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Relationships between contract status and player performance in the Australian Football League

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ABSTRACT

This study analysed the extent to which player performance differs within the Australian Football League (AFL) with respect to the status of a player's contract. AFL Player Ratings (AFLPR) and contract data were obtained during the 2013–2020 AFL seasons for all 827 players listed by an AFL club at the beginning of the 2020 season. A model of "expected performance" was created allowing for an exploration into the differential with actual performance as a function of contract status. Paired t-tests indicated that there was a difference in performance pre- and post-signing their contract for players who signed mid-season (mean change and 95% confidence interval of -1.48 ± 0.93 and -0.49 ± 0.48 AFLPR, at ten match intervals for those in- and out-of-contract at the conclusion of that year's season, respectively). Further differences existed between the groups of players who signed mid-season, as compared to those who signed during the off-season. Correlation analyses indicated that more consistent performers are somewhat less likely to see a reduction in performance post signing as compared to less consistent performers. The applications of these findings have the potential to support organisational decisions relating to the timing and nature of player contracting.

Introduction

Assessing the impact of external factors on player performance is commonplace in the team sport literature (Fahey-Gilmour et al., 2019; Gómez et al., 2019; Teune et al., 2022). Often, this research is conducted to gain an improved understanding of how these factors affect performance, and how they can be adapted, manipulated, or better understood to improve associated decision-making processes (Browne et al., 2019; McIntosh et al., 2021). Some examples of external factors that were found to have an important affect with regard to performance include a player's nationality/locality to the league (Della Torre et al., 2018; Gómez et al., 2019), player preparation (injuries and/or illness) (Fahey-Gilmour et al., 2019; Sarlis et al., 2021), as well as practice environments (Browne et al., 2019; Davids, 2012; Robertson et al., 2019; Teune et al., 2022).

An integral incentive for an athlete in any team sport is the status of their contract and the associated factors (i.e., remuneration, length, incentive-based) (Della Torre et al., 2018; Frick, 2011). Whilst multiple studies have assessed the relationship of player performance on player value in the team sport notational literature, there is limited knowledge on the relationship between a player's contract status and individual player performance. Three notable studies exist, all focussing on European soccer leagues (Della Torre et al., 2018; Frick, 2011; Gómez et al., 2019). Frick (2011) assessed performance in the German Bundesliga between 1995 and 2008, investigating both salaries and contract lengths with respect to player performance. The analysis was conducted using various methods including an ordinary least squares model, a random-effects model, and a median regression model. Each model considered variables

such as player position, age, career professional games, career league games, as well as basic performance statistics in order to control for any potential non-linear confounding relationships with performance. The findings indicated that player performance increased in the later stages of existing contracts, and it was hypothesised that a player's effort and motivation is affected depending on the state of their contract cycle. Marginal contract-related changes in individual performance are surmised to affect team performance and potentially have substantial economic consequences for the organisation.

Della Torre et al. (2018) assessed performance in the Italian Serie A across the 2012–2013 and 2013–2014 seasons. Whilst the core topic of this study was to assess pay disparities, this assessment required the creation of a model to analyse the relationship between pay and performance. Similar to the Frick (2011) study, control variables were used in order to account for any confounding non-linear-relationships. These variables included age, player role, nationality, contract duration and stage of contract cycle, as well as the market value of the team. The inclusion of these control variables allowed for tangible findings around player performance at different stages of the contract cycle, suggesting that players similarly perform at a higher level during the final year of their contract, as compared to earlier years. The authors indicate that this finding is somewhat explained by a pay-performance relationship, whereby periods of good performances are rewarded by re-contracting or renegotiation of existing contracts.

Whilst the two previous studies have assessed contract status with respect to the length of time prior to contract renewal,

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a more recent study by Gómez et al. (2019) investigated player performance differences in the seasons both immediately pre- and post-signing a new contract. This study was conducted across four different European leagues (French, German, Italian, and Spanish professional leagues) during the 2008 to 2015 seasons, and found that players' performances did not show a substantial improvement or decline in the analysed matches pre- or post-signing a new contract. Though each of these studies consider performance prior to contract signing directly, the periods for comparison differ greatly, and give a good understanding of player performance with respect to different stages of a player's contract cycle.

