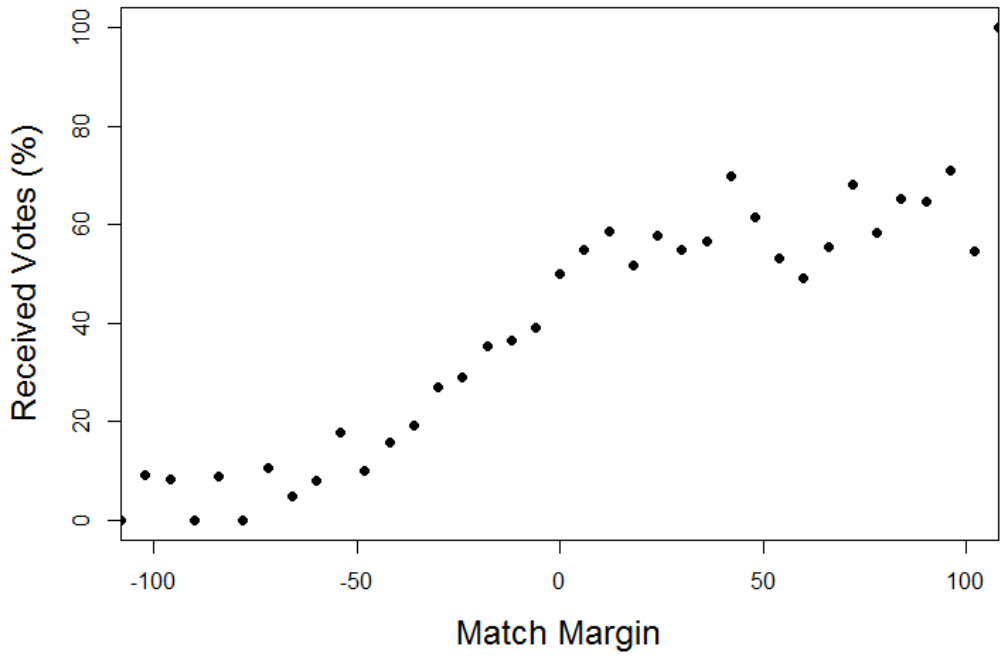
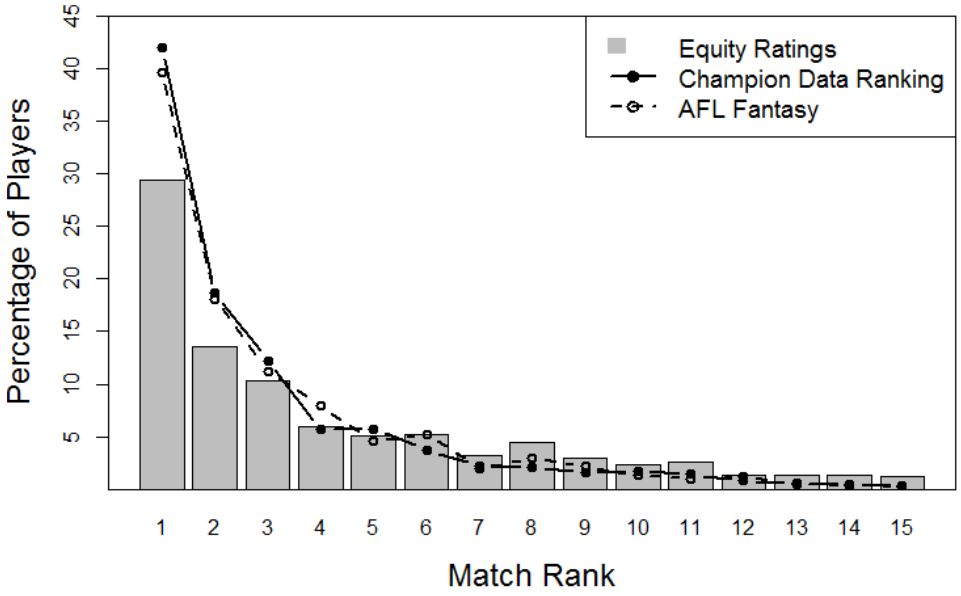


Figure 9.12: Proportion of a team's top-scoring players who received Brownlow Medal votes, by match margin.

In games where the margin was less than six points either way, 50% of top-scoring players received Brownlow Medal votes. For teams that won by six to 11 points, this rose to 55%, and for teams losing by the same margin it fell to 39%.

Though there appears to be a strong relationship between Equity Rating points and Brownlow Medal votes, Equity Ratings was outperformed by both Champion Data ranking points and AFL Fantasy points in predicting Brownlow Medal votes, as can be seen in Figure 9.13

(a)



(b)

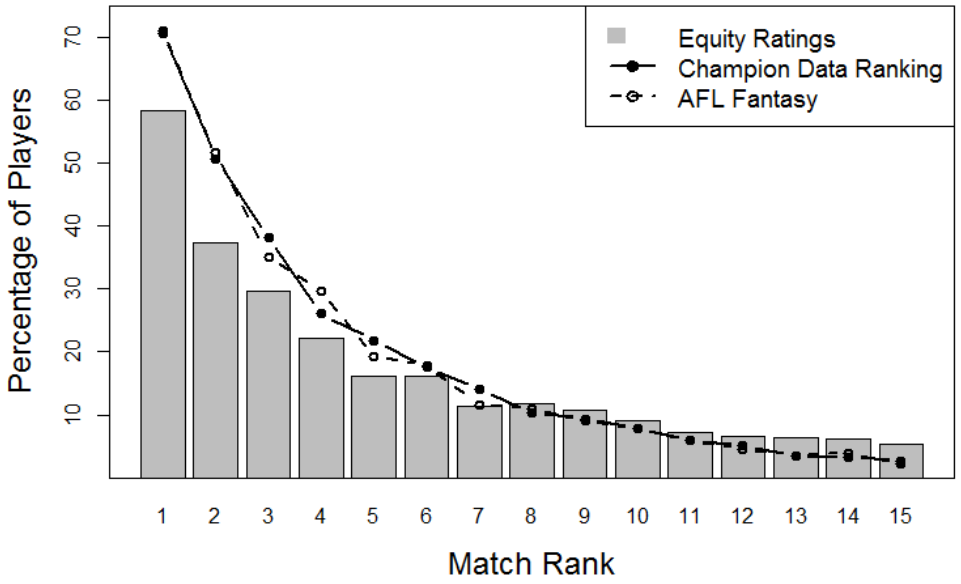


Figure 9.13: Brownlow Medal votes assigned by ordinal representation of player performance.
(a) Three votes
(b) Any votes.

Just 29% of players who top-scored in Equity Ratings (across both teams) were awarded three votes by the umpires, compared to 42% of top-scoring players in Champion Data ranking points and 40% of players in AFL Fantasy. Similarly, just 58% of top-scoring players in Equity Ratings were awarded any votes by the umpires, compared to 71% for both of the other systems.

When splitting players into position categories, Equity Ratings also underperforms relative to Champion Data ranking points and AFL Fantasy. Table 9.17 contains average ordinal ranks in the three rating systems for players who were awarded at least one vote in the Brownlow Medal.

Position	Equity Ratings	Ranking Points	AFL Fantasy
Key Def	12.2	**7.7**	9.7
Gen Def	9.6	5.5	**5.1**
Ruck	7.8	**3.3**	5.8
Mid	8.0	4.5	**4.2**
Mid-Fwd	6.7	4.7	**3.4**
Gen Fwd	8.3	**6.3**	7.3
Key Fwd	4.9	**4.6**	5.2

Table 9.17: Average ordinal rank of Brownlow Medal vote winners, by position.

Key defenders who received Brownlow Medal votes were on average placed roughly 12th in Equity Ratings, eighth in ranking points and 10th in AFL Fantasy.

Midfielders who received votes were on average eighth in Equity Ratings, between fourth and fifth in ranking points and fourth in AFL Fantasy.

Since we only have information about three players per game, this limits any conclusions that can be drawn. In addition, umpires have the primary role of officiating the game, with the allocation of Brownlow Medal votes being secondary. It is also worth noting that previous work by Bailey and Clarke [2] has shown that umpires significantly over-valued performances by players with distinguishing features such as those with fair-coloured hair or dark skin. This suggests that Brownlow Medal votes are not an ideal comparison for player performance.

9.3.5 Coaches Association Votes

At the conclusion of each game, the two head coaches of the competing teams award votes to five players, in a decreasing scale from five votes to the best player down to one vote for the fifth-best player. With this scale we have more information than is available from Brownlow Medal votes and it is hoped that coaches have a better understanding of player performance.

Though a maximum of 10 players can receive votes, in 156 of 197 games in the 2015 season the votes were split between six (72 games) or seven (84 games) players. On only 11 occasions did the two coaches agree on the best five players in the game and in only two games did they also agree on the order of the five best players.

Like the Brownlow Medal votes, Equity Ratings is outperformed by ranking points and AFL Fantasy in predicting coaches votes in games, though there does appear to be a strong relationship.

Figure 9.14 shows the average ordinal rank of players in each of the three systems, relative to how many votes they received from the coaches.

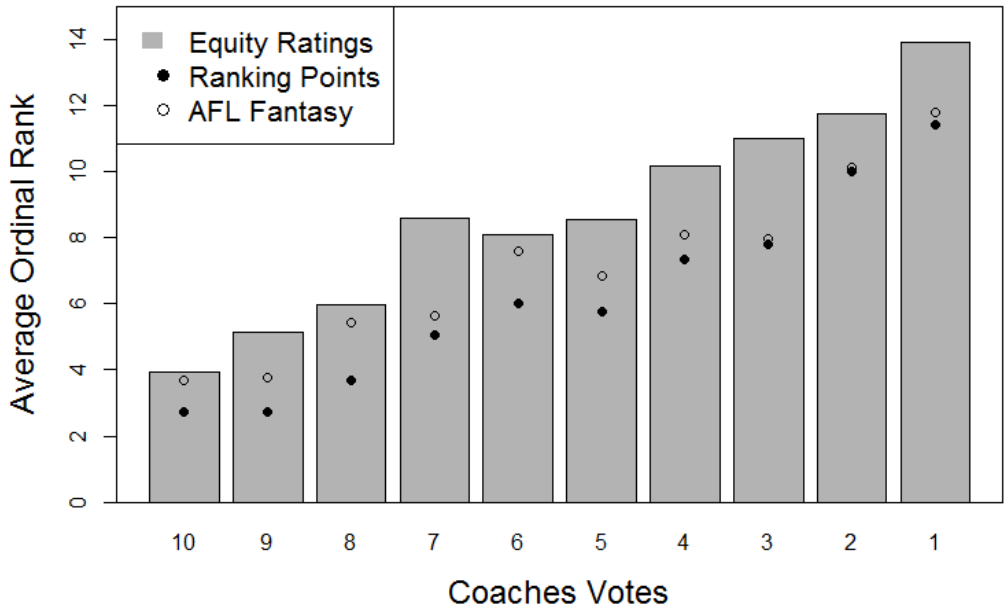


Figure 9.14: Average ordinal rank of players awarded coaches votes.

Though the opinion of the coaches is important, there is a potential for subconscious bias in the above results. Coaches have access to both ranking points and AFL Fantasy scores for players live during games, but not Equity Ratings. This would affect their decision identifying the best players of the game, and where to assign their votes.

9.3.6 Club Best & Fairest

At the time of writing, 17 of the 18 AFL clubs had awarded their best and fairest player for the 2015 season. In addition to publishing the winner, clubs also made the top-10 finishers public.

Due to the different voting systems employed by different clubs, the number of votes are not comparable, but the order of players is.

Since best and fairest awards are given on season totals, rather than on a single-game basis, total points for the season will be compared to the player's overall finish in the best and fairest. Figure 9.15 contains a comparison of the three rating systems, and coaches votes, against best and fairest result.

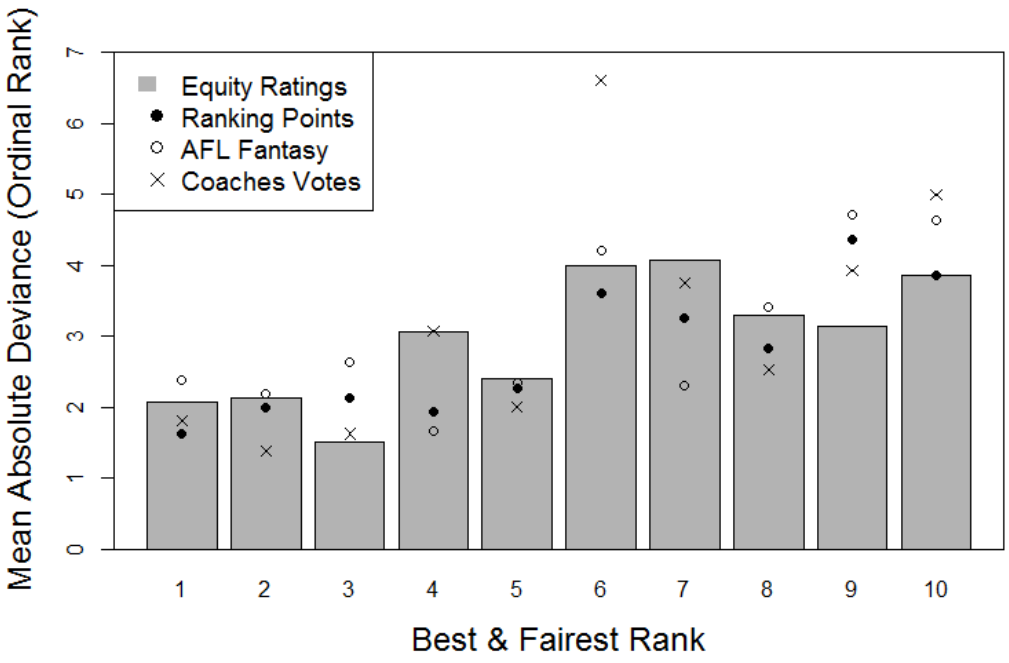


Figure 9.15: Comparison of rating system outcomes to best and fairest results.

Of players who won the club's best and fairest award, the average rank within the club for total Equity Rating points gained was 3.1, compared to just 2.6 for ranking points. This is taken as a mean absolute deviance (distance from first) of 2.1 and 1.6, respectively.

Across all players to finish in the top-10, ranking points was the closest predictor, out by a mean absolute deviance of 2.7 places. Equity Ratings was second-closest at 2.9 places, and AFL Fantasy was third at 3.1 places.

Interestingly, coaches votes were further from best and fairest results than any of the three player rating systems at 3.1 places of absolute deviance.

One example of a best and fairest result that is hard to explain objectively is Ben Stratton. He finished sixth in Hawthorn's best and fairest, despite sitting 19th for Equity Ratings, 19th for Ranking Points, 19th for AFL Fantasy and 18th for coaches votes. This lack of correlation between coaches votes and club best and fairest results again highlights the difficulty in objectively assessing a player's contribution in a team environment.

9.3.7 Correlation with Match Margin

Due to the nature of the Equity Rating system, it is expected that the correlation between a team's combined Equity Rating across all opposition relative to the opposition team be nearly perfect with the final margin of the game. Every action is assessed based on its contribution to the position of each team, as measured by the equity of possession.

Correlations also exist for other rating systems, but they are not as strong as they are for the Equity Ratings model, as can be seen in Figure 9.16. Here we have a plot of the total differential in points awarded to players in the two teams against the final margin.

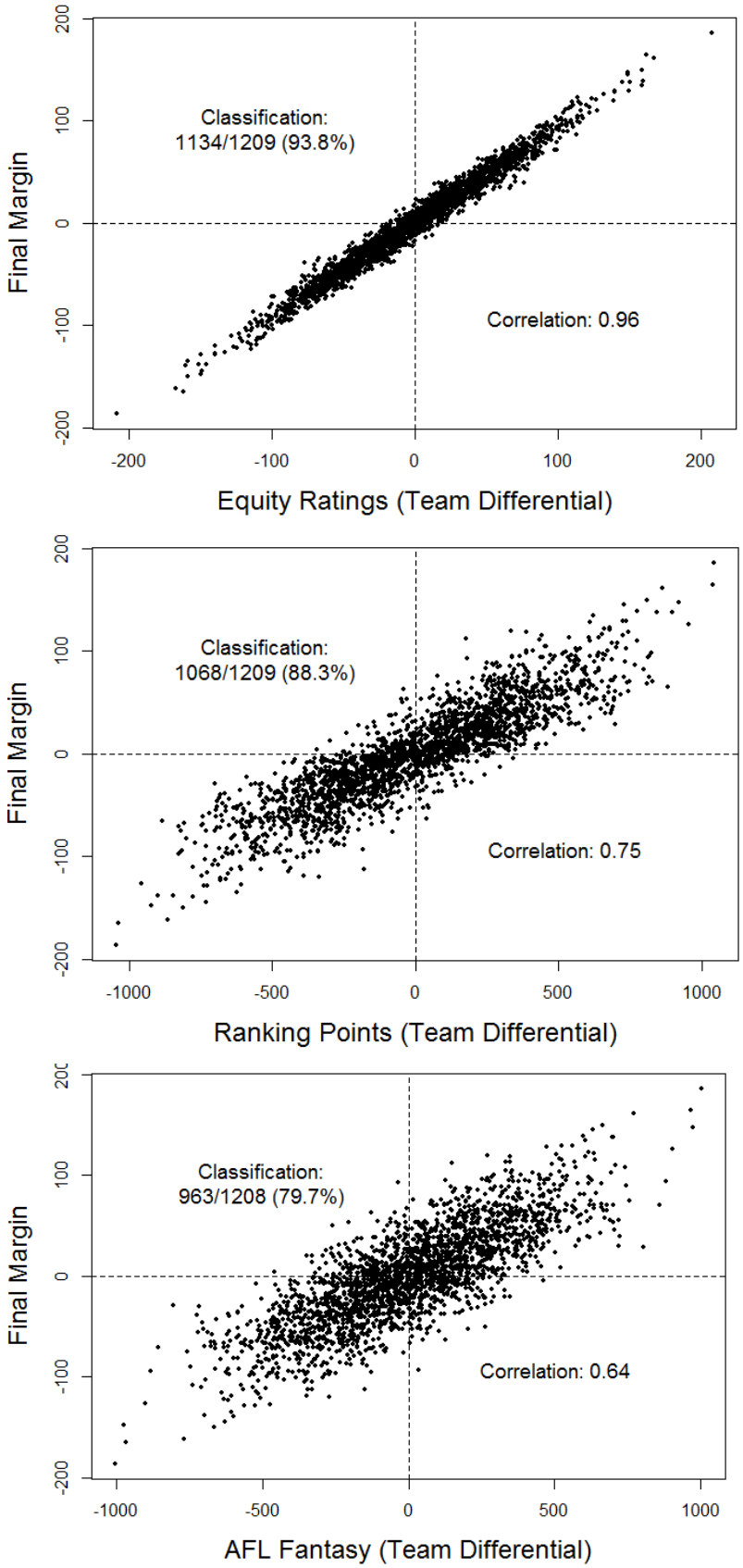


Figure 9.16: Relationship between final margin and player rating system outcomes.

The classification power of Equity Ratings is also stronger than other systems, with the total points scored by winning teams exceeding the total points by losing teams in 93.8% of games.

This can be seen in Table 9.18, which also contains correlations between team points and the final margin, as well as the average and largest margins in misclassified games.

Rating System	Margin Cor.	Class. Power	Avg Misclass.	Max Misclass.
AFL PR	0.964	93.8%	5.0 points	17 points
CD RP	0.747	88.3%	12.2 points	63 points
AFL F	0.637	79.7%	17.1 points	93 points

Table 9.18: Relationship between rating systems and game margin.

Of the 75 games misclassified by in-game Equity Ratings, the final margin in the game was on average five points. The largest misclassification was in Round 1 of 2014 in a game between Melbourne and St Kilda. Melbourne won 0.3 more points in Equity Ratings than St Kilda but lost by 17 points.

In Round 10 of 2015 Hawthorn received 40 fewer Champion Data ranking points than St Kilda but won the game by 63 points. Equity Ratings had Hawthorn ahead by 51 points.

In Round 2 of 2014 Melbourne received 36 more AFL Fantasy points than West Coast but lost by 93 points. Equity Ratings had West Coast ahead by 91 points.

9.4 Conclusion

We set out to create a player rating system that was:

1. Less biased by player position.

2. A better representation of player performance.

Based on the above results it is clear that Equity Ratings improves on previous rating systems in reducing the bias of player positions. General defenders were identified as a position that was over-rated in previous systems, and Equity Ratings saw this effect reduced. All other position categories were closer to the leading position category - Midfielders.

Though Equity Ratings was outperformed by existing systems in regard to matching subjective awards, the lack of consistency in these subjective awards showed the difficulty in assessing player performance. Umpires have been shown to be biased to those they notice more, rather than those who impact games. Coaches were inconsistent in votes given directly after the game for the AFL Coaches Association and votes tallied at a later date for the club's best and fairest.

It was clear that the Equity Rating points awarded within games closer reflected the final margin than other player rating systems. This gives confidence that the rating system accurately rewards player performance.

Chapter 10

Industry Implementation

In late 2012, AFL Media approached Champion Data with the intention of implementing a Player Rating system to answer the question of 'Who is the best player in the competition?'. Equity Ratings, as introduced throughout this research, were considered the most appropriate measure to assess player performance.

Through consultation with AFL Media, rules for the tallying of match scores were put in place to establish an overall standing for all listed players. These overall standings now appear on AFL.com.au as the 'Official AFL Player Ratings'.