The AFL is the elite competition of Australian football (AF), which is an invasion team sport played between two opposing teams. Each AFL club list consists of up to 47 players (Australian Football League, 2020), whereby clubs are limited in their ability to remunerate players by a salary cap. Players can be drafted to, traded for or recruited by an AFL club through a variety of ways at multiple points throughout the season (outlined in Appendix 1). However, players who are already listed by an AFL club can have their contract renewed at any point throughout the year.

The ability to benchmark and forecast player performance longitudinally is inherently valuable to sporting organisations and could be used to guide decisions relating to player contracting, recruitment and development (Kalén et al., 2019). Whilst the literature around player performance forecasting in other team sports is extensive through the use of both linear and non-linear, as well as traditional statistical and machine learning methodologies, there is only one notable study which exists in the AF literature which looks to forecast player performance on a game-by-game basis. Using a variety of methodologies, Sargent and Bedford (2010) were able to demonstrate that a Tukey-smoothed forecast produced a significantly smaller error than other unsmoothed methods when forecasting on a game-by-game basis.

The aim of this study was to analyse the extent to which the player performance, defined as AFL Player Ratings (AFLPR),

differs pre- and post-contract signing within AFL players, dependent on the status and timing of their contract. The methodology of this study was designed to assess the hypotheses that; 1) player performance would be above expectation in the period immediately prior to contract signing for those contracted mid-season (i.e., to reflect re-contracting or renegotiation of existing contracts as a response to improved performance), and 2) there would be no difference seen in player performance pre- and post-signing. These hypotheses are visualised in Figure 1.

Methods

Data

Data were collected across the AFL for all 1610 matches played across the 2013–2020 AFL seasons. This included 22 matches played by each team during the regular season rounds for seasons 2013–2019, and 17 for the 2020 season (reduced games due to the impact on the playing schedule by the COVID-19 pandemic). A further nine matches were played throughout the finals series each season. One match was abandoned prior to play during the 2015 season.

The date of each player's most recently signed contract, and the state of their previous contract was collected for all 827 players who were listed by an AFL club at the beginning of the 2020 season. The dates for each player's most recently signed contract spanned from the 2013–2014 off-season (Lance Franklin signed a nine-year deal), through to the 2019–2020 off-season. By utilising the most recent contract for every player at a specific timpoint, it allowed the investigation to obtain a representative sample of the player landscape within the AFL and minimise the potential for bias. Figure 2 outlines the number of players contracted at each point in time, and Table 1 outlines how contract statuses were classified, and the number of players within each classification. The date was outlined by when each
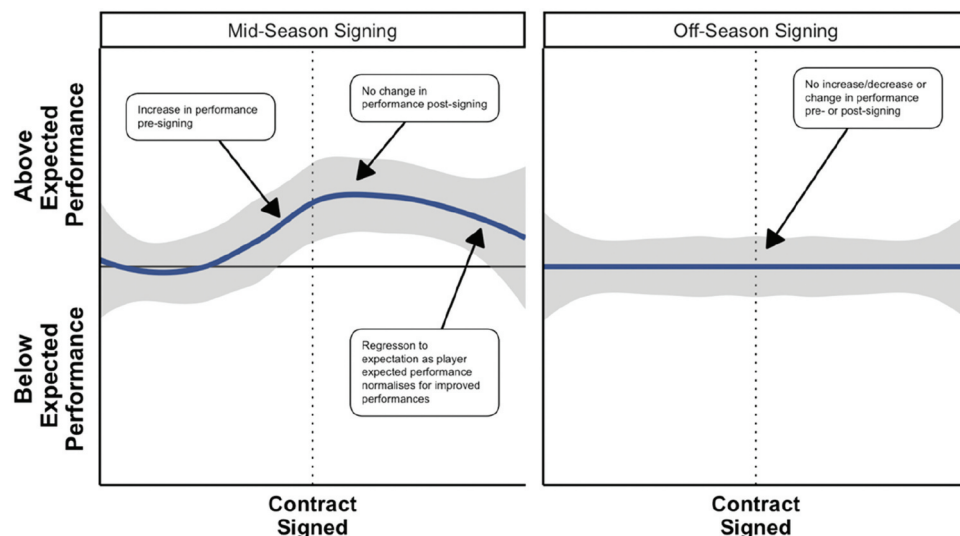