10.1 Included Games

The implementation of the AFL Player Ratings was based on existing rating systems in individual sports, such as golf (PGA [44] & LPGA[43]), and tennis (ATP [40] & WTA [45]).

All of these systems are based on accruement of points from tournament results over a dynamic time period. Points are awarded based on finishing position in tournaments, with more prestigious tournaments allowing more

points.

Both golf systems use a two-year window, with recent results carrying more weight than past results. Both tennis systems use one year of results with no time-based weights applied.

In the case of the PGA (men's golf tour), overall rankings are based on an average points per tournament entered. All results are split into 13-week blocks and the most recent 13 weeks carry full weight towards overall rankings. Subsequent 13-week blocks are weighted down by 25% per block.

For the LPGA, overall rankings are also based on average points per tournament entered, but the weighting of past results differs from the PGA. The most recent 13 weeks of competitions also carry full weight, but from that point forward each week further in the past is downgraded by one-91st of its original value.

On the men's tennis tour (ATP), overall rankings are based on total points accrued in a one-year period. Players gain points from the four Grand Slams, eight 'Premier' tournaments and their next-six best tournament results.

On the women's tennis tour (WTA), overall rankings are based on total points accrued in a one-year period from the player's best 16 tournaments. If she appeared in Grand Slams or 'Premier' tournaments in that time, they must count towards her overall ranking, even if poor results were obtained.

In the interests of simplicity, the period of time used to formulate the AFL Player Ratings needed to be a round number. With consideration to this, it was decided that two years of games for AFL players would be a representative sample. One season was considered too short to fully represent a player's contribution, while three seasons was considered to be too far into the past to influence a player's standing in the game.

This time period is dynamic, so as an example, after Round 17 of the 2015 season, a player's overall standing is based on performance from Round 18 of

2013 to Round 17 of 2015.

The aim of the system was to not only find the best players, but to reward a player's total contribution. As such, the overall standings were based on total points gained, as opposed to average per game. Players who regularly missed games through injury or suspension would then be downgraded relative to their peers who had played every game.

Measuring player quality was still the primary aim, so a buffer was built into the system so that players missing a low number of games were not punished. For a player whose team does not play in the finals series, a maximum of 44 games can be played over the course of two seasons. For those involved in finals it is possible to play up to 52 games.

The number of games included in a player's overall standing was chosen as 40, due to the fact that over the previous two-year period (2011-2012) the top-100 ball-winners (average disposals per game) had a median games played of 41 and the top-200 had a median of 39.5 games. A full distribution of the top-200 players is shown in Figure 10.1.

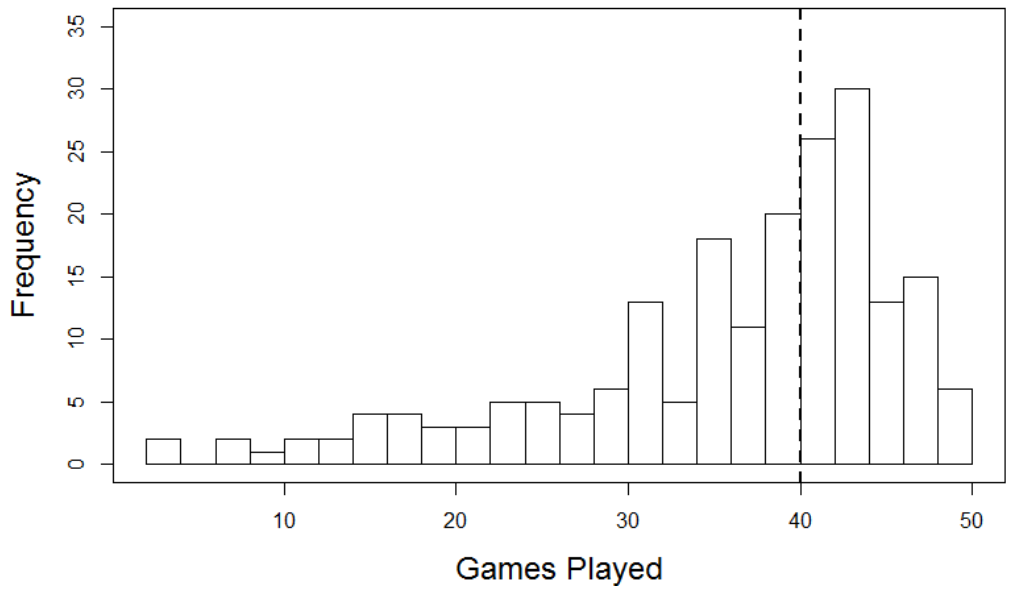


Figure 10.1: Games played by the top-200 ball winners across the 2011 and 2012 seasons

Equity Ratings are available from 2010 and since two seasons of games are to be included in the AFL Player Ratings, overall standings are only available from the start of the 2012 season.

10.2 Weighting of Games

With the window set at a dynamic range of two years, the final decision was on how to weight games.

A system similar to the PGA weights was used, where full weight would be applied to a block of most recent games and previous games would be gradually assigned less weight. The initial suggestion was to use 20 games as the range for full weight applied, and the previous 20 games to receive a five per cent reduction in weight per game. In the interests of achieving more stability of the overall standings over time this was adjusted to 30 games receiving full weight and subsequent games being given a 10% reduction.

The final formula for calculating a player's overall points was then set as:

$$PR(j) = \sum_{i=1}^{n_j} E_R^i(j) \times \max\Big(0, \min\big(1, (41-i)/10\big)\Big) \tag{10.1}$$

where n_j is the number of games played in the last two seasons by player j and $E_R^i(j)$ is the Equity Rating points gained by player j in his i^{th} most-recent game.

Note that the second term of Equation 10.1 will take on a value of one from game numbers one through 31. For games 32 through 40 there is then a 10% reduction per game, and for games 41 and above it takes a value of zero.

Players who have played 40 or more games in a two-year period are then achieving their maximum possible score for the overall standing since no more games carry any weight. Missing enough games so that only 39 games have been played results in a player 'missing out' on the chance to add points from

the 40th game, though this game only carries 10% of its original weight.

Due to the weights applied to earlier games, a player can gain the equivalent of 35.5 fully-weighted games from Equation 10.1. Thus, a player missing out on playing game number 40 has lost just 0.3% of their potential output (0.1 / 35.5) despite missing 2.5% of the included games.

Figure 10.2 shows the percentage of a player's potential output that is lost by players playing less than 40 games. Playing just 30 games results in a potential output of 84.5%, meaning a player has missed out on 15.5% of potential points despite missing 25% of included games.

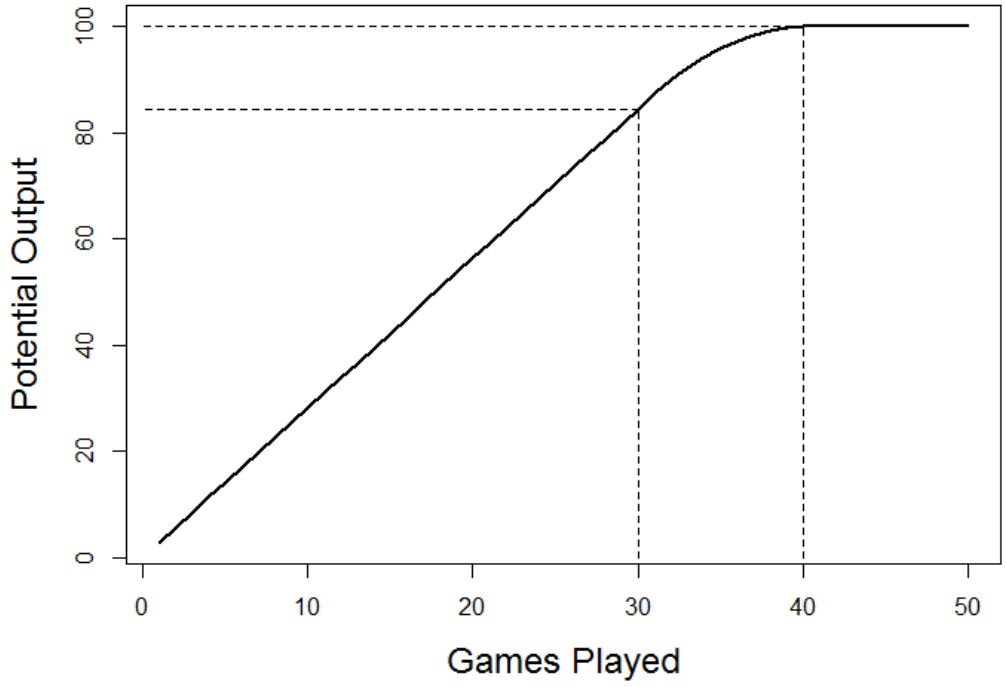


Figure 10.2: Potential output as a percentage of maximum output for a player's overall standing based on games played.

If the weights were chosen to decline by five per cent after game number 20, games 22 through 40 would be worth less relative points than in the above situation. This results in less of a penalty for games missed and more volatility in the order of players week-to-week.

At 40 games played the player would still have 100% of his maximum

output, since the number of included games hasn't changed. With just 20 games fully weighted, at 30 games played a player has a potential output of 91.0%, compared to the 84.5% above.

At 20 games played the player's output is at 65.6%, compared to 56.3% with 30 games fully weighted. Figure 10.3 contains a comparison for the two sets of game weights, which will be discussed in more detail in the following section.

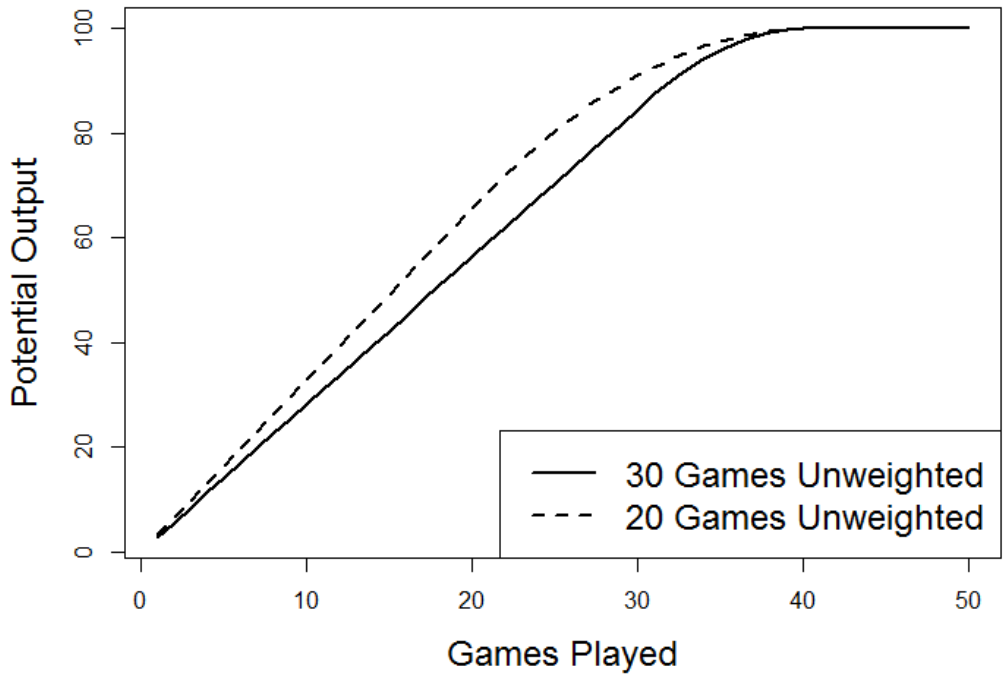


Figure 10.3: Potential output as a percentage of maximum output for a player's overall standing based on games played and game weights.

10.3 Effect of Match Weights

The effect of the chosen weights can be seen in three ways, which will be investigated in this section.

1. The number of changes to the overall standings.

2. The penalty for missing games through injury or suspension.

3. The time taken for an improving player to rise up the leader board.

10.3.1 Changes to Overall Standings

Stability of the overall standings, especially at the top of the leaderboard, was seen as an essential way of gaining the trust of the general public when the Official AFL Player Ratings were launched.

Weekly changes to the overall standings are shown in Figure 10.4. Note that 'changes' are only recorded when a player moves up to a certain overall standing. In this way, players in first and second changing places will only be registered as one change to the leaderboard, rather than counting each player.

From the start of 2012 to the end of 2015 there were 104 rounds, excluding Round 1 of each season. In that time there has only been two changes to the No.1 player overall, seven changes to the No.2 player and 19 changes to the No.3 player.

The percentage of observed changes climbs gradually for the top-50 players overall, then no increase in changes is seen. Outside of the top-200 players there is a slight decline in the percentage of changes observed. This is likely due to players outside the top-200 being less likely to be selected, as can be seen in Figure 10.5. Not being selected potentially means no change to a player's AFL Player Rating points, making it less likely that the player will move up the overall standings.

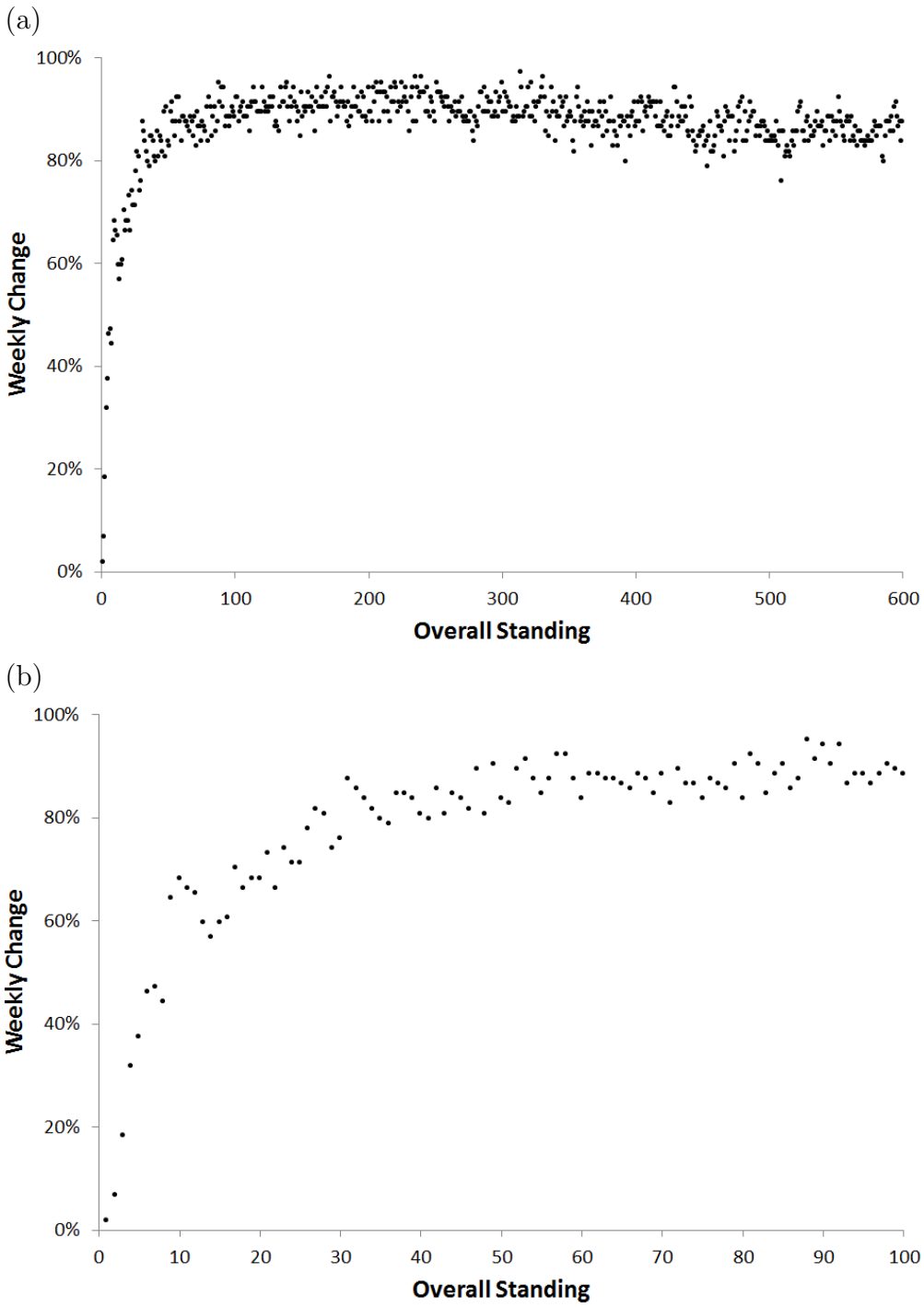


Figure 10.4: Weekly changes to overall standings.
(a) Top-600 Players.
(b) Top-100 Players.

Of players sitting in the top-100 in the overall standings whose team played the following week, 82% played. For players from 101st to 200th, 80% played. Players outside the top-200 saw a linear decline of 1.2% per 10 places in the

overall standings (R-squared = 87.7%) down to the 600th player.

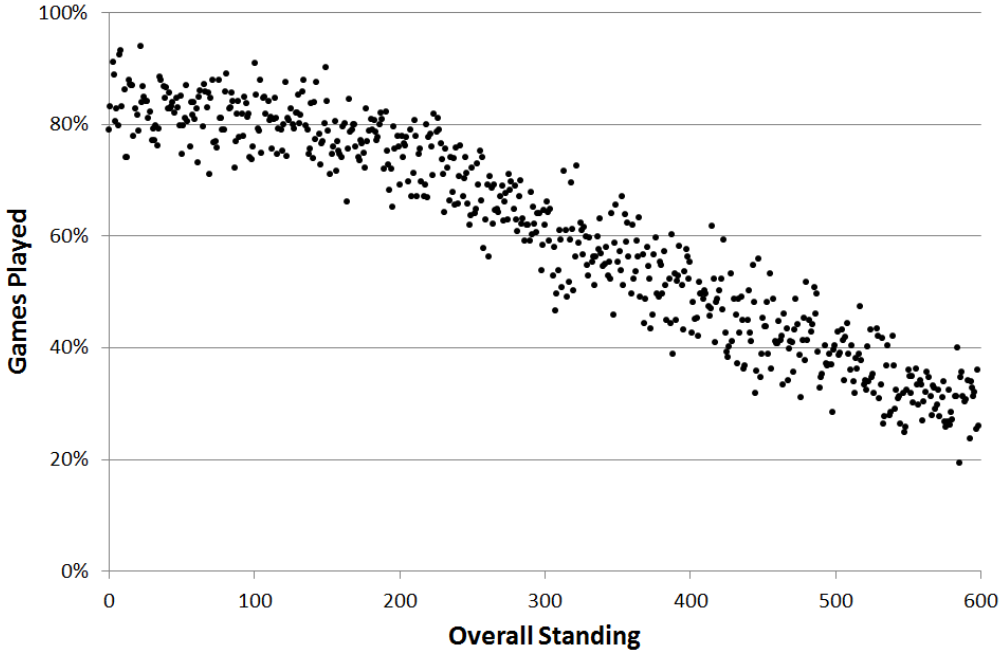


Figure 10.5: Available games played by players by overall standing.

The effect of different weighting of matches can also be measured based on the number of observed changes. We will compare the AFL Player Ratings system of weights to the system of weights previously mentioned, where 20 games were fully weighted and subsequent games were progressively weighted down by five percent. The results for top-200 players are shown in Figure 10.6 with changes summarised into 10-player groups.

Players one through 10 saw a change rate of 36.6% on average in the AFL Player Ratings, compared to 41% in the 20-game weighting system. As we can see from Figure 10.6, this is a significant reduction to the number of observed changes, and thus a significant increase in the stability of the overall standings.

Four of the first five 10-player groups (Top-50 players) show significant reductions in observed changes.

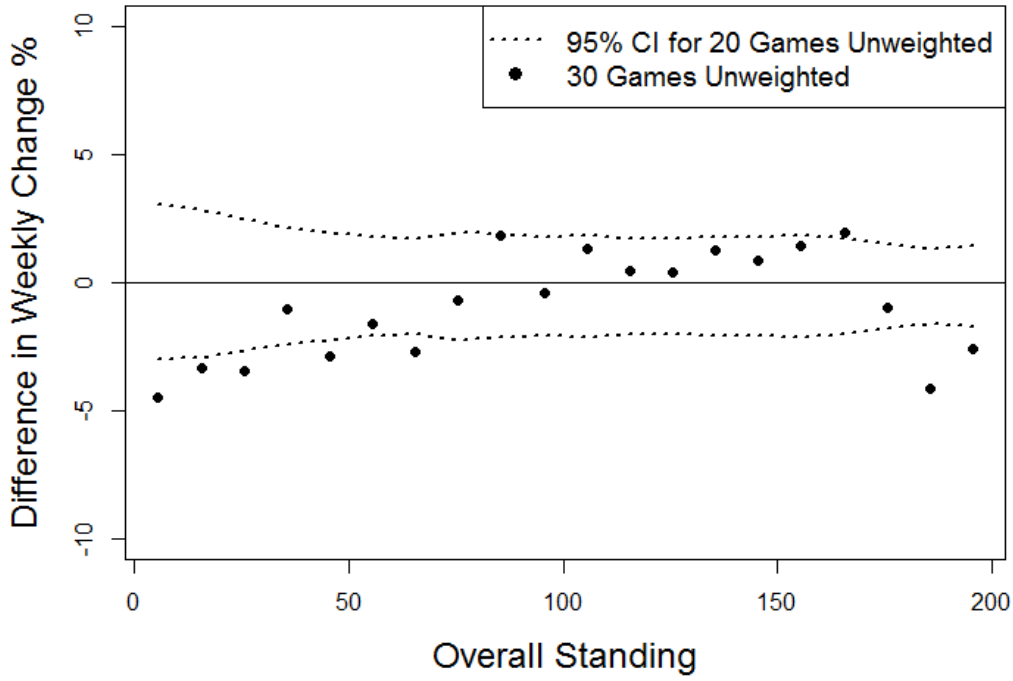


Figure 10.6: Effect of game weight on observed changes to overall standings.

10.3.2 Penalty for Games Missed

In Figure 10.3 we saw the theoretical implications of changing the weights on games. To relate this back to an actual player, we will use the case of Gary Ablett.

Ablett was well clear on top of the overall standings as the No.1 player in the competition when he was injured in Round 16, 2014 - missing the last seven games of 2014. He returned for the start of the 2015, only to aggravate the injury in Round 2 and miss a further 11 weeks. Upon returning he played three games before again succumbing to injury and missing the final seven rounds.

Ablett's overall score was protected for three weeks while his total games played over two seasons was still 40 or above, but it started to fall from this point. Figure 10.7 shows this decline relative to his points at the time of the injury - for the AFL Player Ratings system and for the 20-game weighting system.

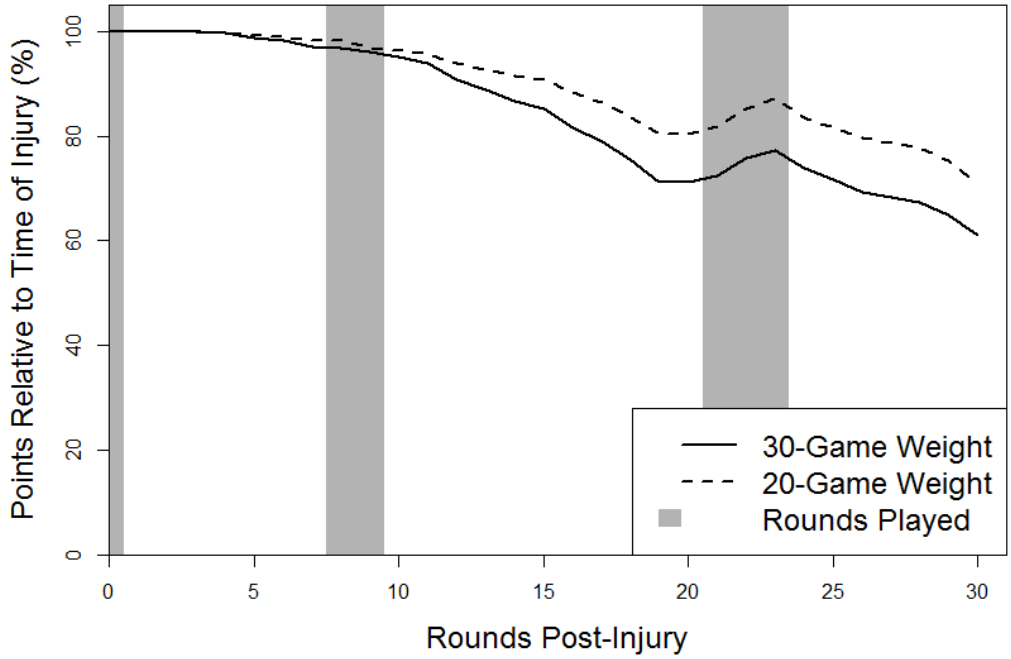


Figure 10.7: Gary Ablett's drop in points after injury.

As at the end of the 2015 season, Ablett had fallen to 61% of his starting points value, with just 21 games played in the previous two seasons. At that point he sat at 47th overall. If the 20-game weighting system was applied he would have had 71% of his starting points, and would have been placed at 14th overall.

In this situation, the existing weighting system is preferable, since one of the main aims was to reward players who have made significant contributions by playing games. Ablett is still arguably the best player in the AFL, with his latest three-week run of games between injuries netting 87.5 Equity Rating points - nearly 30% higher than any other player in the competition. Having missed 23 of a possible 44 games in the last two seasons though (and 23 of the last 29) it is hard to argue that his contribution is the 14th-best of any player.

10.3.3 Rise Through Overall Standings

Two types of players make rapid rises up the overall standings - improving players and new players.

Improving Players

Gary Ablett's heir to the throne of 'best player in the AFL' was 2015 Brownlow Medallist Nat Fyfe. Though Scott Pendlebury was the player to take Ablett's place as the No.1 player, it was Nat Fyfe who eventually led the competition and placed a big gap between himself and the rest of the competition.

Fyfe's form early in 2015 garnered interest from the media looking for an Ablett replacement [24] and some bookmakers even paid out on bets placed for Fyfe to win the Brownlow Medal after just eight rounds of a 23 round season [20].

Fyfe's rise through the overall standings was slower though, as he didn't reach No.1 until after Round 17. Under the 20-game weighting system his rise would have been faster, reaching No.1 in Round 10.

Though this may be interpreted as a weakness of the existing system, it could also be interpreted as a strength. Players are slower to reach their true standing after a rise in form, but it ensures that overall standings are based on repeated, consistent form, as opposed to shorter bursts of form that may not be lasting.

New Players

Based on total Equity Rating points gained in 2015, Touk Miller was the top-scoring 2015 debutant. In the AFL Player Ratings he reached 330th overall. With a 20-game weighting system applied he would have reached 294th - higher than the official overall standing, but not significantly so.

10.4 Assessment of Overall Standings

The overall standings were launched to the general public in the early rounds of the 2013 AFL season. At the time, the top-10 players were as follows:

#	Player	Club	Position	Points
1	Gary Ablett	Gold Coast Suns	Mid	746.8
2	Josh Kennedy	Sydney Swans	Mid	624.5
3	Joel Selwood	Geelong Cats	Mid	623.9
4	Scott Pendlebury	Collingwood	Mid	622.4
5	Cyril Rioli	Hawthorn	Mid	604.8
6	Dane Swan	Collingwood	Mid	599.0
7	Patrick Dangerfield	Adelaide Crows	Mid	597.7
8	Jobe Watson	Essendon	Mid	594.6
9	Marc Murphy	Carlton	Mid	582.6
10	Sam Mitchell	Hawthorn	Mid	568.9

Table 10.1: Top-10 players at launch (Round 6, 2013)

There was almost unanimous agreement from the general public about some of the entries in the list, such as Gary Ablett, Jobe Watson, Scott Pendlebury and Josh Kennedy.

Other players caused some controversy, such as Cyril Rioli. He has been labelled as a player whose 'inconsistency in his performance from not only week to week but also quarter to quarter' has seen him fail to reach his full potential[33].

Similar players, whose volume of involvement does match their efficiency, also drew criticism for being too high in the overall standings. Some examples of these players will be discussed in detail in Section 10.4.2.

Gary Ablett's name on top of the overall standings was something that came to be a standard for the AFL Player Ratings. After back-dating the system to Round 1 2012 (when overall standings can first be calculated with a full two-year sample) Ablett was on top for 85 consecutive weeks, and his reign was only interrupted by injury.

10.4.1 Celebrating Gary Ablett

As has been mentioned previously, only injury caused Gary Ablett to be replaced at the top of the AFL Player Ratings. His period of dominance spanned five seasons, meaning two-and-a-half distinct periods of time can be found, since overall standings at any point are based on the previous two seasons.

Overall Standings

Despite this, no player came close to his score at any stage until his injuries meant he missed games. Figure 10.8 has a plot of Ablett's AFL Player Rating points over time, compared to his nearest rival. After he was overtaken the 'rival' line becomes the leading overall player.

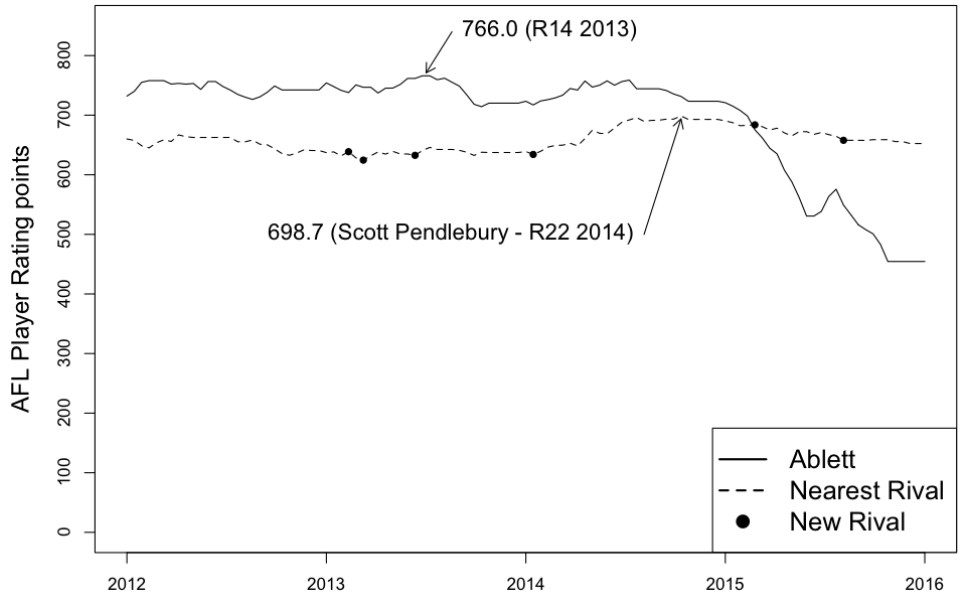


Figure 10.8: Timeline of Gary Ablett's AFL Player Rating points compared to nearest rival.

Four players appeared at second place behind Ablett. The transition between each of these players is shown as a dot on the 'rival' line in Figure 10.8. These players were:

1. Scott Pendlebury

2. Joel Selwood

3. Josh Kennedy

4. Patrick Dangerfield

5. Scott Pendlebury

Scott Pendlebury was the player who eventually overtook Ablett after he dropped post-injury, but was overtaken himself by Nat Fyfe.

Ablett's lowest point in the AFL Player Ratings while still having 40 qualifying games was 714.3 points after Round 22, 2013. The highest point any other player had reached was Scott Pendlebury's 698.7 points after Round 22, 2014.

Ablett's best period was the two years prior to Round 14, 2013 where he amassed 766.0 points.

This makes Ablett's worst 40-game patch 2.2% better than any other player's best 40-game period, and his best 9.6% better than any other player's best.

The first time his score dropped below Pendlebury's best effort was after Round 4, 2015 where his included games dropped to 34 of a possible 40. From Figure 10.2 we saw that at 34 games included, a player's potential output has dropped to roughly 94%.

Season Averages

Ablett's consistently good form can also be observed when looking at average Equity Rating points per game within seasons.

Player	Club	Season	Matches	Average
Gary Ablett	GCS	2014	15	22.2
Gary Ablett	GEEL	2010	24	21.7
Gary Ablett	GCS	2012	20	21.3
Gary Ablett	GCS	2015	6	20.2
Gary Ablett	GCS	2013	21	20.1
Scott Pendlebury	COLL	2014	21	19.9
Gary Ablett	GCS	2011	20	19.8
Scott Pendlebury	COLL	2011	25	19.1
Patrick Dangerfield	ADEL	2015	23	18.8
Nat Fyfe	FREM	2015	20	18.8

Table 10.2: Top-10 seasons by a player for Equity Rating per game.

From Table 10.2 we can see that Gary Ablett averaged more than 20 Equity Ratings per game in five of six seasons from 2010 to 2015, only missing out by 0.2 per game in 2011.

The 2011 season was the debut season for the AFL's first expansion team, the Gold Coast Suns, for which Ablett was signed as the marquis player. In this season they lost by an average of 54 points per game, scoring 70 points and conceding 124 per game. No other player managed to average more than 20 points across a full season from 2010 to 2015.

Nat Fyfe started 2015 as though he was destined to join Ablett, averaging 22.1 points through 13 rounds. He was ultimately injured and his average fell throughout the year. Fyfe is the only player aside from Ablett to maintain an average of at least 22 points through more than four rounds to start a season.

Single Game Equity Ratings

We can look at an even more granular level by considering Ablett's single-game scores relative to other players. Figure 10.9 contains a quantile plot of Ablett's Equity Rating scores from 2010 to 2015 relative to all other players who have played at least 100 games in that time (186 qualify).

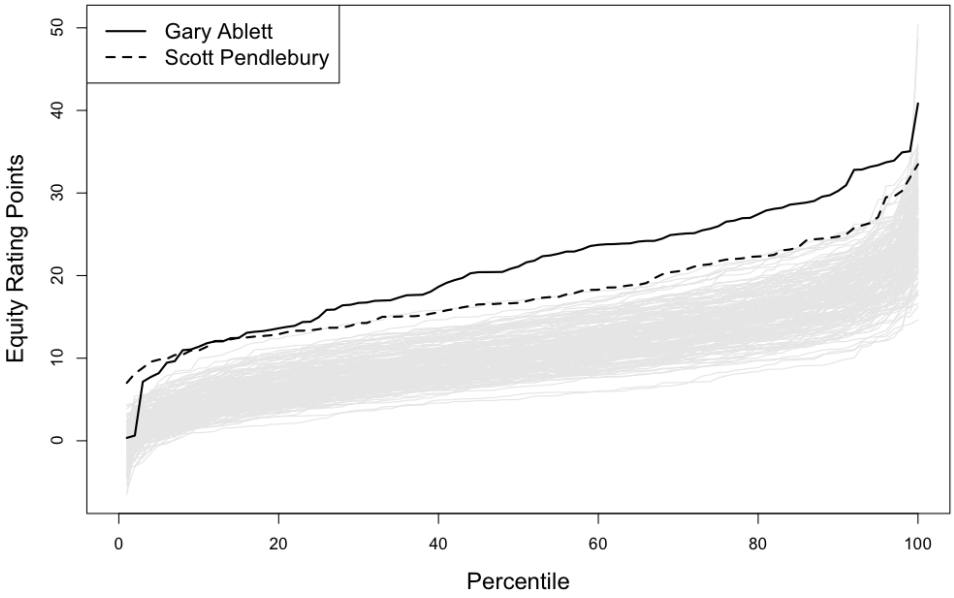


Figure 10.9: Percentiles of performance for all players with 100 or more games from 2010 to 2015.

For all percentiles from the 16th through to the 99th Ablett is the leading player. The 60th percentile for Gary Ablett's Equity Ratings is 23.7 points. Scott Pendlebury is again the next player behind Ablett, but with a 60th percentile of just 18.3 points - nearly 30% behind Ablett.

Ablett has scored 23.7 points or more in 43 games. Pendlebury has done so the second-most at just 20 times. Table 10.3 contains other such thresholds for Ablett compared to the next-best player.

Threshold (points)	Ablett	Next-Most	(Player)
30.0	12	6	Scott Pendlebury
28.0	20	7	Ryan Griffen
26.0	26	11	Lance Franklin
			Scott Pendlebury
24.0	38	20	Scott Pendlebury
22.0	51	33	Scott Pendlebury
20.0	60	45	Scott Pendlebury

Table 10.3: A count of Ablett's games over selected thresholds, compared to the next-best player.

Justification for Dominance

Gary Ablett has been consistently at the top of the overall standings because he is a multi-dimensional player who can contribute in different situations. He is effective at stoppages, as a link player in open play and as a goalkicking option in the forward line.

Gary Ablett's inside game has been remarkable consistent in recent times, having been in the top-four players for contested possessions in every season from 2010 to 2014. Only one other player was in the top-10 in every season - Matt Priddis from West Coast.

It is the balance of inside and outside games that has been his signature though. He is one of just four players to feature in the top-20 for both contested possessions and uncontested possessions over the period of 2010 to 2015. Table 10.4 below shows a comparison between Ablett and the other players in the top-10 for contested possessions from 2010 to 2014. Each entry in the table is that player's rank relative to other midfielders for contested possessions, uncontested possessions, metres gained, goals, score involvements, and score assists.

Player	CP	UP	MG	G	SA	SI
Josh Kennedy	1	176	122	78	67	31
Gary Ablett	2	7	2	3	7	1
Matt Priddis	3	83	97	201	94	53
Matthew Boyd	4	5	8	201	67	31
Jobe Watson	5	29	77	35	13	4
Patrick Dangerfield	6	210	34	12	140	37
Scott Pendlebury	7	15	28	54	13	7
Nat Fyfe	8	123	30	35	29	26
Chris Judd	8	110	31	78	7	16
Tom Liberatore	10	172	84	241	140	122

Table 10.4: Top-10 midfielders for contested possessions (2010-2014).

Note that Ablett is in the top-eight players for all six metrics. No other player reached the top-10 in more than three categories and only Scott Pendle-

bury was inside the top-100 for all six metrics.

Ablett's contribution when he plays forward of the ball is also significant. As we see in Table 10.4 above, he was third of midfielders for goals kicked per game. There are two components that allow this contribution to occur - his ability to get into scoring positions, and his ability to capitalise on those opportunities.

Champion Data has only recorded one-on-one contests since 2012, and these are only recorded after a kick. Contests in general play are not explicitly recorded, unless the player wins possession. Of the 82 midfielders who have been involved in at least 20 contests from 2012 to 2015, only eight have a win percentage significntly better than AFL average, Ablett being one. He won 34 of 85 contests in that time.

Figure 10.10 below shows one-on-one contests for all midfielders from 2012 to 2015 and how many they won. The dotted lines indicate the boundary for statistical significance at a 95% confidence level.

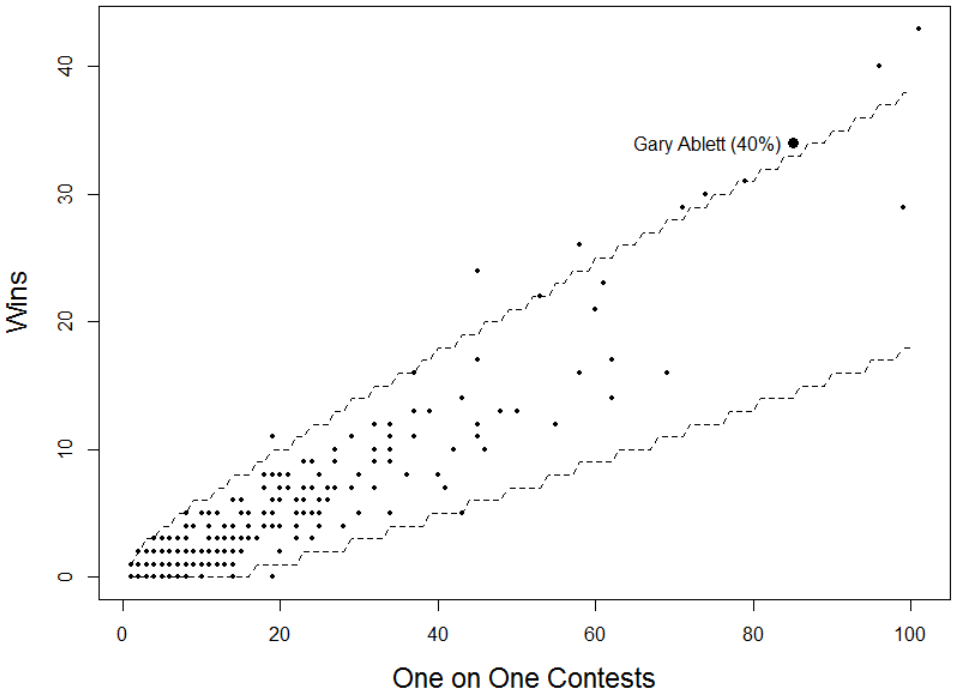


Figure 10.10: One on one contests for midfielders (2012-2015).

His kicking in front of goal can often be overlooked, since his overall accuracy is not overly impressive. From 280 shots he has kicked 151 goals for an accuracy of 53.9% - ranked 44th of the 194 players to take at least 100 shots from 2010 to 2014.

Based on the difficulty of his shots though, the average player would have only kicked 120 goals - an expected accuracy of just 42.8%. Using kick ratings as a base, he was the most effective shot at goal in the competition, as is shown in Table 10.5 below.

Metric	Value	Rank
Expected Hit Rate	42.8%	171st
Accuracy	53.9%	44th
Kick Rating	+11.1%	1st

Table 10.5: Gary Ablett's shots at goal (2010-2014).

Gary Ablett's influence on his teammates (and the opposition) can also be seen by considering the outcomes of centre bounces, where each team has only three midfielders and one ruckman competing for the ball.

From the 2015 season, just 9.2% of a team's centre clearances were won by the ruckmen. The remaning 90.8% are won by midfielders - 30.3% per player.

For the period from 2010 to 2014 Gary Ablett won 272 centre clearances - ranked fifth of all players. While he was in attendance at the centre square, his team won a combined 952 clearance, making his contribution 28.6% - below the average per player for a midfielder. Despite this, the team's centre clearance differential was much better with Ablett in the centre square than without him. From 2,178 centre bounce attendances in this five-year period, his team won the clearances 952-904, a differential of +2.2%.

From the 742 centre bounces where he played the game but was not present in the centre square, they won 277 and lost 332 - a differential of -7.4%. This difference of +9.6% (2.2 minus -7.4) is the second-best of any midfielder with at least 1,000 attendances in that time.

In many aspects of the game, Ablett's name consistently appears near the top of the list. His standing at the top of the AFL Player Ratings is not contradicted by any other player rating systems, but the gap between him and the rest of the competition is a great indication of his value.

10.4.2 Player Case Studies - Positively Rated

Below are some case studies for players who have been perceived as too high in the overall standing, relative to public opinion. In these case studies we will justify why these players are worthy of being considered amongst the best players in the competition, and in the process we will identify the player traits that are well represented by the AFL Player Ratings system.