Figure 1. Hypothesised time vs. performance concept with regards to when a player signs a contract.
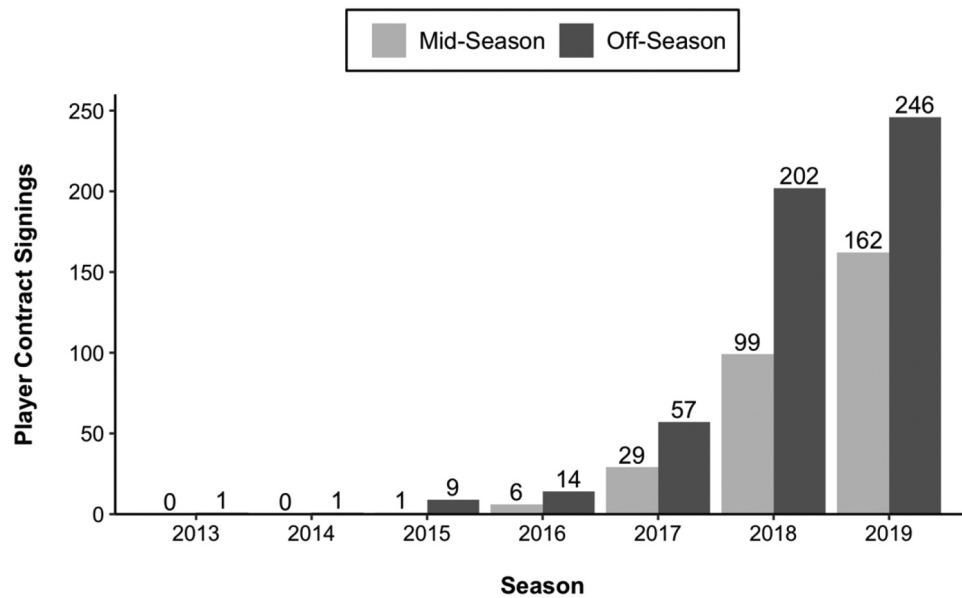
Figure 2. Distribution of players contracted at each point in time for the 827 players who were listed by an AFL club at the beginning of the 2020 season (Off-season indicates between the conclusion of that year's season, and the beginning of the proceeding).

Table 1. Description of the contract status classifications and the distribution contract signings by 643 players listed by an AFL club prior to the 2020 season.

Contract status classification	Description	Players in classification
Mid-season Out-of-contract	Signed a new contract during the AFL season. These players would have been out-of-contract at the conclusion of the season.	193
Mid-season In-contract	Signed a new contract during the AFL season. These players would have still been in-contract at the conclusion of the season (i.e., one or more seasons remaining on their existing contract).	79
Off-season Out-of-contract	Signed a new contract after the conclusion of their team's AFL season. These players were out-of-contract at the time of signing. This includes those who resigned with the same club, traded to another club, or signed with another club as a free agent.	207
Off-season In-contract	Signed a new contract after the conclusion of their team's AFL season. These players were still in-contract at the time of signing (i.e., one or more seasons remaining on their existing contract). This includes those who were traded to another club despite their existing contract.	164

player's respective AFL club released a media statement indicating the contract singing. Some additional secondary sources were utilised to confirm and finalise these data, including national and state newspapers (Herald Sun, The Advertiser, Courier Mail, The West Australian, Geelong Advertiser). The final dataset consisted of 643 players, after the removal of players which could not have obtained both an expectation/benchmark and a post-contract signing level of performance needed for the analyses. This included 97 AFL listed players who were selected at either the National, Rookie or Pre-Season drafts, as well as those selected through the category-B selection process or during the pre-season supplemental selection period during the 2019–2020 offseason, as well as a further 87 players who were similarly selected during these drafts/periods throughout the 2018–2019 offseason and were given initial two-year contracts.

The AFLPR were utilised as the measure of player performance in this study. These were obtained from Champion Data Pty Ltd. and used due to their established validity and equity-based nature (Jackson, 2009; McIntosh et al., 2018). In this metric, a player's match performance is determined by the overall change in equity that is created by that player's actions during the course of a match (Jackson, 2009). The change in equity for each action is determined by assessing the expected

value of their team scoring next both before and after the action. These expected values are based on contextual information relating to the possession and disposal (i.e., field position, pressure from opponents, disposal outcome) collected from AFL matches preceding back to the 2004 season (Jackson, 2009). Due to the impact which the COVID-19 pandemic had on the scheduling for the 2020 AFL season, match times were reduced by 20% to account for a lack of turnaround time between matches. As the AFLPR are summative in nature, the reduced game time saw a corresponding reduction in AFLPR (20.0% reduction in mean AFLPR in the 2020 season as compared to the 2019 season). To account for this in the analysis, the raw AFLPR for the 2020 season were modified (multiplied by 1.25). The mean and distribution for the raw AFLPR across the 2013 to 2019 seasons, as well as the modified AFLPR across the 2020 season are outlined in Figure 3.