Cyril Rioli (Hawthorn)

Cyril Rioli's fifth-place at the launch of the overall standings was the highest point he has reached, but his drops down the overall standings have been more about games missed than poor form.

Injuries in the 2013 and 2014 seasons saw him play just 15, and 12 games in those respective seasons, seeing his overall standing drop as low as 146th.

The 2015 season saw him play 24 games, bringing his two-year total games played to 36 and his overall standing back up to 18th - first of all small forwards.

As was previously mentioned, Cyril Rioli has been criticised for his lack of consistency. He has never averaged more than 17.3 disposals per game within a single seasons, which is seen as a negative. In Rioli's case, the number of involvements is not as important as the quality of those involvements.

Claims of inconsistency also appear invalid.

Since debut he has given at least one score assist in 83% of his 157 games played - three percentage points higher than any other small forward with 50 or more games in that time.

He has kicked a goal in 76% of games - ranked seventh of the same group.

He is third in the AFL for score assists per game since 2008 and ranks second of small forwards for score involvements.

Since debut he is just 123rd for total disposals, and second for score assists. His ratio of one score assist for every 9.2 disposals is also the second-best of the top-200 players for total disposals, as can be seen in Figure 10.11

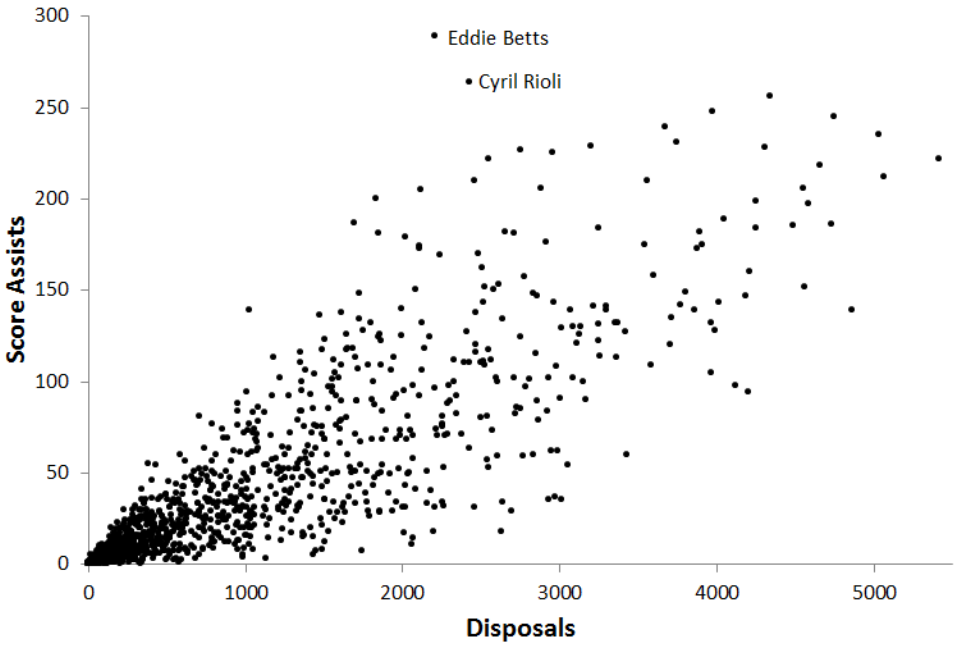


Figure 10.11: Score assists vs disposals for all players from 2008 to 2015

Nic Naitanui (West Coast Eagles)

Nic Naitanui was in 13th position when the overall standings were launched, but reached the top-10 in ninth position three weeks later.

Like Rioli, injury meant Naitanui missed games, playing just 11 in 2013. He returned in 2014 with 20 games, but played with the effects of injury

throughout the season[27], falling to 74th overall.

He played 23 games in 2015 and again returned to the top-10 at eighth overall - second of all ruckmen.

Naitanui doesn't do the bulk of ruck work that others in a similar position may do in a game, which gives the impression that he has had a smaller impact.

During the 2015 season he attended 75% of West Coast's centre bounces as the ruckman and 50% of other stoppages.

When he was in the centre bounce, West Coast won a clearance at 49.3% of centre bounces and lost 34.7% for a differential of +14.6% - the best differential of any player in the top-100 for centre bounce attendances.

With another player in the ruck, West Coast won just 40.1% of centre bounces and lost 42.7% for a differential of -2.5%, suggesting that Naitanui's positive rating isn't just the result of having an effective midfield in the square with him.

In the 2015 season Naitanui averaged 29 fewer ruck contests per game than the top-scoring ruckman Todd Goldstein. Despite this, he won just three fewer hitouts to advantage.

He was second in the competition of all ruckmen in 2015 for hitouts to advantage per ruck contest, clearances and goals.

Brent Harvey (North Melbourne)

Brent Harvey was at 17th overall at the launch of the ratings, has been as high as fourth overall, and has never been lower than 19th.

He is another player who has more effect on games than his 23-disposal average would suggest. His ball use is arguably the best we have seen in modern times, especially in the forward half of the ground.

Of players with 500 or more kicks from 2010 to 2015, Harvey has the best kick rating. From 1,564 kicks he hit his target 1006 times (64.3%). Based on the difficulty of those kicks, the average player would have hit the target 56.7% of the time, or with 887 kicks. This means Harvey has a kick rating of +7.6% and hit the target with 119 more kicks than expected.

For kicks in the forward half he has a kick rating of +8.3% - more than two percentage points higher than any other player.

When kicking inside the forward 50, Harvey found a mark from 135 of 403 kicks (33.5%) - five percentage points clear of any other player in the top-100 for total kicks. The AFL average in that period was just 20.5%. Figure 10.12 highlights his dominance in this area of the game.

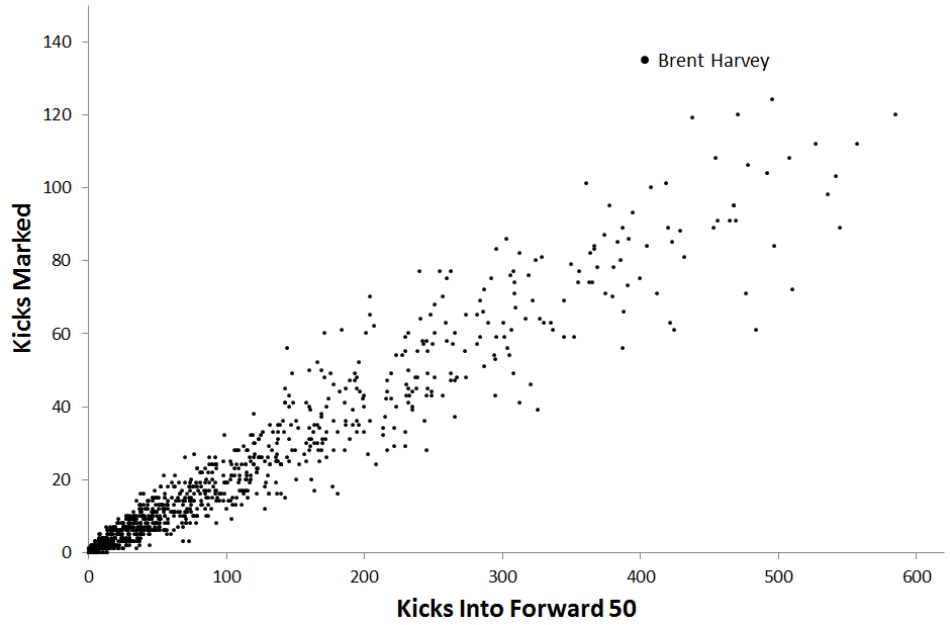


Figure 10.12: Marks from kicks inside 50 from 2010 to 2015

Marcus Bontempelli (Western Bulldogs)

Marcus Bontempelli emerged in 2015 as a new prototype player for the AFL Player Ratings. He could be considered a midfield-version of the players discussed above, with his impact outweighing his volume of involvement.

In 2014 he averaged 11.7 Equity Rating points per game - ranked 116th in the competition and the sixth-best debut season of any player from 2010 to 2015.

Because he had only played 16 games, he was still outside the top-350 in the overall standings. By Round 12 of the following season (2015) he had reached the top-200, by Round 17 he was in the top-100 and by Round 22 he was in the top-20.

At 19.67 years of age he was the youngest player to reach the top-100, just ahead of Gold Coast's Harley Bennell who was 19.88 years old when he first reached the top-100 in 2012.

Remarkably, he was still just 19.76 years old when he reached the top-20. No other player had done so before their 22nd birthday.

Similar to the previously-mentioned players, Bontempelli's game is based on efficiency of ball use rather than on total volume. Unlike those players, he is in the early stages of his career, so we don't have as big a sample to examine.

In his 2015 season he did everything you would ask of a midfielder except have a high volume of involvement, without dominating in any single area. Of 126 midfielders to play at least 10 games, he was in the top-35% of players for metres gained, goals, contested possessions, pressure applied and kick rating. The only other player to achieve the same was Collingwood's Scott Pendlebury.

Metric	Bontempelli	Pendlebury	Fyfe	Gray	Dangerfield
Metres Gained	89%	75%	86%	68%	90%
Goals	90%	84%	93%	100%	94%
Contested Poss.	73%	75%	100%	96%	98%
Pressure Applied	77%	82%	60%	62%	71%
Kick Rating	74%	96%	17%	58%	63%

Table 10.6: Metric percentiles for selected midfielders in 2015.

From Table 10.6 above, we can see Bontempelli compared to the other top-five midfielders for average Equity Rating points per game in 2015.

As we have mentioned previously, Nat Fyfe finished the 2015 season as the top-ranked player in the overall standings. Bontempelli's average performance across many categories matches Fyfe's at the same age, which helps to justify Bontempelli's current standing. Table 10.7 has a comparison of the two players in their first two seasons.

Metric	Bontempelli	Fyfe
Matches	37	39
Disposals	18.9	20.9
Metres Gained	363	368
Inside 50s	4.6	3.7
Contested Poss.	9.2	10.2
Cont. Poss. %	48%	48%
Goals	0.9	0.8
Score Assists	0.9	1.2
Tackles	4.6	3.6
Clearances	3.8	2.7

Table 10.7: Comparison of Bontempelli and Fyfe in first two seasons.

In addition to the above Bontempelli has also shown great ability in one-on-one contests, an area for which Fyfe is renowned. From 34 such contests he has beaten his opponent in 16, for a win percentage of 47%. Fyfe had a win percentage of 45% from 2014-2015, and only two players with at least 20 contests had a better win rate than Bontempelli - Dustin Martin (56%) and Gary Ablett (48%).

10.4.3 Player Case Studies - Negatively Rated

The reverse effect of players being perceived as too high in the overall standings is that there are a similar number of players who are seen as being too low. The players highlighted below are examples of such players.

Dan Hannebery (Sydney Swans)

Dan Hannebery is one clear example. He is considered one of the best players in the competition on the back of taking out the AFL Coaches Association MVP for the 2015 season. He also made the All Australian team and finished second in Sydney's best and fairest award in 2015.

In the AFL Player Ratings he finished 2015 in just 39th position after peaking at 32nd overall. He was 50th in the competition for average AFL Player Ratings points per game in 2015.

He is a proven ball-winner and ranked third in the competition for average disposals per game in 2015

What he does with the ball holds him back though. Amongst outside players (those with a contested possession rate below 40% - 262 qualify) he ranks just 206th for metres gained per disposal and has the fifth-worst kick rating.

When kicking inside 50 in 2015, Hannebery found a mark with just nine of 100 kicks - the worst rate of the top-50 for total kicks into the forward 50 and well below Brent Harvey's six-year average of nearly 34%.

As an outside player who doesn't use the ball well, the AFL Player Ratings system is saying that his contribution is significantly less than industry awards seem to indicate.

Travis Cloke (Collingwood)

Travis Cloke is a key forward who has been defined by his marking ability and his wayward kicking.

He was in 56th place overall at the launch of the AFL Player Ratings (fifth of key forwards), but has been as high as 30th overall (second of key forwards).

By the end of the 2015 season he had dropped to 220th overall (22nd of key forwards).

From 2010 to 2013 he was a clear No.1 in the AFL for contested marks with 3.0 per game - more than 30% above his closest rival Kurt Tippett (2.2 per game). In 2014 he dropped outside the top-10 and in 2015 he ranked seventh.

Prior to the 2015 season (where he didn't qualify for the top-20 for total shots) he was in the bottom-half of the top-20 for total shots for accuracy in each of the previous five seasons, finishing last twice and in the bottom-three in three of five seasons. All six seasons are shown in Table 10.8. In 2015 his accuracy improved, but he was outside the top-20 in the competition for total shots. Had he qualified, his accuracy would have ranked ninth.

Season	Contested Marks	Accuracy	Equity Rating
2010	1st	20th	149th
2011	1st	11th	32nd
2012	1st	15th	81st
2013	1st	18th	199th
2014	14th	20th	382nd
2015	7th	9th*	242nd

Table 10.8: Travis Cloke's rank for contested marks, accuracy (of top-20 for total shots) and Equity Rating by season.

Combining all six seasons he is a clear No.1 for contested marks per game but has the worst kick rating in front of goal of the top-30 for total shots.

As an example of how this poor accuracy has hurt him in the AFL Player Ratings we will consider the 2014 and 2015 seasons - the games that contribute to his overall standing at the end of the 2015 season. From his 143 shots at goal he kicked 71 goals, 52 behinds and had 20 missed shots - an accuracy of nearly 50%. His expected hit rate from these shots was 52.8%.

The final equity of a shot that registers a goal is 6.0 points, a behind 1.5 points and a missed shot roughly 0.5 points. From this we can say that a missed shot is worth 5.5 points less than a goal and 1.0 points less than a

behind.

If Cloke had converted his 20 missed shots into 5 goals (to raise his accuracy to be in line with his expected hit rate) and the remaining 15 into behinds, he would have gained an additional 37.5 points. After adjusting for the weighting on games this is the equivalent of 36.6 points in the overall standings - enough to move him up to 156th overall - 64 places higher than his actual standing - and 14th of key forwards.

Luke McPharlin (Fremantle)

Key defenders are traditionally one of the hardest positions to effectively rate in Australian football. Their primary role is to nullify an opponent, so in many situations thier contribution can't be measured by tracking events relating to the ball.

By placing a larger emphasis on acts closer to defensive goal, Equity Ratings improves on AFL Fantasy and Champion Data ranking points for rating key defenders, as we saw in Figure 9.9, but there are still some who fail to register as strong contributors.

Key defenders who are rated reasonably high in player rating systems are those who impact the game by either spoiling marking contests, winning intercept possessions, or contributing offensively.

Lockdown defenders may not do any of those three things, but still play an important role for the team. By staying disciplined and playing close to their opponent they may prevent their opponent from ever being a viable target, and thus prevent the ball coming in their direction. If this happens, the player has no chance to record an on-ball event that contributes to player rating systems.

One such example is Luke McPharlin from Fremantle. In the 2011 and 2012 seasons he finished in the top-five of Fremantle's best and fairest count,

and in 2012 he was rewarded with an All Australian selection - one of three key defenders selected.

At launch he was 280th in the overall standings - 27th of key defenders. He had been as high as 245th in the 2012 season - 20th of key defenders.

Relative to all players from 2011 to 2012, McPharlin ranked seventh in the competition for intercept marks, but was just 31st for all intercept possessions. He ranked outside the top-100 players for spoils, and outside the top-250 for total disposals and contested possessions.

Though one-on-one contests weren't recorded for the 2011 season, McPharlin was involved in just 32 as a defender in 2012. All of the top-five had at least double the number of contests, indicating that McPharlin is effective in reducing the viability of his opponents as targets.

In Round 8 of 2012 against Hawthorn, McPharlin was responsible for defending Lance Franklin. Franklin averaged 4.4 one-on-one contests per game in the 2012 season and 3.6 goals per game. In that game McPharlin restricted him to one goal and just one one-on-one contest.

Across the season, his combined opponents averaged 2.3 one-on-one contests per game, or 47 in total across the 21 games than McPharlin played. His 32 contests is then 32% below what he was expected to be involved in.

Some of this reduction can be credited to his team's defence rather than his own defensive accountability. Fremantle conceded 9.1 defensive one-on-one contests for the 2012 season - 13% below the AFL average. In the defensive 50 they conceded 4.3 per game - 17% below AFL average.

The compilation of a defensive rating for players similar to McPharlin, and the associated complications, will be introduced in Section 11.2.

10.4.4 Conclusion - Desirable Player Traits

From the above case studies we can deduce that the following player attributes are desirable for players to be highly placed in the AFL Player Ratings.

- **Winning contested possessions**. Since uncontested possessions carry little value in the Equity Rating system, players who can win their own ball are placed higher than in previous systems.
- **Good ball use**. Every disposal is assessed relative to the average outcome expected from that situation, so players who can deliver the ball successfully to valuable areas of the ground (such as inside the forward 50) are rewarded in the Equity Ratings.
- **Hitouts to advantage**. Neutral hitouts carry no weight for ruckmen, so those who can consistently direct the ball to a teammate are highly valuable.
- **High accuracy**. Just like with ball use, a player's shots at goal are judged based on expectation. Players with an accuracy better than expected can be rewarded heavily, while those with bad accuracy are suitably punished.

10.5 Limitations on Use

As at the end of the 2015 season the AFL Player Ratings have been public for nearly three full seasons. Uptake within the industry and by the general public has been slower than expected, and several factors have played key roles in this.

10.5.1 Commercial Landscape

Due to the perceived commercial nature of the product, there is a reluctance by the football media to enhance coverage of the system. AFL Media are the current custodians of the ratings and they are hosted on AFL.com.au. Rival media outlets may be unwilling to promote the system as it would, in turn, be promoting a competitor's website.

In addition to this, the major external news outlet, the Herald Sun (and related News Limited equivalents) has a vested interest in fantasy football through the SuperCoach brand. This is a fantasy game based on Champion Data ranking points where users gain points based on the scores of the players they have selected. One of the major selling points of SuperCoach is that the scoring system is better than its main football rival (AFL Fantasy). Promoting AFL Player Ratings could devalue the SuperCoach scoring system.

AFL Media promotes its official fantasy game - AFL Fantasy, so they face an issue of saturating their audience with numbers by promoting both AFL Fantasy and AFL Player Ratings in the same article.

10.5.2 Complexity of Calculation

Since the compilation of the rating system is more complicated than anything before seen in the AFL industry, many are reluctant to trust the results. As was mentioned in Section 10.4 above, members of the general public still revert to raw disposal counts to assess player performance.

When a player is the top-scoring player in Equity Ratings, but only the 10th-highest player for disposal count, this raises suspicion.

The same is also true when a player leads the game for total disposals but scores low in Equity Ratings.

10.5.3 Available Resources

As at the end of the 2015 season the only readily available information for the general public is a player's overall standing, and a timeline of past overall standings. No information is provided about a player's peak output, improvement over time, or performance within a single game.

Two examples of detailed information provided on an ad-hoc basis are shown below.

Equity Rating

Through the official twitter account of the AFL Player Ratings (@AFLPlayerRating) Equity Ratings were presented at the end of the each game for the 2015 season. An example of this can be seen in Figure 10.13.

Within one plot, the information provided was:

- Players involved in the game.
- Players starting as substitutes (name in green).
- Players substituted out of the game (name in red).
- Each player's Equity Rating for the game.
- Each player's Equity Rating by quarter.

Player Match Plot

To help educate the general public on which actions contributed to player scores, a detailed plot of involvements was also added to twitter for several players after select games. An example of one of these can be seen in Figure 10.14.

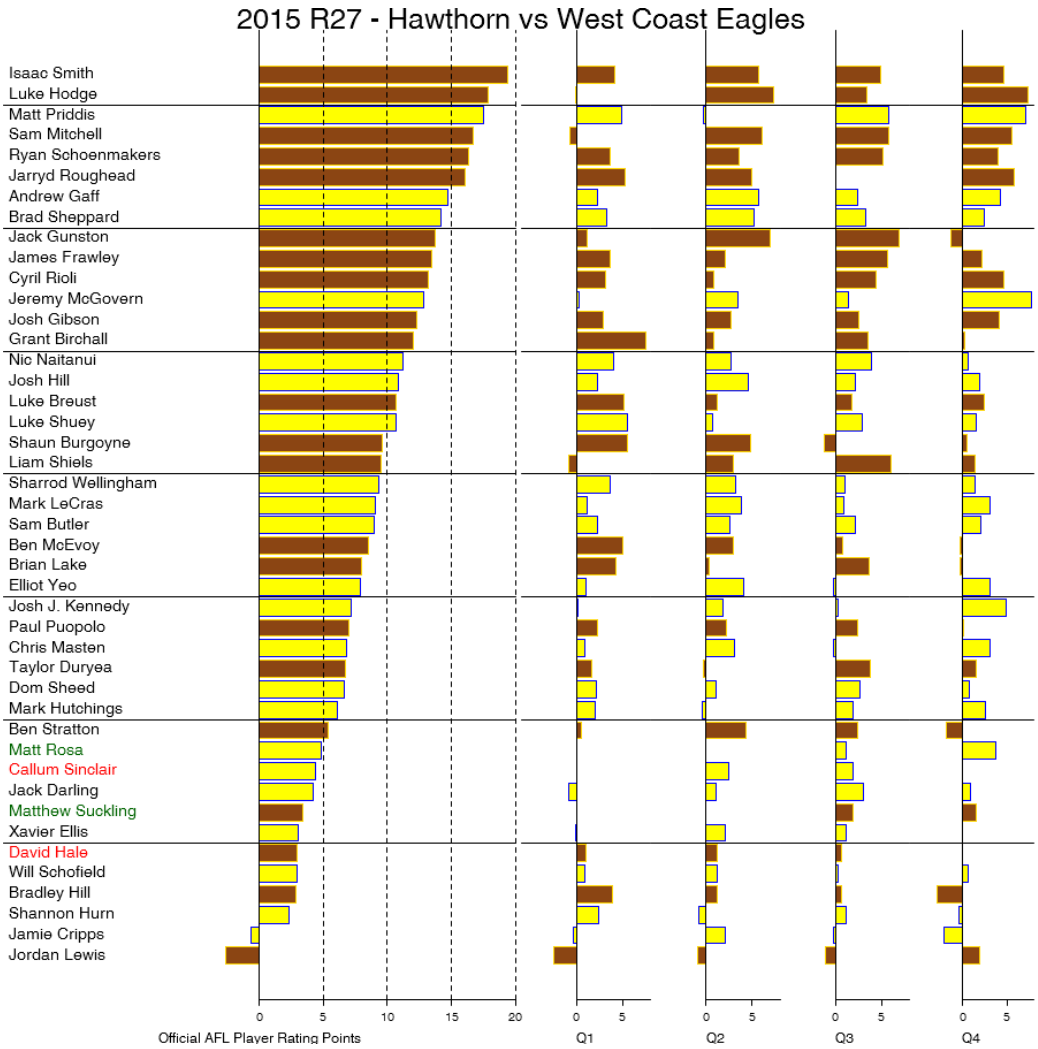


Figure 10.13: Single game Equity Ratings provided to the general public via Twitter.

Every disposal by the player is shown, with colours to indicate the effectiveness of the disposal and dashed lines to identify handballs from kicks. The possession leading to the disposal was coloured to indicate whether it was contested or uncontested and hollow points indicated those won either at a stoppage or off the opposition. Free kicks, spoils and hitouts to advantage are also plotted, when available.

Game Previews

AFL Player Ratings can also be used as a preview for players selected to player in a game. Table 10.9 and Figure 10.15 have information for all 22 players

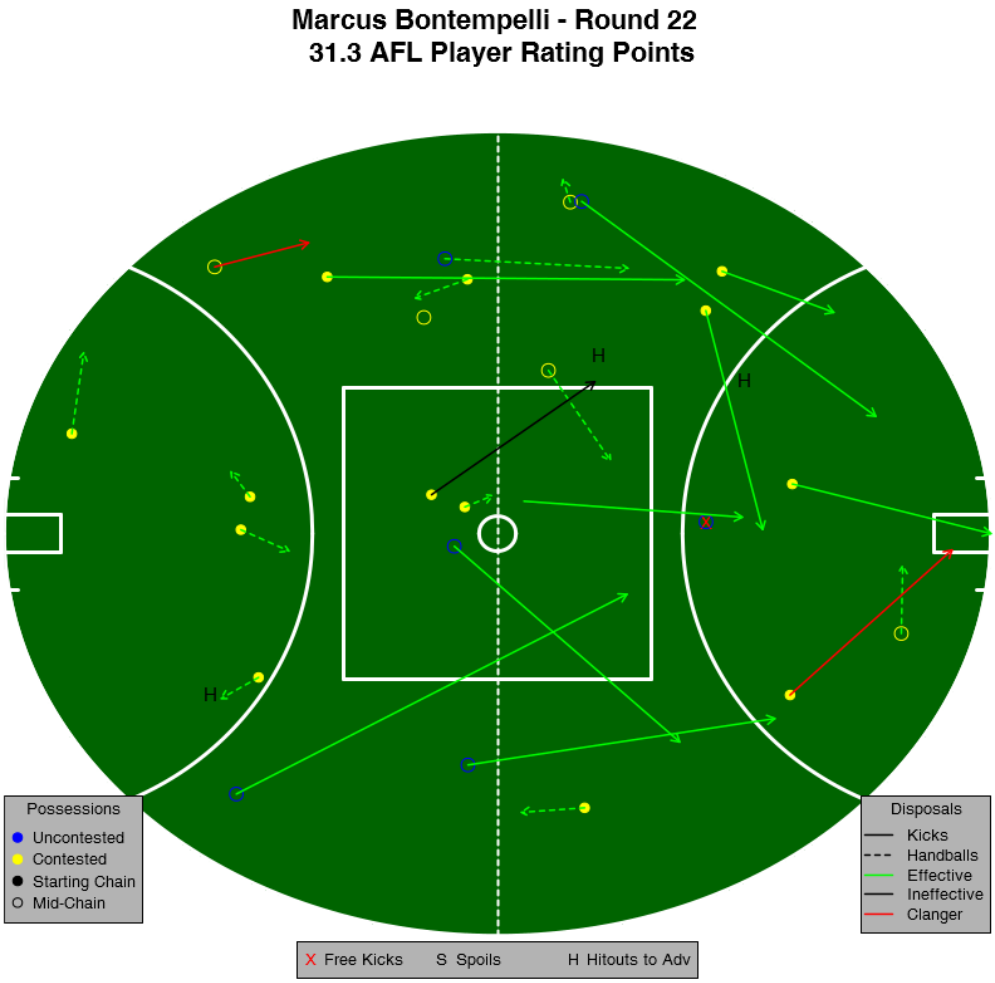


Figure 10.14: Detailed representation of a player's game.

selected for the 2015 grand final for West Coast. Information presented in Table 10.9 for each player includes:

- Player position.
- Current overall standing.
- Career-high overall standing (and when it occurred).
- Average Equity Rating points scored in the 2015 season.
- Career-best Equity Rating (and when it occurred).
- Equity Rating in previous meeting with grand final opponent.
- Average Equity Rating in all career games against grand final opponent.

Player	Club	Pos	Overall	Career High Overall Standing			2015 Match Rating		Career Best Game				QF	v GF Opponent	
			Standing	Standing	Season	Round	Mt	Avg	Season	Round	Opponent	Rating	Rating	Mt	Avg
Nic Naitanui	West Coast Eagles	Ruck	8	8	2015	23	22	16.6	2015	9	Geelong Cats	33.0	15.0	7	15.3
Matt Priddis	West Coast Eagles	Mid	15	14	2015	19	23	14.3	2014	20	Collingwood	26.5		8	13.2
Luke Shuey	West Coast Eagles	Mid	23	18	2015	21	24	13.7	2011	9	Western Bulldogs	32.6	9.5	8	12.9
Josh J. Kennedy	West Coast Eagles	Key Fwd	52	48	2015	2	24	12.7	2014	8	GWS Giants	35.4	11.7	8	13.8
Mark LeCras	West Coast Eagles	Gen Fwd	79	31	2012	5	23	11.7	2010	16	Essendon	43.2	15.7	5	10.2
Shannon Hurn	West Coast Eagles	Gen Def	92	25	2013	24	24	10.5	2012	24	North Melbourne	27.9	10.8	9	8.6
Jack Darling	West Coast Eagles	Key Fwd	98	74	2015	1	14	9.9	2014	1	Western Bulldogs	24.4	6.8	8	11.6
Andrew Gaff	West Coast Eagles	Mid	104	96	2015	23	24	10.7	2015	23	St Kilda	21.6	4.9	8	9.9
Jeremy McGovern	West Coast Eagles	Key Def	108	108	2015	26	19	12.1	2015	1	Western Bulldogs	25.6	5.5	3	10.2
Elliot Yeo	West Coast Eagles	Gen Def	121	121	2015	26	23	11.4	2015	15	Adelaide Crows	26.6	9.5	4	12.4
Sharrod Wellingham	West Coast Eagles	Gen Def	148	82	2012	20	23	10.6	2011	5	Essendon	20.8	10.5	8	8.9
Jamie Cripps	West Coast Eagles	Gen Fwd	155	155	2015	26	24	9.9	2015	1	Western Bulldogs	19.5	7.6	5	6.1
Chris Masten	West Coast Eagles	Mid	179	102	2014	2	21	9.3	2011	23	Brisbane Lions	22.0		6	10.1
Josh Hill	West Coast Eagles	Gen Fwd	225	97	2013	15	21	11.1	2014	22	Melbourne	23.6	18.7	7	11.2
Brad Sheppard	West Coast Eagles	Gen Def	230	229	2015	23	24	9.0	2012	8	St Kilda	17.3	6.8	4	4.0
Will Schofield	West Coast Eagles	Key Def	233	185	2012	15	20	8.3	2012	15	North Melbourne	20.7	10.3	8	7.1
Matt Rosa	West Coast Eagles	Mid	268	129	2012	2	16	8.2	2015	4	Brisbane Lions	24.6	8.9	7	6.4
Sam Butler	West Coast Eagles	Gen Def	302	267	2015	11	16	9.6	2015	4	Brisbane Lions	22.4	4.4	6	8.0
Dom Sheed	West Coast Eagles	Mid	305	305	2015	26	22	8.8	2015	21	Western Bulldogs	19.0	5.5	2	5.7
Mark Hutchings	West Coast Eagles	Mid	318	316	2015	1	12	9.1	2013	19	Gold Coast Suns	17.1	15.8	3	10.7
Xavier Ellis	West Coast Eagles	Gen Def	339	248	2012	1	14	5.7	2010	20	Melbourne	17.9	1.7	3	6.6
Callum Sinclair	West Coast Eagles	Ruck	404	404	2015	26	19	7.9	2015	17	Sydney Swans	13.8	6.4	2	4.7

Table 10.9: Match preview for selected 22 players.

In Figure 10.15 all 22 players are presented in order of average Equity Rating points per game for the 2015 season. From this plot it is clear that the depth of Hawthorn's playing list exceeds that of West Coast, with large gaps from the fourth-best player on each team to the 17th-best player.

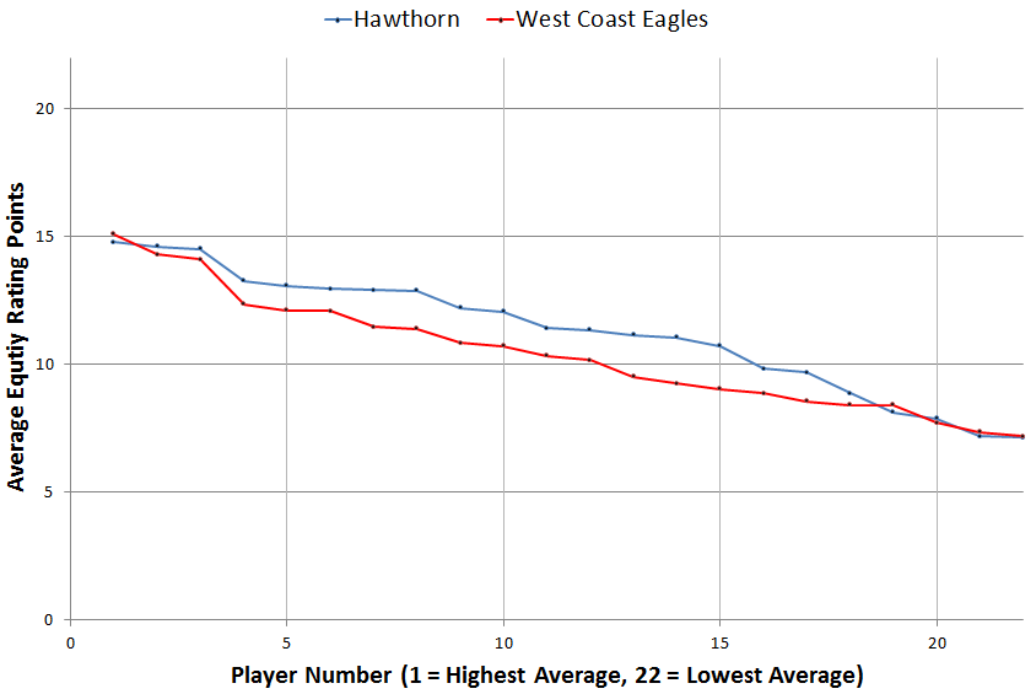


Figure 10.15: Comparison of selected 22 players for a match.

One of the secondary aims of the rating system was to generate conversation, both amongst the general public and in the media. The lack of detailed information, including game-by-game scores, has held this back.

Future development of the website has been discussed, and this will be crucial to extending the current usage of the AFL Player Ratings. Increasing the information available to the general public can only help to increase curiosity, which should in turn create more discussion and acceptance of the AFL Player Ratings.

10.5.4 Club Intellectual Property

Modern football, especially in the public arena, is a team-first environment where coaches are reluctant to promote the performance of individuals over any of their teammates. This makes it difficult to determine the uptake of the AFL Player Ratings inside club analysis departments.

In addition to the reluctance to put players above the team, clubs are in a competitive environment where good analysis and its efficient application to the workings of the football club is seen as a competitive advantage. Revealing methods of analysis, or even the underlying measures that a club deems important, would essentially be sharing intellectual property and erasing any competitive advantage that may have been obtained.

10.6 Conclusion

Equity Ratings were successfully translated into a longer-term player performance measure known as AFL Player Ratings. The compilation of the rating system was shown to be robust to changes in player form. Players missing games through injury are protected for a number of games, but eventually start to slide down the overall standings.

The AFL Player Ratings were adopted by the league as a perpetual measure of performance to answer the question of 'who is the best player in the AFL?'. They have since generated significant online content for AFL Media and have triggered debate amongst the general public, justifying their use by the league's official media arm.

Gary Ablett was established as the clear No.1 player in the competition in the early years of the ratings. Other players to consistently appear near the top of the leaderboard are those who win contested possessions, use the ball well and are accurate in front of goals.

Lockdown defenders, and those who are inefficient with the ball are further down the leaderboard.

Issues faced when trying to promote the AFL Player Rating were discussed, and suggestions have been put forward to provide more detailed information to AFL clubs and to the general public.

Chapter 11

Additional Uses

This chapter will introduce some potential uses for the AFL Player Ratings outside of the existing performance measure.

11.1 Value Above Replacement

In American Baseball player performance has been assessed using Wins Above Replacement (WAR) [52], where a player's contribution is compared to that which you would expect from the next-best available player (generally a minor-league player).

We can apply similar logic to AFL players, where comparisons are made against fringe players - those who are not part of their club's best team.

We can define a player's Value Above Replacement (VAR) for player j as

$$VAR(j) = ER(j) - ER_r(P_j) \tag{11.1}$$

where $ER(j)$ is the player's average Equity Rating per game, P_j is the player's position and $ER_r(P_j)$ is the average Equity Rating per game of a replacement player in that position.

To determine the value of a replacement player, we consider how many players from each position are active in a game, on average. Table 11.1 below contains counts of each player position in the 2015 season. The 'Per Match' column is calculated as the total number of player games divided by 206 (the number of games in 2015) and again divided by two to get a measure for each team involved in the match. The 'AFL Total' column is the 'Per Match' number extrapolated out to 18 teams, rounded up to the nearest number.

Position	Player Games	Per Match	AFL Total	Replacement Value
Key Def	1048	2.5	46	6.7
Gen Def	1939	4.7	85	6.0
Ruck	552	1.3	25	8.8
Mid	2559	6.2	112	7.9
Mid-Fwd	729	1.8	32	5.7
Gen Fwd	1352	3.3	60	6.7
Key Fwd	885	2.1	39	6.8

Table 11.1: Identifying the replacement player for each position in 2015.

From Table 11.1 we then use the AFL Total column to identify which player to use as the replacement. Teams play 2.5 key defenders per game on average, so the replacement player is the 46th-best key defender (2.5 x 18 = 45). The replacement midfielder is the 112th-best.

By then comparing each player's average points per game to the replacement player we have a measure of a player's importance.

Using this measure Easton Wood, a general defender, moves from 16th for average Equity Rating to sixth for VAR.

Likewise, Chad Wingard, a general forward, moves from 13th to seventh.

The top-10 players for VAR and their rank in raw Equity Ratings are in Table 11.2.

This measure gives a version of the Equity Ratings that has been adjusted for player position, enabling better comparisons across positions.

#	Player	Position	Equity Rating
1	Gary Ablett	Mid	1
2	Patrick Dangerfield	Mid	2
3	Nat Fyfe	Mid	3
4	Robbie Gray	Mid	4
5	Marcus Bontempelli	Mid	5
6	Easton Wood	Gen Def	16
7	Chad Wingard	Gen Fwd	13
8	Scott Pendlebury	Mid	7
9	Todd Goldstein	Ruck	6
10	Rory Sloane	Mid	9

Table 11.2: Top-10 players for Value Above Replacement.

11.2 Defensive Rating

By considering Champion Data's match-up capture we can get a measure of a player's defensive capabilities.

We define, for player j, his Conceded Rating as

$$CR(j) = 100 \times \frac{\sum_i t_i(j) \times \Delta E_F(i \mid O_i = j)}{\sum_i t_i(j)} \tag{11.2}$$

and his Opponent Rating as

$$OR(j) = 100 \times \frac{\sum_i t_i(j) \times E_{R100}(i)}{\sum_i t_i(j)} \tag{11.3}$$

where $i \in (1, \ldots, 22)$ and $\Delta E_F(i \mid O = j)$ is player i's Equity Rating within the game when matched up on player j, $t_i(j)$ is the time players i and j spent matched up on each other and $E_{R100}(i)$ is player i's average Equity Rating per 100 minutes of game time across the previous two seasons.

From Equations 11.2 and 11.3 we then have a measure for what player j conceded to his opponents per 100 minutes of game time (CR) and what his opponents would normally score per 100 minutes of game time (OR). From

this, we can define a player's Defensive Rating as

$$DR(j) = \frac{OR(j) - CR(j)}{OR(j)} \tag{11.4}$$

which tells us what percentage of his expected Conceded Rating he prevented. A positive value indicates that his opponents had less of a contribution than usual, while a negative rating indicates that his opponents did better than usual.

The top-10 players for the 2015 season for this measure are in Table 11.3. Though the measure is compiled for all players and opponents, only those who played on at least 10 opponents within a game for 50 minutes or more are included in this list.

Player	Club	Opponents	Conceded Rating	Opponents Rating	Defensive Rating
Luke McPharlin	FRFC	13	5.05	9.11	+45%
Nathan Brown	COFC	19	5.70	8.99	+37%
Phil Davis	GWS	11	6.22	9.74	+36%
Alex Rance	RFC	20	5.99	9.18	+35%
James Frawley	HFC	10	6.44	9.27	+31%
Daniel Talia	AFC	21	7.10	9.72	+27%
Brent Harvey	NMFC	11	6.89	9.22	+25%
Nic Naitanui	WCFC	13	7.37	9.78	+25%
Heath Shaw	GWS	10	7.56	9.98	+24%
Ted Richards	SYFC	19	7.09	9.31	+24%

Table 11.3: Defensive Ratings for players with at least 10 opponents of 50+ minutes.

Of the eight defensive players on the list, six have been selected in All Australian teams.

It is also worth noting that two non-defensive players are in the top-10 for Defensive Rating - Brent Harvey and Nic Naitanui. These two players were featured in Section 10.4.2 as players whose value was underrated by the general public.

For Harvey, this could be a due to him being a stronger defensive player than expected, or that his opponent (generally defensive midfielders) have to sacrifice part of their game to defend him.

With Naitianui being a ruckman, many of his opponents will also be ruckmen going head-to-head against him. This high defensive rating is likely due to his offensive dominance restricting opportunities for his opponents.

The leading player for this measure, Luke McPharlin, was also featured in the case studies in Section 10.4.2 - as a player who is underrated by the AFL Player Ratings due to his overly defensive nature and lack of involvement in offensive play. McPharlin's opponents in 2015 scored 4.1 Equity Rating points per game below their season average - equivalent to a drop of 45% of their standard contribution.

Incorporating this defensive measure (4.1 Equity Rating points per game) into his Equity Rating contribution would see him move from roughly 480th in the 2015 season for average points per game to roughly 170th.

Though this seems like a worthy improvement, it should be noted that Harvey and Naitanui's presence in the top-10 for this defensive metric suggests that many players above McPharlin would also increase their output, limiting the effect of the inclusion of Defensive Ratings. For this reason it is proposed that Defensive Ratings be treated as a separate performance measure to Equity Ratings and AFL Player Ratings.

11.2.1 Team Effect

Another consideration to make is about the effect of a team's defence on a player's defensive rating. Fremantle in 2015 conceded the second-fewest points per game and the fewest inside 50s. The average Equity Rating points scored by players against Fremantle was just 8.4 points, compared to the highest team Gold Coast at 10.3 points and the AFL average of 9.3 points.

This could be the result of having many strong defensive players, but decoupling a single player's defensive efforts from this team effect is currently not possible. With the ball going inside 50 less against Fremantle than any other team, Luke McPharlin may have a high defensive rating because the opposition had less opportunities to send the ball to his opponent, rather than McPharlin effectively defending him or preventing him from being a viable target.

In an attempt to adjust for this we can include a Team Defence component in an Adjusted Defensive Rating

$$ADR(j) = DR(j) - TD(j) \tag{11.5}$$

where TD(j) is the average score below AFL average of a player playing against player j's team. In the case of Fremantle this is roughly 10%.

Player	Club	Opponents	Defensive Rating	Team Defence	Adj Def Rating
Nathan Brown	COFC	19	+37%	-6%	+43%
Phil Davis	GWS	11	+36%	-0%	+36%
Luke McPharlin	FRFC	13	+45%	+11%	+34%
Charlie Dixon	GCFC	15	+20%	-12%	+32%
Daniel Talia	AFC	21	+27%	-3%	+30%
Alex Rance	RFC	20	+35%	+9%	+26%
Jack Frost	COFC	13	+19%	-6%	+25%
Heath Shaw	GWS	10	+24%	-0%	+25%
Brent Harvey	NMFC	11	+25%	+3%	+23%
Eddie Betts	AFC	18	+20%	-3%	+23%

Table 11.4: Adjusted Defensive Ratings.