Data relating to player characteristics were collected to assess the relationship with performance. Player experience (determined by the number of AFL matches played, independent of seasons) and the positional role classification (determined by Champion Data's classification at the conclusion of each season; classifications outlined in Appendix 2 were each collected as descriptive variables. Prior to data collection, the study was approved by the relevant human research ethics committee.
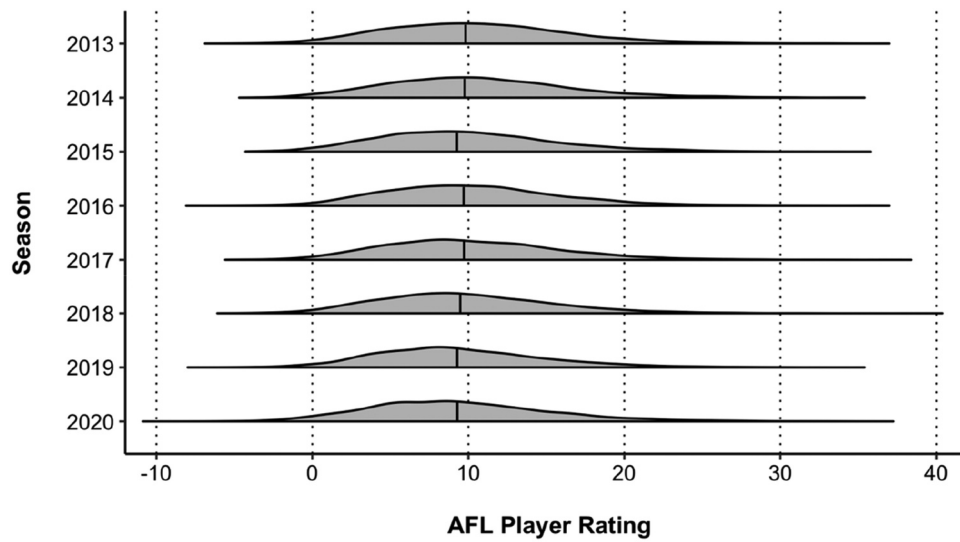
Figure 3. Density plots outlining the mean and distribution for the raw AFLPR across the 2013 to 2019 seasons, as well as the modified AFLPR across the 2020 season.
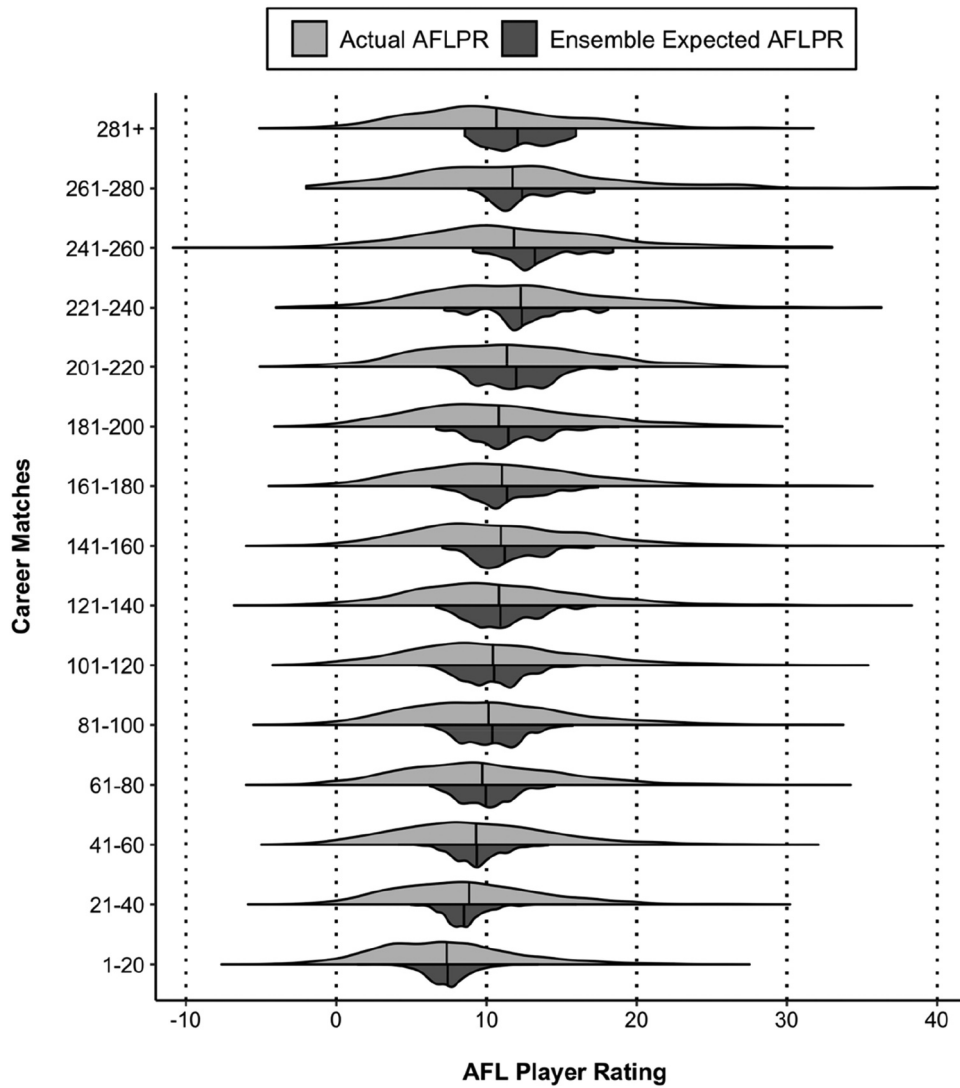

Figure 4. Violin plots outlining the mean and distribution of actual and expected performance across the test data set for career match experience.

Statistical analysis

Assessing 'expected performance'

Two methods for assessing "expected performance" were evaluated. The first method was created using a linear mixed model adapted from McIntosh et al. (2019). To allow for discretization that balanced model fit, non-linearity and complexity, categorisation levels for experience were determined by evaluating the change in Akaike's Information Criterion (Akaike, 1987) for differing amounts of categories. As a result, experience was expressed in intervals of 20 matches (1–20, 21–40, 41–60, . . . , 281+) as visualised in Figure 4. The model was conducted using the *lme4* package (Bates et al., 2015), in the R statistical computing software version 4.2.1 (R Core Team, 2022) and took the form:

$$PRpm = \beta 0 + \beta 1Xpm + \beta 2Yps + \alpha p + \varepsilon pm$$

where PRpm is the AFLPR of player p in match m. β0, β1 and β2 are fixed coefficients, and X and Y are observed covariates. Xpm represents the amount of matches the player has played in their career inclusive of the corresponding match. Yps represents the player's positional effect, which is consistent across each season. The parameter $\propto$p is a player random effect, which makes the intercept of the model specific to each player. This effect is a draw from a normal distribution with equal variance for all players. The parameter εpm denotes the player match residual error. Data from the seasons prior to each player's most recently signed contact were assembled as the training data ($n = 23829$ matches), and all remaining seasons were used as a "held-out" test data set ($n = 25488$ matches). The in-sample performance of the model rendered a root mean square error of 5.01 AFLPR (39.3% of a players mean rating).

The second method was outlined by a rolling mean of AFLPR calculated using the weightings as per the formulation for the Official AFLPR (obtainable on the AFL website, https://www.afl.com.au). The formula for this calculation is below and is adapted from the original calculation used by the AFL which is available in Jackson (2016). This model took the form:

$$AFLPR(j) = 1/n_j \sum_{i=1}^{n_j} E_R^i(j) \times \max(0, \min(1, (41 - i)/10))$$

where n_j is the number of games played in the last two seasons by player j. $E_R^i(j)$ is the AFLPR by player j in their ith most-recent game. "Max$\left(0, \min\left(1, \frac{(41-i)}{10}\right)\right)$" indicates that the most recent 31 games receive full weight and match 32 through 40 receive 90%, 80%. . ., 10% of weight, respectively. If less than 40 matches were played across the previous two-year period, a mean of all weighted matches were calculated.