Nathan Brown and Phil Davis now move ahead of McPharlin, due to their teams having worse defensive records than McPharlin's.

The method of adjusting for defensive ratings can be improved through future work. A method similar to that used by Stern [57] could measure team defence within a single game rather than across several seasons. In this paper

he used the 'resources used' by both batsmen and bowlers in limited overs cricket and compared their output against other players within the same game to get a measure of relative performance.

With the addition of player tracking data, Champion Data's match-up allocations would be more reliable, and information may be known about player positioning and team defensive structures, and how that translates to defensive ratings.

Chapter 12

Discussion and Conclusion

12.1 Contributions

This thesis has furthered the use of statistics in Australian football.

Through visualisation of spatial data (heatmaps), clubs and players are able to better identify and communicate tactical traits of opposition teams and players. Heatmaps were introduced to the industry as early as 2008 and were immediately commercialised by Champion Data. They are now in use by AFL teams, media outlets and the general public.

Kick ratings were created to account for the difficulty of a player's attempted kicks when assessing kicking ability. By comparing the result of kicks to the expectation on the player relative to what his peers have done in the past, the outcome is put in context, allowing reasonable comparison across players in different positions. Kick ratings have been implemented within the industry and are in use by AFL teams and media outlets.

The most significant contribution of this thesis has been the creation of a new player rating system. This system, Equity Ratings, is the most comprehensive measure of player performance to be used in Australian football. It is

the first time that spatial data and pressure data have been used in a player rating system, making it a more detailed and accurate representation of player performance.

It was shown that Equity Ratings were less biased towards midfielders than the two most commonly-used existing player rating systems - AFL Fantasy and Champion Data ranking points. There was also a near-perfect correlation with match scores, indicating that the majority of events that influence the final result are considered and measured accordingly.

The game-level Equity Rating system was built into a long-range measure of performance in the form of the Official AFL Player Ratings. This system was commercialised and adopted by the league as the official measure of player performance. Results appear on the league's official website.

12.2 Limitations

The main limitation of the Equity Ratings system is that it relies on underlying data entered manually. There is an element of subjectivity in the available information that introduces human error. Though this is unlikely to be completely eradicated, the inclusion of player tracking data will provide more robust methods of capturing required information.

The complexity of the algorithms behind Equity Ratings have limited its uptake within the industry. Through continued education of AFL coaches and media personalities, it is hoped that this can be overcome in the near future. Further development of available resources on AFL.com.au and within Champion Data software for use by AFL club staff should also aid this process.

12.3 Transferability

The underlying logic of Equity Ratings should be transferable to any sport, providing there is a richness of data already available. For the algorithm to be employed successfully, it requires clearly identifiable phases of play, a way of measuring the value of each phase, and records of every change of phase assigned to a specific player.

A similar approach has recently been employed in the NBA by Cervone, et al. [13], making use of player tracking data to calculate expected points for each possession (EPV), which can be converted into a player rating system.

Other sports that have been identified as having data close to the level required, while not having an applicable player rating system in place, include rugby league, rugby union, soccer, american football and volleyball.

12.4 Future Work

Future work will see the continued development of Equity Ratings. A full investigation will be undertaken into the the effect of different playing venues on equity gradients and they will be checked for significant changes across seasons.

With the inclusion of player tracking data, the underlying equity gradients can be made more accurate by decreasing the associated error with the capture of spatial information. In turn, this will enable the possibility of more granular possession phases to better measure the state of the game.

Appendix A

Glossary

50m Penalty Awarded to a team/player if an infringement occurs after a mark, free-kick or during a behind kick-in.

Advantage Rate Percentage of hitouts that reach an intended teammate.

AFL Player Ratings A long-range measure of player performance that considers Equity Ratings for a player's most-recent 40 games in a two year period.

Ball Up When the umpire restarts play via a bounce or throw up after a stoppage within the field of play. Does not include centre bounces.

Baulk Using deception as the ball carrier to beat an opponent, by sidestepping or feigning disposal.

Baulked When a player is beaten and evaded by the ball carrier.

Behind A minor score, as judged by the goal umpire. Behinds are worth one point to a team's total score.

Behind Assist Creating a behind by getting the ball to a teammate either via a disposal, knock-on, ground kick or hitout.

Block Effectively shepherding an opponent out of a contest to the benefit of a teammate.

Broken Tackle Evading a tackle attempt by an opponent and legally disposing of the ball in space.

Centre Bounce An umpire bounce or throw up at the start of each quarter and after a goal.

Centre Bounce Attendance Starting inside the centre square at a centre bounce, either as the ruckman or as one of three midfielders.

Chain Involvement Number of team chains that a player is involved in. A chain involvement includes all hitouts, disposals and possessions.

Chain Launch Possession chains launched by an intercept possession, free kick, hitout-to-advantage or clearance.

Clanger An error made by a player resulting in a negative result for his side. Disposal clangers are any kick or handball that directly turns the ball over to the opposition. Frees and 50 metre penalties against, No Pressure Errors, Dropped Marks, Ball-Up Kick-Ins and Debits are all included in clangers.

Clanger Handball Handballs that give possession directly to the opposition.

Clanger Kick Kicks that give possession directly to the opposition.

Clearance Credited to the player who has the first effective disposal in a chain that clears the stoppage area, or an ineffective kick or clanger kick that clears the stoppage area.

Contest - Lose Conceding the next possession to your opponent in a one on one contest. Includes spoils by the defensive player to his teammate.

Contest - Lose Percentage Percentage of one on one contests where the opponent won the next possession.

Contest - Neutral One on one contests where neither of the two involved players were the next to win possession.

Contest - Neutral Percentage Percentage of one on one contests where neither player won the next possession.

Contest - One on One A 50-50 contest that occurs after a kick, and involves only two players - a target player and a defender. Each player must have a reasonable chance to win the ball in order for a one-on-one to be recorded.

Contest - Win Winning the next possession after a one on one contest. Includes spoils by the defensive player to a teammate.

Contest - Win Percentage Percentage of one on one contests where the player won the next possession.

Contest Defender One on one contests as the defensive player.

Contest Target One on one contests as the targeted player.

Contested Knock On Using the hand to knock the ball to a teammate's advantage rather than attempting to take possession from a contested situation.

Contested Mark When a player takes a mark under physical pressure of an opponent or in a pack.

Contested Possession A possession which has been won when the ball is in dispute. Includes looseball-gets, hardball-gets, contested marks, gathers from a hitout and frees for.

Crumb A type of groundball get that is won by a player at ground level after a marking contest. The player must not be involved in the original contest. Crumbing Possessions can be either hardball or looseball-gets.

Disposal Legally getting rid of the ball, via a handball or kick.

Disposal Efficiency Percentage of disposals that are effective.

Dispossessed Losing possession of the ball due to a tackle without recording a disposal.

Effective Clearance Effective clearances occur when the ball was successfully moved out of a stoppage area without immediately being turned over.

Effective Clearance Percentage Percentage of clearances that are effective clearances.

Effective Handball A handball to a teammate that hits the intended target.

Effective Kick Short A kick of less than 40 metres that results in the intended target retaining possession. Does not include kicks that are spoiled by the opposition.

Effective Long Kick A kick of more than 40 metres to a 50/50 contest or better for the team.

Equity Rating A measure of a player's performance in a given game, based on the change to Field Equity effected by a player's actions.

Expected Hit Rate The competition average of how often players have hit their kicks from a given combination of kicking zone, target zone, pressure level, kicking distance, direction and intent.

Field Equity The value of having possession of the ball at a point on the ground, measured by the likelihood of being the next team to score. Field Equity changes based on location, and the type of possession registered.

First Possession The initial possession that follows a stoppage, including a looseball-get, hardball-get, intended ball-get (gather), free kick or ground kick.

Free Against When an infringement occurs resulting in the opposition receiving a free kick from the umpires.

Free For When a player is interfered with and is awarded a free kick by the umpires.

Free For Off Ball Frees for that don't warrant a player receiving a contested possession, with the majority being 'after disposal' frees where the player receiving the free is knocked down after disposing of the ball. Counted as uncontested possessions.

Gather Possessions that were a result of a teammate deliberately directing the ball in the player's direction, via a hitout, disposal or knock-on, excluding marks and handball receives. Gathers from a hitout are contested possessions the rest are uncontested.

Gather From Hitout A possession gained from a teammate's hitout-to-advantage. Counted as a contested possession.

Goal A major score, as judged by the goal umpire. Worth six points to a team's total score.

Goal Assist Creating a goal by getting the ball to a teammate either via a disposal, knock-on, ground kick or hitout, or by winning a free kick before the advantage is paid to the goal scorer.

Ground Ball Get Contested possessions won at ground level, excluding free kicks. Groundball gets can either be hardball gets or looseball gets.

Ground Kick A deliberate kick without taking possession that gains either significant distance from the point of contact or an uncontested possession for a teammate.

Handball Disposing of the ball by hand.

Handball Efficiency Percentage of handballs that are effective.

Handball Receive An uncontested possession that is the result of a teammate's handball.

Hard Ball Get A disputed ball at ground level under direct physical pressure or out of a ruck contest, resulting in an opportunity to effect a legal disposal.

Hit Out Sharked A hitout that directly results in an opponent's possession.

Hit Out To Advantage A hitout that reaches an intended teammate.

Hitout Knocking the ball out of a ruck contest following a stoppage with clear control, regardless of which side wins the following contest at ground level.

Hitout Win Percentage Percentage of ruck contests resulting in a hitout win.

Ineffective Handball Handballs that are not advantageous to the team, but do not directly turn the ball over to the opposition.

Ineffective Kick Kicks that are not advantageous to the team, but do not directly turn the ball over to the opposition.

Inside 50 Moving the ball from the midfield into the forward zone. Excludes multiple entries within the same chain of possession.

Inside 50 Result Recorded when a player inside the forward 50 is clearly the sole target of a teammate's kick into the forward 50. The inside 50 target player will be recorded regardless of the outcome of the kick.

Intercept Any possession that is won that breaks an opposition chain.

Intercept Mark Any mark taken from an opponent's kick.

Kick In When a player kicks the ball back into play after an opposition behind. Kick-ins are regarded as a function of the team and do not count as kicks, although they are similarly graded for quality.

Kick Inside 50 When a player records an inside 50 for his team by kicking the ball from the midfield zone into the forward line.

Kick Long to Advantage A long kick that results in an uncontested possession by a teammate. If an error is made by the player receiving the kick a kick long to advantage is still recorded for the player kicking the ball.

Kick to Handball Ratio Number of kicks recorded per handball.

Kick Rating A measure of kicking ability based on how often players hit their target relative to what others have done in similar situations.

Kicking Efficiency Percentage of kicks that were effective.

Knock On When a player uses his hand to knock the ball to a teammate's advantage rather than attempting to take possession within his team's chain of play.

Loose Ball Get A disputed ball at ground level not under direct physical pressure that results in an opportunity to record a legal disposal.

Mark When a player cleanly catches (is deemed to have controlled the ball for sufficient time) a kicked ball that has travelled more than 15 metres without anyone else touching it or the ball hitting the ground.

Mark Dropped An uncontested marking opportunity that is dropped, resulting in a contest at ground level.

Mark On Lead An uncontested mark taken after out-sprinting an opponent.

Mark Play On Playing on immediately without retreating behind the mark.

Mark Play On Percentage Percentage of marks where the players plays on immediately without retreating.

Metres Gained Net metres gained with the ball by a player, by running, kicking or handballing, combining measures towards attacking goal and away from defensive goal.

Metres Gained Assisted Total metres gained by a teammate that receives an uncontested possession from your disposal.

Metres Gained Effective Total metres gained by a player or a team from effective disposals.

Missed Shot Genuine shots at goal that either fell short with no score being registered or resulted in an out on the full.

No Pressure Error Fumbling or losing possession of the ball whilst under little or no pressure from the opposition.

Possession When a player grabs the ball with a reasonable amount of time to dispose of it.

Ranking Points The Official Champion Data AFL Rankings system was established in 1999 and has been developed into a robust and comprehensive system for objectively measuring player performance through the use of statistical measures. The rankings are geared to reward the winning factors of a game of AFL football. They are used as the scoring measure in the Herald-Sun SuperCoach fantasy game.

Rebound 50 Moving the ball from the defensive zone into the midfield.

Retain Disposal Disposals retained by a teammate.

Retain Handball Handballs retained by a teammate.

Retain Kick Kicks retained by a teammate.

Retention Disposal Rate Percentage of disposals that were retained by a teammate.

Retention Handball Rate Percentage of handballs that were retained by a teammate.

Retention Kick Rate Percentage of kicks that were retained by a teammate.

Ruck Contest Starting as one of the two ruckmen competing for the ball at a stoppage.

Rundown Tackle A tackle that is a result of a hard chase that has been applied to catch the player in possession.

Running Bounce Touching the ball to the ground, either directly or via a bounce, to allow a player to avoid being penalised for running too far.

Rushed Behind Behinds that have not been scored directly off a player's boot, excluding those that were touched on the goal line.

Score Accuracy Percentage Percentage of scoring shots that resulted in a goal, derived by goals divided by the sum of goals and behinds. Excludes rushed behinds.

Score Assist Creating a score by getting the ball to a teammate either via a disposal, knock-on, ground kick or hitout, or by winning a free kick before the advantage is paid to the goal scorer.

Score Involvement Number of scoring chains where a player was involved with either a disposal, hitout-to-advantage, kick-in or knock on. If a player has two disposals in the same scoring chain, he is only credited with one score involvement.

Score Launch Scoring chains launched by an intercept possession, free kick, hitout-to-advantage or clearance.

Scoreboard Impact A player's total amount of points scored from goals and behinds plus points scored from score assists. Goals and goal assists equal six points each and Behinds and behind assists equal one point each.

Shot at Goal Percentage The accuracy from all shots at goal. The percentage is derived by goals divided by the sum of goals, behinds and missed shots.

Smother Suppressing an opposition disposal by either changing the trajectory of the ball immediately after the disposal or by blocking the disposal altogether.

Spoil Knocking the ball away from a marking contest preventing an opponent from taking a mark.

Spoil Efficiency The percentage of spoils that end up in a teammate's possession or a stoppage, effectively killing the play.

Stoppage Set pieces where the ball is returned to play after a goal, an out of bounds or a ball up being called. There are three stoppages; Centre Bounces, Ball-Ups and Throw-Ins.

Tackle Using physical contact to prevent an opponent in possession of the ball from getting an effective disposal.

Third Man Up A player that jumps over the competing ruckmen at an around the ground stoppage to win a hitout. A third-man up is only recorded when the player wins a hitout.

Throw In Boundary umpire restarts play by throwing the ball back in after a stoppage out of bounds.

Turnover Losing possession to the opposition in general play. General play excludes events that happen between a stoppage and the clearance.

Uncontested Mark Marks taken under no physical pressure from an opponent. Includes marks taken on a lead and from opposition kicks.

Uncontested Possession Possessions gained whilst under no physical pressure, either from a teammate's disposal or an opposition's clanger kick. Includes handball receives, uncontested marks (including lead marks) and intended ball gets from a disposal.

Appendix B

Overall Standings

Overall Standings for the AFL Player Ratings, as at the conclusion of the 2015 season, based on performance in the 2014 and 2015 seasons.

Player	Club	Pos	Matches	Rating Points	Overall Standing	Position Standing
N.Fyfe	FRFC	Mid	40	652.4	1	1
S.Pendlebury	COFC	Mid	40	628.2	2	2
P.Dangerfield	AFC	Mid	40	625.2	3	3
T.Goldstein	NMFC	Ruck	40	605.9	4	1
R.Sloane	AFC	Mid	40	588.5	5	4
J.Selwood	GFC	Mid	40	587.9	6	5
R.Gray	PAFC	Mid-Fwd	40	581.1	7	1
N.Naitanui	WCFC	Ruck	40	565.6	8	2
J.Kennedy	SYFC	Mid	40	543.0	9	6
B.Harvey	NMFC	Mid-Fwd	40	539.0	10	2
M.Bontempelli	WBFC	Mid	37	535.8	11	7
S.Jacobs	AFC	Ruck	40	531.9	12	3
L.Franklin	SYFC	Key Fwd	39	529.7	13	1
M.Priddis	WCFC	Mid	40	526.1	14	8
A.Sandilands	FRFC	Ruck	40	524.4	15	4
J.Roughead	HFC	Key Fwd	40	520.3	16	2
T.Boak	PAFC	Mid	40	518.6	17	9

Player	Club	Pos	Matches	Rating Points	Overall Standing	Position Standing
C.Rioli	HFC	Gen Fwd	36	510.4	18	1
D.ZoRucko	BFC	Mid-Fwd	40	509.2	19	3
C.Wingard	PAFC	Gen Fwd	40	506.9	20	2
E.Betts	AFC	Gen Fwd	40	502.1	21	3
C.Ward	GWS	Mid	40	502.1	22	10
B.Deledio	RFC	Mid-Fwd	37	497.8	23	4
L.Shuey	WCFC	Mid	40	495.1	24	11
D.Heppell	EFC	Mid	40	494.7	25	12
D.Beams	BFC	Mid	35	491.9	26	13
A.Treloar	GWS	Mid	40	486.4	27	14
L.Breust	HFC	Gen Fwd	40	484.5	28	4
H.Hartlett	PAFC	Mid	40	482.9	29	15
A.Rance	RFC	Key Def	40	478.7	30	1
L.Hodge	HFC	Mid	40	477.9	31	16
D.Mundy	FRFC	Mid	40	477.9	32	17
N.Dal Santo	NMFC	Mid	40	477.6	33	18
E.Wood	WBFC	Gen Def	40	476.8	34	1
M.Murphy	CFC	Mid	39	476.2	35	19
R.Griffen	GWS	Mid	40	476.0	36	20
L.PaRucker	SYFC	Mid	40	475.7	37	21
D.Armitage	SKFC	Mid	36	474.7	38	22
D.Hannebery	SYFC	Mid	40	470.9	39	23
S.Mitchell	HFC	Mid	40	467.6	40	24
S.Sidebottom	COFC	Mid	35	467.3	41	25
M.Duncan	GFC	Mid	35	467.1	42	26
S.Edwards	RFC	Mid-Fwd	39	464.7	43	5
J.Gunston	HFC	Key Fwd	40	463.1	44	3
B.Smith	AFC	Gen Def	40	461.3	45	2
J.Riewoldt	RFC	Key Fwd	40	460.4	46	4
G.Ablett	GCFC	Mid	21	454.5	47	27
J.Lewis	HFC	Mid	40	452.5	48	28

Player	Club	Pos	Matches	Rating Points	Overall Standing	Position Standing
D.Martin	RFC	Mid	40	452.0	49	29
K.Jack	SYFC	Mid	40	451.8	50	30
T.Hawkins	GFC	Key Fwd	40	450.2	51	5
J.McVeigh	SYFC	Mid	40	448.3	52	31
B.Cunnington	NMFC	Mid	40	448.3	53	32
I.Maric	RFC	Ruck	36	447.6	54	5
S.Hill	FRFC	Mid	40	446.8	55	33
R.Murphy	WBFC	Gen Def	40	446.0	56	3
J.Kennedy	WCFC	Key Fwd	40	445.4	57	6
T.Lynch	GCFC	Key Fwd	40	444.8	58	7
R.Douglas	AFC	Mid	35	443.1	59	34
B.Goddard	EFC	Mid	40	441.8	60	35
T.Rockliff	BFC	Mid	34	441.4	61	36
D.Smith	GWS	Gen Fwd	40	436.9	62	5
L.Dahlhaus	WBFC	Mid-Fwd	40	435.7	63	6
J.Westhoff	PAFC	Key Fwd	40	435.5	64	8
P.Ryder	PAFC	Ruck	39	432.2	65	6
H.Bennell	GCFC	Mid-Fwd	30	431.5	66	7
H.Taylor	GFC	Key Def	40	431.0	67	2
S.Burgoyne	HFC	Gen Def	40	430.7	68	4
L.Shiels	HFC	Mid	40	430.6	69	37
J.Stringer	WBFC	Gen Fwd	40	429.4	70	6
S.Thompson	AFC	Mid	40	429.3	71	38
J.Steven	SKFC	Mid	39	428.4	72	39
T.Cotchin	RFC	Mid	40	424.8	73	40
N.Jones	MFC	Mid	40	423.2	74	41
D.Swan	COFC	Mid	38	422.8	75	42
O.Wines	PAFC	Mid	38	420.9	76	43
D.Prestia	GCFC	Mid	30	420.4	77	44
N.Malceski	GCFC	Gen Def	40	419.3	78	5
D.Shiel	GWS	Mid	31	416.1	79	45