An ensemble model was compiled using the mean of the two estimates and was used for all further comparisons as the root mean square error was less than that of both the measures in isolation (linear mixed model = 5.34, rolling mean of AFLPR = 5.25, ensemble = 5.22).

Assessing performance with respect to the status and timing player contracts

Utilising the ensemble measure of "expected performance" the differential with actual performance was explored to assess whether there is an association with the timing of a player's contract status. To analyse these differences, paired t-tests and Cohen's d effect sizes were conducted at the timepoints of five and ten matches (but limited to a 12-month period either side) both pre- and post-signing. An ANOVA and post-hoc Tukey tests were also performed to determine whether player performance means were different between each of the contract status classifications at the same timepoints pre- and post-signing. Each of these analyses were undertaken using the *stats* package (R Core Team, 2022).

Follow-up analysis was undertaken to determine if differences are more prevalent in those dependent on the stage of a players career (number of career matches), the benchmark level of a player's performance (expected AFLPR at the time of signing), as well as the consistency of a player's performances (relative standard deviation of performances prior to signing). Pearson's correlation and linear regression analyses assessed the difference of each player's mean performance relative to expectation in games post signing, versus pre-signing. The ten match timepoint both pre- and post-signing was used as a result of the initial investigation findings. Both of these analyses were undertaken using the *Hmisc* package (Harrell, 2017). A level of significance was accepted at $p < 0.05$ in all analyses.

Results

Descriptive statistics and distributions for player experience and position, and how they relate to both actual and expected performance across the dataset is outlined in Figures 4 and 5, respectively. The residual of rating points between the actual performances and the ensemble measure of expected performance were assessed and visualised for players both pre and post the signing of contracts. Figure 6 outlines the differences seen in performance for players who signed contracts either within the midst of a season, or during the off-season, respectively, for those still in contract as well as those who were out-of-contract (or to be out-of-contract at the conclusion of the season). The paired t-test results shown in Figure 6 indicate that there was a significant difference in performance pre- and post-signing their contract for the group of players who were out-of-contract and signed mid-season (PRpm = −0.62, d = −0.187, p = 0.039 and PRpm = −0.49, d =-0.214, p = 0.047, at the five and ten match intervals, respectively), as well as the group of players who were in-contract and signed mid-season (PRpm = −1.48, d = −0.555, p = 0.003, at the ten match interval).

The results of the ANOVA and post-hoc Tukey tests are outlined in Figure 7, and indicate that differences were only seen between groups of players who signed mid-season as compared to those who signed during the off-season, and only in matches prior to signing contracts.