Player	Club	Pos	Matches	Rating Points	Overall Standing	Position Standing
M.LeCras	WCFC	Gen Fwd	39	414.8	80	7
M.Boyd	WBFC	Gen Def	38	412.8	81	6
A.Swallow	NMFC	Mid	40	411.6	82	46
L.Montagna	SKFC	Mid	37	410.8	83	47
H.Shaw	GWS	Gen Def	40	407.6	84	7
C.Guthrie	GFC	Mid	40	403.8	85	48
M.Hurley	EFC	Key Def	40	403.2	86	3
B.Gibbs	CFC	Mid	32	401.5	87	49
J.Watson	EFC	Mid	27	400.6	88	50
J.Bartel	GFC	Mid	34	398.7	89	51
J.McGovern	WCFC	Key Def	33	396.3	90	4
S.Johnson	GFC	Gen Fwd	38	396.0	91	8
J.Macrae	WBFC	Mid	40	395.7	92	52
G.Birchall	HFC	Gen Def	40	395.3	93	8
K.Tippett	SYFC	Key Fwd	36	394.4	94	9
A.Gaff	WCFC	Mid	40	393.0	95	53
T.McDonald	MFC	Key Def	40	392.8	96	5
B.Ebert	PAFC	Mid	40	392.8	97	54
P.Puopolo	HFC	Gen Fwd	40	390.1	98	9
J.Green	BFC	Gen Fwd	36	389.9	99	10
K.Simpson	CFC	Gen Def	40	389.4	100	9
L.Neale	FRFC	Mid	40	389.0	101	55
C.Enright	GFC	Gen Def	40	388.6	102	10
J.Gibson	HFC	Key Def	40	388.3	103	6
S.Higgins	NMFC	Gen Fwd	40	387.7	104	11
J.Darling	WCFC	Key Fwd	37	387.6	105	10
S.May	GCFC	Key Def	37	387.6	106	7
I.Smith	HFC	Mid	40	387.3	107	56
B.McEvoy	HFC	Ruck	32	385.8	108	7
C.Yarran	CFC	Gen Def	35	385.5	109	11
L.Picken	WBFC	Mid	40	385.3	110	57

Player	Club	Pos	Matches	Rating Points	Overall Standing	Position Standing
S.Hurn	WCFC	Gen Def	40	383.9	111	12
J.Caddy	GFC	Mid	35	383.9	112	58
J.Elliott	COFC	Gen Fwd	37	381.0	113	12
B.Stanton	EFC	Mid	40	379.4	114	59
B.Vince	MFC	Mid	40	379.2	115	60
T.Walker	AFC	Key Fwd	38	378.6	116	11
A.Miles	RFC	Mid	36	378.6	117	61
E.Yeo	WCFC	Gen Def	37	378.4	118	13
B.Howlett	EFC	Mid-Fwd	40	376.8	119	8
P.Hanley	BFC	Mid	31	376.0	120	62
T.Bell	CFC	Gen Fwd	35	375.2	121	13
M.Blicavs	GFC	Ruck	40	374.8	122	8
M.Walters	FRFC	Gen Fwd	30	373.3	123	14
D.Petrie	NMFC	Key Fwd	40	373.3	124	12
J.Blair	COFC	Gen Fwd	40	372.2	125	15
S.Motlop	GFC	Mid-Fwd	37	371.4	126	9
J.Ziebell	NMFC	Mid	40	371.3	127	63
M.Pavlich	FRFC	Key Fwd	40	369.5	128	13
J.Waite	NMFC	Key Fwd	39	369.2	129	14
M.Williams	COFC	Gen Def	35	369.0	130	14
S.Martin	BFC	Ruck	32	368.5	131	9
D.Pearce	FRFC	Mid	40	366.5	132	64
S.Savage	SKFC	Gen Def	34	365.9	133	15
D.Zaharakis	EFC	Mid-Fwd	39	365.7	134	10
M.Stokes	GFC	Mid	34	364.1	135	65
C.Hooker	EFC	Key Def	40	361.9	136	8
M.White	PAFC	Mid-Fwd	40	361.0	137	11
M.Barlow	FRFC	Mid	40	359.3	138	66
L.Jetta	SYFC	Mid	40	359.2	139	67
S.Wellingham	WCFC	Gen Def	37	359.1	140	16
J.Pittard	PAFC	Gen Def	40	358.7	141	17

Player	Club	Pos	Matches	Rating Points	Overall Standing	Position Standing
S.MuMid-Fwdord	GWS	Ruck	28	358.5	142	10
M.Robinson	BFC	Mid	33	358.1	143	68
D.Cross	MFC	Gen Def	39	356.7	144	18
B.Hill	HFC	Mid	40	356.4	145	69
M.Wallis	WBFC	Mid	33	356.4	146	70
D.Swallow	GCFC	Mid	28	356.0	147	71
S.Crameri	WBFC	Gen Fwd	40	354.1	148	16
J.Howe	MFC	Gen Fwd	40	353.9	149	17
T.Langdon	COFC	Gen Def	40	352.7	150	19
M.Hibberd	EFC	Gen Def	40	352.6	151	20
T.Greene	GWS	Mid-Fwd	37	349.1	152	12
W.Langford	HFC	Mid	32	345.4	153	72
M.Johnson	FRFC	Key Def	33	344.5	154	9
B.McGlynn	SYFC	Mid-Fwd	28	343.6	155	13
A.Goodes	SYFC	Gen Fwd	40	342.4	156	18
B.Matera	GCFC	Gen Fwd	35	342.2	157	19
M.Rischitelli	GCFC	Mid	40	342.1	158	73
D.Tyson	MFC	Mid	37	341.3	159	74
W.Minson	WBFC	Ruck	31	340.5	160	11
T.Chaplin	RFC	Key Def	40	340.2	161	10
Z.Merrett	EFC	Mid-Fwd	37	339.8	162	14
J.Polec	PAFC	Mid	29	338.2	163	75
J.Jenkins	AFC	Key Fwd	40	338.1	164	15
J.Cripps	WCFC	Gen Fwd	40	337.9	165	20
A.Everitt	CFC	Gen Fwd	39	336.8	166	21
M.Firrito	NMFC	Key Def	40	336.6	167	11
C.Mayne	FRFC	Gen Fwd	40	336.2	168	22
T.Scully	GWS	Mid	32	336.2	169	76
J.Crisp	COFC	Mid	28	333.9	170	77
A.Hall	GCFC	Mid	31	333.7	171	78
T.Liberatore	WBFC	Mid	22	333.7	172	79

Player	Club	Pos	Matches	Rating Points	Overall Standing	Position Standing
J.Viney	MFC	Mid	36	333.6	173	80
D.Rampe	SYFC	Gen Def	40	333.2	174	21
N.Riewoldt	SKFC	Key Fwd	39	332.6	175	16
T.Lynch	AFC	Gen Fwd	31	332.6	176	23
J.Newnes	SKFC	Mid	40	332.5	177	81
L.Henderson	CFC	Key Fwd	33	330.6	178	17
B.Houli	RFC	Gen Def	40	329.6	179	22
M.Wright	AFC	Gen Fwd	36	329.5	180	24
T.Varcoe	COFC	Gen Def	40	328.4	181	23
L.Dunstan	SKFC	Mid	35	327.6	182	82
J.Rivers	GFC	Key Def	34	327.1	183	12
C.Masten	WCFC	Mid	40	327.1	184	83
L.Thomas	NMFC	Gen Fwd	40	327.1	185	25
J.Redden	BFC	Mid	31	326.0	186	84
D.Mackay	AFC	Gen Def	39	325.5	187	24
R.Laird	AFC	Gen Def	39	324.9	188	25
K.Kolodjashnij	GCFC	Gen Def	40	323.6	189	26
R.Bastinac	NMFC	Mid	40	322.4	190	85
M.Baguley	EFC	Gen Def	40	320.8	191	27
J.Schulz	PAFC	Key Fwd	40	320.7	192	18
S.Dempster	SKFC	Gen Def	40	320.1	193	28
S.Grigg	RFC	Mid	38	319.9	194	86
C.Dixon	GCFC	Key Fwd	30	318.7	195	19
B.Ellis	RFC	Mid	40	318.7	196	87
J.Cameron	GWS	Key Fwd	36	318.5	197	20
Z.Tuohy	CFC	Gen Def	40	318.3	198	29
L.Dunn	MFC	Key Def	40	318.1	199	13
H.Lumumba	MFC	Gen Def	40	316.7	200	30
H.Ballantyne	FRFC	Gen Fwd	35	316.5	201	26
J.Harbrow	GCFC	Gen Def	37	316.1	202	31
J.Hill	WCFC	Gen Fwd	31	315.6	203	27

Player	Club	Pos	Matches	Rating Points	Overall Standing	Position Standing
E.Curnow	CFC	Mid	37	315.0	204	88
N.Vlastuin	RFC	Gen Def	40	314.0	205	32
L.Greenwood	COFC	Mid	30	312.6	206	89
H.Grundy	SYFC	Key Def	40	312.0	207	14
S.Thompson	NMFC	Key Def	40	312.0	208	15
J.Adcock	BFC	Gen Fwd	40	311.8	209	28
M.Broadbent	PAFC	Gen Def	40	311.5	210	33
J.Patfull	GWS	Key Def	37	310.7	211	16
S.Rowe	CFC	Key Def	40	308.1	212	17
A.Mackie	GFC	Gen Def	37	307.3	213	34
J.White	COFC	Key Fwd	36	307.1	214	21
S.Atley	NMFC	Gen Def	40	307.1	215	35
M.Lobbe	PAFC	Ruck	40	307.1	216	12
B.Sheppard	WCFC	Gen Def	39	307.1	217	36
R.Schoenmakers	HFC	Key Fwd	31	306.9	218	22
J.Johannisen	WBFC	Gen Def	31	306.5	219	37
R.Palmer	GWS	Gen Fwd	31	305.8	220	29
J.Trengove	PAFC	Key Def	35	305.8	221	18
M.Suckling	HFC	Gen Fwd	40	305.3	222	30
T.Adams	COFC	Mid	30	305.1	223	90
J.Kelly	GFC	Mid	40	305.0	224	91
T.Cloke	COFC	Key Fwd	37	304.9	225	23
A.Christensen	BFC	Mid-Fwd	30	304.9	226	15
T.McKenzie	GCFC	Gen Def	35	303.2	227	38
J.Hombsch	PAFC	Key Def	40	301.6	228	19
T.Richards	SYFC	Key Def	40	301.1	229	20
P.Chapman	EFC	Gen Fwd	29	300.8	230	31
S.Coniglio	GWS	Mid	32	300.1	231	92
J.Laidler	SYFC	Gen Def	40	299.9	232	39
T.Mzungu	FRFC	Mid	34	299.1	233	93
J.Murdoch	GFC	Mid	40	297.7	234	94

Player	Club	Pos	Matches	Rating Points	Overall Standing	Position Standing
G.Ibbotson	FRFC	Gen Def	36	296.9	235	40
T.Dickson	WBFC	Gen Fwd	27	296.7	236	32
J.Watts	MFC	Mid-Fwd	40	296.5	237	16
N.Smith	SYFC	Gen Def	40	295.9	238	41
W.Schofield	WCFC	Key Def	38	295.5	239	21
T.Goldsack	COFC	Gen Def	33	294.5	240	42
J.O'Meara	GCFC	Mid	22	290.8	241	95
J.ClaRucke	BFC	Key Def	40	290.6	242	22
L.Taylor	BFC	Mid	40	290.5	243	96
S.Docherty	CFC	Gen Def	35	289.6	244	43
A.Carrazzo	CFC	Mid	30	289.3	245	97
N.Suban	FRFC	Mid-Fwd	40	289.3	246	17
J.Melksham	EFC	Mid	34	288.5	247	98
D.Rich	BFC	Mid	24	285.9	248	99
J.Carlisle	EFC	Key Fwd	36	285.8	249	24
S.Gibson	NMFC	Mid	40	285.0	250	100
M.Pyke	SYFC	Ruck	39	284.9	251	13
D.Morris	WBFC	Key Def	34	284.6	252	23
S.Reid	SYFC	Key Fwd	40	282.6	253	25
B.Lake	HFC	Key Def	33	282.2	254	24
L.Whitfield	GWS	Mid	32	280.0	255	101
B.Grundy	COFC	Ruck	34	279.1	256	14
J.Garlett	MFC	Gen Fwd	31	278.5	257	33
M.Weller	SKFC	Mid	36	277.7	258	102
M.Rosa	WCFC	Mid	31	276.4	259	103
T.Jonas	PAFC	Gen Def	39	276.1	260	44
D.Hale	HFC	Ruck	40	275.6	261	15
P.Duffield	FRFC	Gen Def	38	275.6	262	45
T.Duryea	HFC	Gen Def	40	274.9	263	46
L.Spurr	FRFC	Gen Def	40	274.4	264	47
T.Lonergan	GFC	Key Def	40	273.9	265	25

Player	Club	Pos	Matches	Rating Points	Overall Standing	Position Standing
H.Cunningham	SYFC	Gen Fwd	40	273.8	266	34
G.Rohan	SYFC	Gen Fwd	34	272.7	267	35
A.Cooney	EFC	Gen Fwd	29	271.9	268	36
J.Witts	COFC	Ruck	31	271.1	269	16
A.Schneider	SKFC	Mid-Fwd	28	270.6	270	18
S.Day	GCFC	Key Fwd	36	268.9	271	26
K.Stevens	WBFC	Mid	32	268.3	272	104
C.Pedersen	MFC	Key Fwd	26	268.3	273	27
B.Longer	SKFC	Ruck	34	268.0	274	17
A.Fasolo	COFC	Gen Fwd	29	267.6	275	37
T.Mitchell	SYFC	Mid	25	266.1	276	105
M.Jaensch	AFC	Gen Def	29	264.8	277	48
C.Bird	SYFC	Mid-Fwd	27	263.1	278	19
J.Kelly	GWS	Mid-Fwd	36	260.5	279	20
G.Horlin-Smith	GFC	Mid	28	260.4	280	106
C.Garland	MFC	Gen Def	34	260.2	281	49
J.Daniher	EFC	Key Fwd	40	259.8	282	28
J.Frawley	HFC	Key Def	39	259.5	283	26
R.Shaw	SYFC	Gen Def	40	259.3	284	50
N.Jetta	MFC	Gen Def	32	258.3	285	51
J.Lloyd	SYFC	Mid	40	258.2	286	107
Z.ClaRucke	FRFC	Key Fwd	35	257.8	287	29
S.Wright	NMFC	Gen Def	39	257.5	288	52
S.Butler	WCFC	Gen Def	29	257.5	289	53
B.Brown	NMFC	Key Fwd	33	257.2	290	30
H.Hocking	EFC	Mid	27	256.5	291	108
B.Stratton	HFC	Gen Def	40	256.0	292	54
J.Ceglar	HFC	Ruck	29	255.8	293	18
D.Talia	AFC	Key Def	40	253.0	294	27
D.Sheed	WCFC	Mid	33	252.2	295	109
A.Toovey	COFC	Gen Def	37	251.7	296	55

Player	Club	Pos	Matches	Rating Points	Overall Standing	Position Standing
J.Aish	BFC	Gen Def	32	251.7	297	56
C.Dawes	MFC	Key Fwd	32	251.3	298	31
L.Casboult	CFC	Key Fwd	35	251.0	299	32
T.Vickery	RFC	Key Fwd	27	250.4	300	33
L.McDonald	NMFC	Gen Def	37	250.1	301	57
R.Stanley	GFC	Ruck	27	249.5	302	19
J.Bruce	SKFC	Key Fwd	32	249.0	303	34
C.Dempsey	EFC	Gen Def	31	248.1	304	58
R.Thompson	GCFC	Key Def	31	247.2	305	28
J.Frost	COFC	Key Def	40	245.8	306	29
C.Newman	RFC	Gen Def	35	245.1	307	59
T.Colyer	EFC	Gen Fwd	23	244.3	308	38
C.Judd	CFC	Mid	20	244.2	309	110
S.Fisher	SKFC	Key Def	25	244.2	310	30
C.Sutcliffe	FRFC	Gen Def	40	243.0	311	60
M.Jamison	CFC	Key Def	33	242.3	312	31
N.Haynes	GWS	Key Def	25	242.3	313	32
M.Hutchings	WCFC	Mid	29	241.9	314	111
S.Mayes	BFC	Mid-Fwd	35	239.4	315	21
A.Monfries	PAFC	Gen Fwd	36	238.3	316	39
K.Cornes	PAFC	Mid	32	236.9	317	112
F.Ray	SKFC	Mid	29	236.5	318	113
M.Gawn	MFC	Ruck	22	235.4	319	20
A.Carlile	PAFC	Key Def	32	234.9	320	33
M.Shaw	GCFC	Mid	35	234.7	321	114
R.Bewick	BFC	Gen Fwd	31	234.4	322	40
J.Macmillan	NMFC	Gen Def	23	234.0	323	61
R.Henderson	AFC	Gen Def	25	233.3	324	62
W.Hoskin-Elliott	GWS	Gen Fwd	31	232.9	325	41
M.Gleeson	EFC	Gen Def	31	232.1	326	63
J.Geary	SKFC	Gen Def	27	231.7	327	64

Player	Club	Pos	Matches	Rating Points	Overall Standing	Position Standing
J.Roughead	WBFC	Ruck	31	231.6	328	21
J.Grimes	MFC	Gen Def	30	231.1	329	65
T.Miller	GCFC	Gen Fwd	22	229.5	330	42
D.Roberton	SKFC	Gen Def	27	228.3	331	66
L.Hansen	NMFC	Key Def	34	226.3	332	34
J.Webster	SKFC	Gen Def	28	226.0	333	67
X.Ellis	WCFC	Gen Def	32	225.1	334	68
D.Fletcher	EFC	Key Def	22	224.2	335	35
T.Nicholls	GCFC	Ruck	21	223.8	336	22
L.Hunter	WBFC	Gen Fwd	27	223.3	337	43
P.Ambrose	EFC	Gen Fwd	32	222.7	338	44
E.MacKenzie	WCFC	Key Def	22	222.3	339	36
J.Gwilt	EFC	Key Def	28	221.2	340	37
C.Wood	CFC	Ruck	24	220.8	341	23
D.Myers	EFC	Mid	20	220.6	342	115
M.de Boer	FRFC	Gen Fwd	33	220.4	343	45
R.Lester	BFC	Mid	23	220.2	344	116
D.Thomas	CFC	Mid-Fwd	25	220.0	345	22
J.Bennell	WCFC	Gen Def	28	219.3	346	69
C.Shenton	SKFC	Gen Def	23	218.4	347	70
P.Davis	GWS	Key Def	23	218.1	348	38
B.Jacobs	NMFC	Mid	37	217.7	349	117
M.Paparone	BFC	Gen Def	40	216.9	350	71
P.Cripps	CFC	Mid	23	214.7	351	118
S.Selwood	WCFC	Mid	25	213.0	352	119
K.Cheney	AFC	Key Def	21	211.2	353	39
Z.Smith	GCFC	Ruck	21	210.4	354	24
C.Cameron	AFC	Gen Fwd	29	209.4	355	46
S.Morris	RFC	Gen Fwd	35	208.3	356	47
S.White	CFC	Key Def	32	206.7	357	40
L.Brown	AFC	Gen Def	40	205.5	358	72

Player	Club	Pos	Matches	Rating Points	Overall Standing	Position Standing
D.Grimes	RFC	Gen Def	37	205.3	359	73
R.Nahas	NMFC	Gen Fwd	26	203.7	360	48
J.Billings	SKFC	Gen Fwd	25	203.4	361	49
L.McPharlin	FRFC	Key Def	31	202.7	362	41
R.Conca	RFC	Mid	22	201.8	363	120
M.Jones	MFC	Gen Fwd	29	201.2	364	50
C.Pearce	FRFC	Gen Def	27	201.1	365	74
J.Merrett	EFC	Mid-Fwd	29	199.0	366	23
T.Menzel	CFC	Gen Fwd	33	198.5	367	51
D.Stanley	GCFC	Mid-Fwd	30	198.3	368	24
P.Seedsman	COFC	Mid	21	196.9	369	121
J.Hogan	MFC	Key Fwd	20	195.8	370	35
J.Impey	PAFC	Gen Def	35	195.8	371	75
J.Lyons	AFC	Mid-Fwd	23	193.9	372	25
A.Black	NMFC	Key Fwd	28	193.7	373	36
A.Sexton	GCFC	Mid-Fwd	27	193.6	374	26
S.Lemmens	GCFC	Gen Fwd	36	192.5	375	52
Z.Williams	GWS	Mid	20	191.6	376	122
T.Hunt	RFC	Gen Def	30	191.6	377	76
J.Podsiadly	AFC	Key Fwd	21	190.7	378	37
B.Griffiths	RFC	Key Fwd	29	190.2	379	38
L.Jong	WBFC	Mid	19	189.6	380	123
A.Walker	CFC	Gen Def	26	188.9	381	77
T.Bugg	GWS	Gen Def	33	188.1	382	78
D.Merrett	BFC	Key Def	29	188.0	383	42
R.Warnock	CFC	Ruck	18	187.1	384	25
C.Young	COFC	Mid	19	186.6	385	124
S.Gray	PAFC	Mid-Fwd	17	186.2	386	27
D.Lang	GFC	Gen Fwd	21	185.6	387	53
M.Crouch	AFC	Mid	25	183.9	388	125
D.McStay	BFC	Key Fwd	29	183.9	389	39

Player	Club	Pos	Matches	Rating Points	Overall Standing	Position Standing
G.Broughton	GCFC	Gen Def	25	183.2	390	79
M.Jamar	MFC	Ruck	22	182.6	391	26
J.Neade	PAFC	Gen Fwd	18	182.1	392	54
B.Hartung	HFC	Mid	27	181.9	393	126
J.Martin	GCFC	Gen Fwd	23	180.1	394	55
T.Broomhead	COFC	Mid-Fwd	19	179.8	395	28
A.Brayshaw	MFC	Mid-Fwd	21	179.2	396	29
M.Thomas	RFC	Mid	15	179.1	397	127
A.Kennedy	GWS	Gen Def	27	177.9	398	80
M.Hallahan	GCFC	Mid	18	177.7	399	128
J.Batchelor	RFC	Gen Def	36	176.1	400	81
C.Sinclair	WCFC	Ruck	24	173.9	401	27
T.Hickey	SKFC	Ruck	17	173.8	402	28
S.Ross	SKFC	Mid	23	173.5	403	129
J.Lonergan	GCFC	Gen Def	27	172.8	404	82
R.Harwood	BFC	Gen Def	17	169.4	405	83
A.Saad	GCFC	Gen Def	16	169.1	406	84
L.Delaney	SKFC	Key Def	33	168.2	407	43
N.Foley	RFC	Mid-Fwd	18	166.2	408	30
J.Thurlow	GFC	Gen Def	25	165.6	409	85
J.Grant	WBFC	Mid	23	165.5	410	130
A.Tomlinson	GWS	Key Fwd	27	165.3	411	40
M.Buntine	GWS	Gen Def	18	165.0	412	86
J.Patton	GWS	Key Fwd	22	164.4	413	41
T.Sheridan	FRFC	Gen Def	27	164.2	414	87
N.Krakouer	PAFC	Gen Def	14	164.2	415	88
B.Martin	AFC	Mid-Fwd	20	164.0	416	31
A.Young	PAFC	Mid-Fwd	25	163.1	417	32
A.Corr	GWS	Key Def	23	162.5	418	44
N.Hrovat	WBFC	Gen Fwd	19	162.1	419	56
D.Buckley	CFC	Gen Def	26	162.1	420	89

Player	Club	Pos	Matches	Rating Points	Overall Standing	Position Standing
S.Lycett	WCFC	Ruck	18	161.3	421	29
J.Walker	GFC	Key Fwd	23	159.1	422	42
J.Winderlich	EFC	Gen Fwd	17	159.1	423	57
K.Hartigan	AFC	Key Def	25	158.3	424	45
R.Bail	MFC	Mid-Fwd	27	158.1	425	33
L.Adams	NMFC	Gen Fwd	22	157.7	426	58
N.Brown	COFC	Key Def	23	156.0	427	46
R.Tarrant	NMFC	Key Def	23	156.0	428	47
H.Andrews	BFC	Key Def	19	154.9	429	48
J.Tutt	CFC	Mid-Fwd	20	154.3	430	34
D.ArMid-Fwdield	CFC	Gen Fwd	20	153.5	431	59
H.McIntosh	GFC	Ruck	19	152.0	432	30
A.Oxley	COFC	Mid	17	151.6	433	131
S.Dwyer	COFC	Mid-Fwd	18	151.6	434	35
A.Litherland	HFC	Gen Def	19	151.3	435	90
L.Keeffe	COFC	Key Def	18	150.1	436	49
K.McIntosh	RFC	Mid	23	149.1	437	132
A.Mullett	NMFC	Gen Def	21	148.6	438	91
Z.Dawson	FRFC	Key Def	27	148.5	439	50
N.van Berlo	AFC	Mid	20	147.6	440	133
C.Gregson	GFC	Gen Fwd	20	147.0	441	60
D.Gardiner	BFC	Key Def	25	146.5	442	51
M.Kreuzer	CFC	Ruck	14	144.2	443	31
N.Wilson	GWS	Gen Def	19	144.1	444	92
J.Sinclair	SKFC	Gen Fwd	18	143.8	445	61
V.Michie	MFC	Mid	17	143.4	446	134
B.Crouch	AFC	Mid	11	142.8	447	135
R.Petterd	RFC	Mid-Fwd	18	140.8	448	36
N.Grima	NMFC	Key Def	14	140.5	449	52
J.Giles	EFC	Ruck	12	140.0	450	32
C.Beams	BFC	Gen Def	21	139.6	451	93

Player	Club	Pos	Matches	Rating Points	Overall Standing	Position Standing
B.Newton	MFC	Mid	15	139.4	452	136
D.Ellard	CFC	Gen Fwd	23	137.7	453	62
C.McCarthy	GWS	Key Fwd	21	137.6	454	43
L.Russell	GCFC	Mid	27	137.3	455	137
C.Hampton	GWS	Gen Def	16	136.8	456	94
S.Gilbert	SKFC	Gen Def	17	136.3	457	95
M.Spangher	HFC	Key Def	19	136.1	458	53
K.Turner	NMFC	Gen Fwd	19	133.5	459	63
S.Lloyd	RFC	Gen Fwd	20	133.0	460	64
M.Talia	WBFC	Key Def	17	132.4	461	54
C.O'Shea	PAFC	Gen Def	22	131.2	462	96
S.Frost	MFC	Ruck	19	130.7	463	33
M.Maguire	BFC	Key Def	15	130.6	464	55
H.Crozier	FRFC	Gen Fwd	22	130.2	465	65
D.Wells	NMFC	Mid	12	129.6	466	138
J.Bews	GFC	Gen Def	23	129.2	467	97
J.Thomas	COFC	Mid-Fwd	13	127.5	468	37
T.Boyd	WBFC	Key Fwd	23	127.4	469	44
J.Simpkin	HFC	Mid-Fwd	19	125.4	470	38
C.Ellis-Yolmen	AFC	Mid	12	124.5	471	139
D.Kent	MFC	Gen Fwd	17	123.1	472	66
D.Simpson	GFC	Ruck	17	122.5	473	34
L.Jones	CFC	Key Fwd	19	122.4	474	45
I.Heeney	SYFC	Gen Fwd	14	121.5	475	67
A.Vandenberg	MFC	Mid-Fwd	14	121.5	476	39
N.Gordon	RFC	Gen Fwd	21	120.9	477	68
R.Crowley	FRFC	Mid	24	120.6	478	140
S.McKernan	EFC	Ruck	11	119.4	479	35
J.Lonie	SKFC	Gen Fwd	17	119.3	480	69
K.Mitchell	PAFC	Mid-Fwd	18	117.2	481	40
C.Salem	MFC	Gen Def	22	117.1	482	98

Player	Club	Pos	Matches	Rating Points	Overall Standing	Position Standing
B.Macaffer	COFC	Mid	21	116.9	483	141
J.de Goey	COFC	Mid-Fwd	16	116.9	484	41
M.Leuenberger	BFC	Ruck	19	116.5	485	36
N.Robertson	BFC	Mid	20	116.3	486	142
P.McGinnity	WCFC	Gen Fwd	19	115.7	487	70
S.Hampson	RFC	Ruck	15	114.4	488	37
K.Lambert	RFC	Mid	13	113.0	489	143
T.Curren	SKFC	Gen Fwd	18	110.3	490	71
J.Kennedy-Harris	MFC	Gen Fwd	22	110.3	491	72
S.Kerridge	AFC	Mid-Fwd	15	108.5	492	42
T.Bellchambers	EFC	Ruck	18	107.0	493	38
M.Taberner	FRFC	Key Fwd	24	107.0	494	46
D.Towers	SYFC	Gen Fwd	17	106.1	495	73
H.Schade	GCFC	Key Def	15	106.0	496	56
M.Grigg	AFC	Mid-Fwd	15	105.9	497	43
B.Reilly	AFC	Gen Def	10	102.8	498	99
S.Kersten	GFC	Key Fwd	20	101.3	499	47
N.Graham	CFC	Mid	14	101.0	500	144
J.Redpath	WBFC	Key Fwd	15	100.5	501	48
T.Campbell	WBFC	Ruck	13	99.9	502	39
M.Golby	BFC	Gen Def	17	99.8	503	100
F.Roberts	WBFC	Key Def	17	99.4	504	57
D.Terlich	MFC	Gen Def	15	98.8	505	101
L.Plowman	GWS	Key Def	14	96.4	506	58
M.Brown	WCFC	Key Def	20	95.2	507	59
J.Spencer	MFC	Ruck	12	94.9	508	40
B.Sinclair	COFC	Gen Def	11	94.3	509	102
J.Stewart	GWS	Key Fwd	16	93.5	510	49
S.Biggs	WBFC	Mid	13	93.3	511	145
D.Astbury	RFC	Key Def	12	90.5	512	60
T.West	BFC	Ruck	12	90.0	513	41

Player	Club	Pos	Matches	Rating Points	Overall Standing	Position Standing
T.Cutler	BFC	Gen Def	18	90.0	514	103
J.Saunders	SKFC	Gen Fwd	12	87.9	515	74
J.Lever	AFC	Key Def	12	87.2	516	61
B.Jack	SYFC	Gen Fwd	18	86.8	517	75
M.Honeychurch	WBFC	Gen Fwd	14	84.4	518	76
R.Lobb	GWS	Ruck	11	82.2	519	42
B.Ah Chee	PAFC	Mid	11	81.7	520	146
T.Membrey	SKFC	Gen Fwd	13	81.3	521	77
B.Reid	COFC	Key Fwd	8	79.3	522	50
Z.Jones	SYFC	Gen Def	15	78.5	523	104
B.Lennon	RFC	Gen Fwd	16	78.2	524	78
B.Acres	SKFC	Mid	10	78.1	525	147
B.Kennedy	COFC	Mid-Fwd	13	77.5	526	44
T.Derickx	SYFC	Ruck	13	77.5	527	43
L.Duggan	WCFC	Mid-Fwd	12	76.9	528	45
D.Minchington	SKFC	Gen Fwd	8	76.7	529	79
D.Moore	COFC	Key Fwd	9	75.1	530	51
B.McKenzie	NMFC	Mid	11	73.4	531	148
J.Hamling	WBFC	Key Def	11	72.6	532	62
J.Griffin	FRFC	Ruck	9	72.1	533	44
S.Edwards	EFC	Gen Fwd	9	71.8	534	80
P.Stewart	PAFC	Gen Fwd	10	71.1	535	81
C.Daniel	WBFC	Gen Fwd	10	70.4	536	82
A.Pearce	FRFC	Key Def	13	70.2	537	63
R.Knight	AFC	Mid-Fwd	11	70.1	538	46
A.Otten	AFC	Key Def	10	69.7	539	64
J.Toumpas	MFC	Mid	13	68.8	540	149
Z.O'Brien	BFC	Mid	13	68.6	541	150
N.O'Brien	EFC	Mid	9	68.4	542	151
J.Kolodjashnij	GFC	Key Def	9	67.2	543	65
T.Dumont	NMFC	Mid	8	65.4	544	152

Player	Club	Pos	Matches	Rating Points	Overall Standing	Position Standing
M.Daw	NMFC	Ruck	10	65.1	545	45
H.Goddard	SKFC	Key Def	8	64.8	546	66
T.Mohr	GWS	Key Def	8	63.7	547	67
A.Steinberg	EFC	Key Def	10	63.4	548	68
O.Fantasia	EFC	Gen Fwd	8	63.3	549	83
K.Jaksch	CFC	Key Def	11	62.2	550	69
N.Wright	SKFC	Gen Def	12	61.9	551	105
B.Boekhorst	CFC	Gen Fwd	11	60.9	552	84
A.Moore	PAFC	Mid	14	60.7	553	153
M.ClaRuck	GFC	Key Fwd	8	60.4	554	52
T.Garner	NMFC	Gen Fwd	11	59.9	555	85
T.Downie	GWS	Ruck	7	58.9	556	46
M.McDonough	RFC	Gen Def	9	58.5	557	106
J.Lamb	GWS	Gen Fwd	10	58.4	558	86
A.Neal-Bullen	MFC	Gen Fwd	11	58.2	559	87
B.Goodes	WBFC	Mid	9	58.0	560	154
J.Ramsay	COFC	Gen Def	7	56.9	561	107
M.Wood	NMFC	Mid-Fwd	8	56.3	562	47
J.Laverde	EFC	Mid-Fwd	9	55.8	563	48
A.Riley	MFC	Mid-Fwd	13	55.6	564	49
R.Atkins	AFC	Mid	8	54.3	565	155
T.Clurey	PAFC	Gen Def	9	54.1	566	108
C.Cameron	GCFC	Key Def	15	53.9	567	70
M.Dea	RFC	Gen Def	7	53.9	568	109
A.Phillips	GWS	Ruck	5	50.5	569	47
E.Templeton	SKFC	Gen Fwd	12	50.2	570	88
J.Fitzpatrick	MFC	Key Def	8	50.0	571	71
K.Amon	PAFC	Mid	7	49.8	572	156
J.Kelly	AFC	Gen Def	10	49.8	573	110
S.Shaw	AFC	Gen Def	8	49.7	574	111
M.Whiley	CFC	Mid	10	49.3	575	157

Player	Club	Pos	Matches	Rating Points	Overall Standing	Position Standing
J.Freeman	BFC	Key Fwd	10	49.3	576	53
A.Boston	GCFC	Mid-Fwd	8	49.2	577	50
M.Close	BFC	Key Fwd	15	49.0	578	54
J.Steele	GWS	Mid-Fwd	7	48.8	579	51
B.Stretch	MFC	Mid	11	48.6	580	158
B.Dale	WBFC	Gen Fwd	10	48.0	581	89
A.Cordy	WBFC	Ruck	8	48.0	582	48
L.Dawson	BFC	Gen Def	10	48.0	583	112
K.Lucas	WCFC	Mid	7	47.9	584	159
M.Watson	CFC	Key Def	7	46.9	585	72
N.Holman	CFC	Gen Def	9	46.3	586	113
B.Murdoch	SKFC	Gen Fwd	12	45.9	587	90
D.McKenzie	SKFC	Mid	7	45.6	588	160
J.Harmes	MFC	Mid	8	45.5	589	161
T.Armstrong	COFC	Gen Def	6	45.3	590	114
J.Nelson	WCFC	Gen Def	11	44.9	591	115
J.O'RouRucke	HFC	Mid	10	44.0	592	162
S.Tape	GCFC	Gen Def	7	43.6	593	116
J.Garlett	GCFC	Gen Fwd	9	43.5	594	91
S.Darley	WBFC	Gen Def	7	43.2	595	117
F.McInnes	WCFC	Key Fwd	7	42.5	596	55
J.McKenzie	MFC	Mid	10	42.3	597	163
B.Maynard	COFC	Mid	9	41.9	598	164
E.Kavanagh	EFC	Mid	8	41.8	599	165
L.Webb	WBFC	Gen Def	10	41.7	600	118
D.Gorringe	GCFC	Ruck	5	40.8	601	49
S.Colquhoun	PAFC	Mid	6	40.2	602	166
S.McMahon	NMFC	Gen Def	7	40.1	603	119
J.Ashby	EFC	Gen Def	10	39.0	604	120
B.Smedts	GFC	Gen Def	10	38.9	605	121
M.Arnot	RFC	Mid	5	37.7	606	167

Player	Club	Pos	Matches	Rating Points	Overall Standing	Position Standing
T.McLean	WBFC	Gen Fwd	4	37.6	607	92
J.BouRucke	BFC	Key Def	6	36.1	608	73
J.Glenn	GCFC	Mid	5	35.9	609	168
A.Silvagni	FRFC	Key Def	9	35.6	610	74
D.Currie	NMFC	Ruck	4	35.5	611	50
L.McGuane	BFC	Key Fwd	7	35.3	612	56
A.Raines	GCFC	Mid	10	34.8	613	169
N.Cockatoo	GFC	Gen Fwd	11	34.8	614	93
C.Sheehan	CFC	Gen Def	4	33.8	615	122
J.Townsend	GWS	Mid	9	33.4	616	170
C.Gault	COFC	Key Fwd	4	32.1	617	57
J.Leslie	GCFC	Key Def	5	32.0	618	75
J.Tippett	NMFC	Key Def	7	31.3	619	76
N.Vardy	GFC	Key Fwd	3	31.2	620	58
J.Butcher	PAFC	Key Fwd	8	30.9	621	59
K.Langford	EFC	Gen Fwd	8	29.6	622	94
T.Simpkin	SKFC	Key Def	5	27.8	623	77
T.Sumner	GCFC	Gen Fwd	6	27.7	624	95
J.Prudden	WBFC	Mid	4	27.5	625	171
J.Hannath	FRFC	Ruck	6	26.9	626	51
T.Logan	PAFC	Gen Def	3	26.5	627	123
M.Dick	CFC	Gen Def	6	25.4	628	124
C.Sylvia	FRFC	Gen Fwd	6	25.4	629	96
J.Paine	BFC	Key Fwd	6	24.4	630	60
A.Siposs	SKFC	Gen Fwd	3	24.3	631	97
A.Saad	SKFC	Gen Fwd	4	24.1	632	98
J.Marsh	COFC	Key Fwd	5	24.0	633	61
B.Johnson	CFC	Gen Fwd	7	23.5	634	99
C.Ellis	RFC	Mid-Fwd	6	23.5	635	52
P.Karnezis	COFC	Mid-Fwd	4	23.4	636	53
C.Marchbank	GWS	Key Def	5	22.7	637	78

Player	Club	Pos	Matches	Rating Points	Overall Standing	Position Standing
J.Sicily	HFC	Gen Fwd	3	22.5	638	100
L.McCarthy	GFC	Gen Fwd	4	22.2	639	101
T.Nankervis	SYFC	Ruck	5	22.0	640	52
H.Beasley	BFC	Key Def	6	21.9	641	79
J.Anderson	HFC	Mid-Fwd	4	21.5	642	54
D.Howe	HFC	Gen Def	4	21.1	643	125
D.Menzel	GFC	Gen Fwd	2	20.9	644	102
D.Addison	GWS	Gen Fwd	5	20.8	645	103
A.Morabito	FRFC	Mid	3	20.6	646	172
D.Robinson	SYFC	Mid	4	20.6	647	173
T.Barrass	WCFC	Gen Def	3	20.2	648	126
J.McGrath	BFC	Gen Def	3	20.0	649	127
T.O'Brien	HFC	Key Fwd	4	19.8	650	62
B.Evans	BFC	Mid	5	19.5	651	174
B.Hartman	GFC	Mid-Fwd	5	19.4	652	55
C.Smith	WBFC	Mid	4	19.4	653	175
B.Whitecross	HFC	Gen Def	4	18.1	654	128
M.Duffy	FRFC	Gen Fwd	3	17.9	655	104
C.Smith	CFC	Mid	7	17.3	656	176
J.Trengove	MFC	Mid	2	15.6	657	177
C.Menadue	RFC	Mid-Fwd	5	15.5	658	56
A.Browne	EFC	Gen Def	3	14.9	659	129
P.McCartin	SKFC	Key Fwd	6	14.2	660	63
L.Lowden	AFC	Ruck	1	14.1	661	53
S.Blease	GFC	Mid-Fwd	3	13.2	662	57
T.Lee	SKFC	Key Fwd	3	12.6	663	64
J.Holmes	SKFC	Ruck	3	12.6	664	54
A.Woodward	HFC	Mid	2	12.3	665	178
J.Cowan	GFC	Mid	2	12.2	666	179
L.Weller	FRFC	Mid	3	11.9	667	180
W.Hams	EFC	Mid	3	11.7	668	181

Player	Club	Pos	Matches	Rating Points	Overall Standing	Position Standing
B.Grey	FRFC	Mid	1	11.3	669	182
B.Colledge	WCFC	Mid	3	11.3	670	183
T.Pears	EFC	Key Def	2	10.9	671	80
M.Scharenberg	COFC	Gen Def	4	10.8	672	130
L.Sumner	GWS	Gen Fwd	2	10.7	673	105
S.White	SKFC	Key Fwd	2	10.4	674	65
K.Brooksby	GCFC	Ruck	3	9.8	675	55
J.Hall	GCFC	Key Fwd	2	9.7	676	66
C.McKenna	EFC	Mid	2	9.4	677	184
S.Tunbridge	WCFC	Gen Fwd	5	9.3	678	106
B.Walsh	CFC	Mid	3	8.5	679	185
M.Newman	WCFC	Gen Fwd	2	8.1	680	107
E.Hughes	FRFC	Gen Def	1	8.0	681	131
J.Rose	SYFC	Gen Fwd	2	7.8	682	108
T.Smith	FRFC	Key Def	1	7.7	683	81
E.Langdon	FRFC	Gen Fwd	2	7.7	684	109
M.White	MFC	Gen Def	1	7.2	685	132
T.Golds	GWS	Mid	3	7.1	686	186
M.Luxford	GFC	Gen Fwd	2	6.2	687	110
L.Herbert	GCFC	Gen Fwd	3	6.0	688	111
J.Ballard	FRFC	Mid	1	5.8	689	187
T.Fields	CFC	Gen Fwd	2	5.8	690	112
T.Lamb	WCFC	Gen Fwd	1	5.5	691	113
P.Wright	GCFC	Ruck	3	5.5	692	56
L.McBean	RFC	Key Fwd	2	5.3	693	67
C.Byrne	CFC	Gen Def	1	5.2	694	133
Z.Cordy	WBFC	Key Def	2	5.1	695	82
J.Redden	PAFC	Ruck	1	4.6	696	57
X.Richards	SYFC	Key Def	1	4.4	697	83
O.McDonald	MFC	Key Def	2	3.9	698	84
C.Blakely	FRFC	Mid	1	3.2	699	188

Player	Club	Pos	Matches	Rating Points	Overall Standing	Position Standing
S.Naismith	SYFC	Ruck	1	3.1	700	58
B.Staker	BFC	Gen Fwd	6	3.1	701	114
T.Elton	RFC	Key Fwd	1	3.1	702	68
R.Smith	WBFC	Gen Def	1	2.7	703	134
M.Apeness	FRFC	Key Fwd	2	2.7	704	69
C.Knights	RFC	Gen Fwd	1	2.6	705	115
J.Barrett	GWS	Mid	1	2.4	706	189
K.Aylett	EFC	Mid	2	1.8	707	190
N.Drummond	RFC	Mid	1	1.2	708	191
D.Pearce	WBFC	Mid	1	0.7	709	192
M.Warren	NMFC	Gen Def	1	0.5	710	135

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