Further investigations as to whether performance differences are impacted by the stage of a players career, as well as the level and consistency of a player's performances are outlined in Figures 8–10, respectively. These are outlined by the difference of each players mean performance relative to expectation in games post signing, versus mean performance relative to expectation in games pre-signing (positive values indicate the player performed better post-contract signing). Examinations of the scatterplots and Pearson correlations
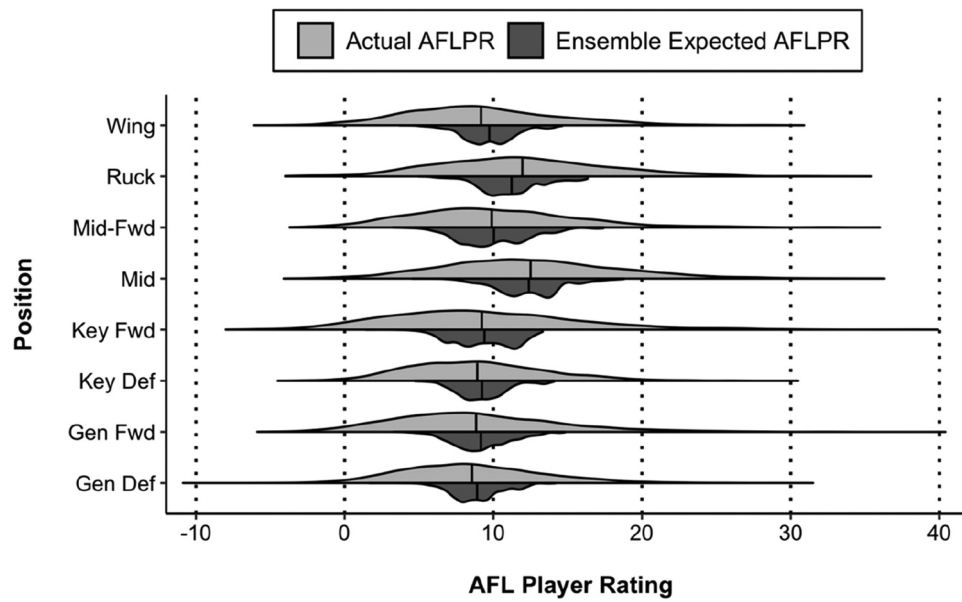
Figure 5. Violin plots outlining the mean and distribution of actual and expected performance across the test data set for position.
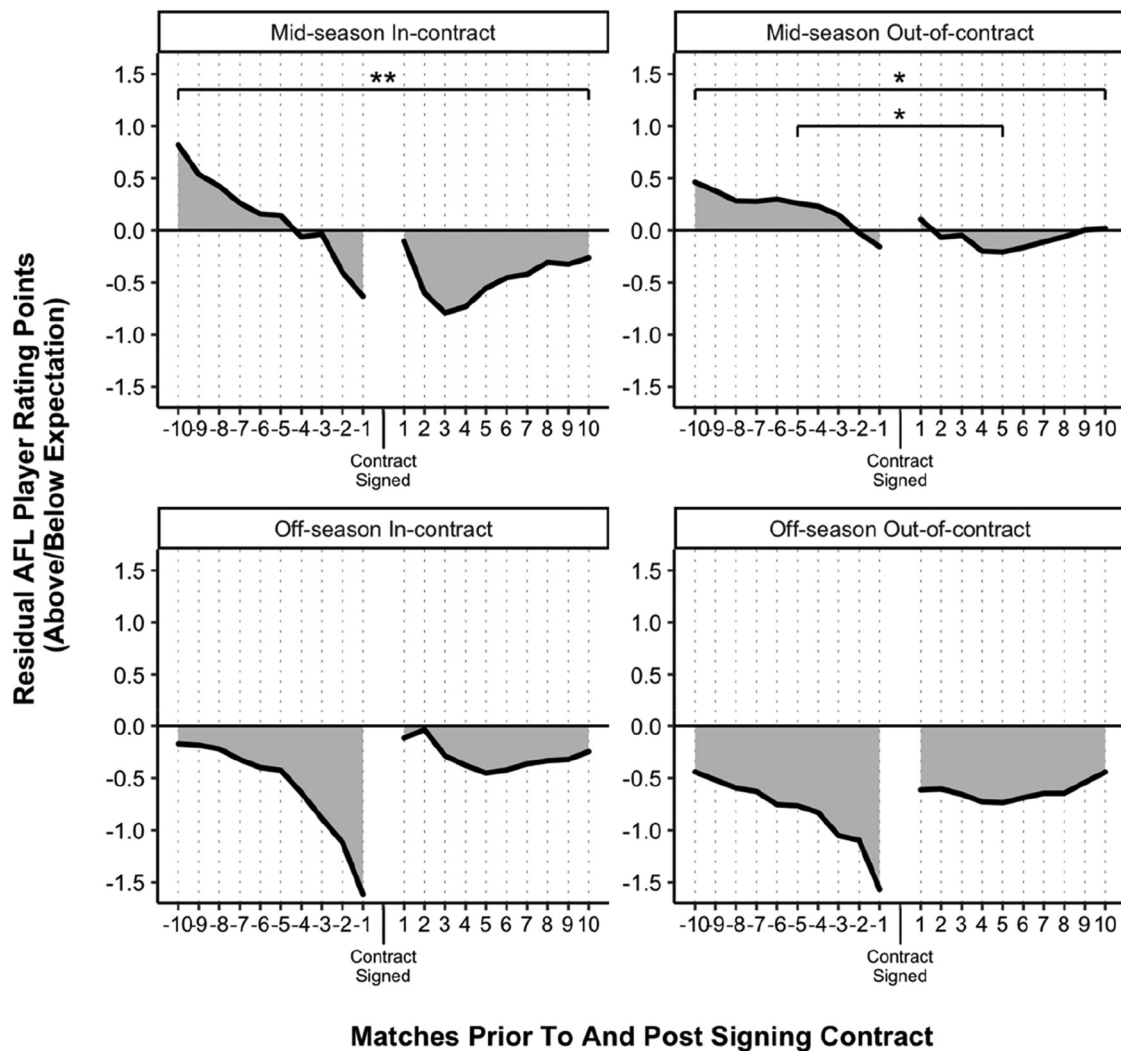

Figure 6. Area plots outlining the mean of residual rating points for matches pre- and post-signing. Plot outlines the residual of all games inclusive from 1 to n or −1 to -n, respectively, for matches prior to (-) and post signing. ** $p < 0.01$, * $p < 0.05$.
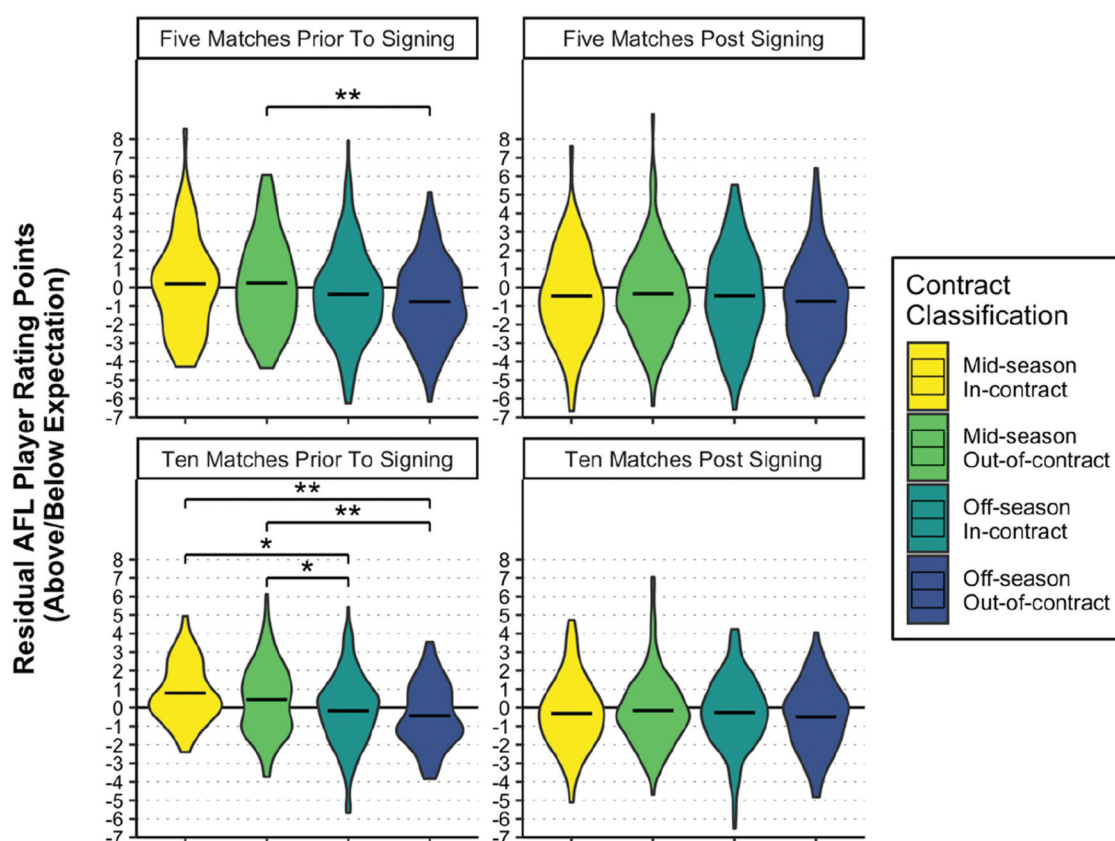
Figure 7. Violin plots outlining the distribution of player mean residual rating points dependent on the classification of their contract status. ** $p < 0.01$, * $p < 0.05$.

Figure 8. Scatterplots outlining the difference of each players mean performance relative to expectation in games post signing, versus pre signing dependent on the stage of the players career and relative to the context of their signing. Blue line indicates a linear fit and the associated standard error. 'r' indicates a Pearson correlation coefficient and 'p' indicate the p-values. Positive values indicate the player performed better post contract signing.

indicate that there is little difference in the performance of pre- and post-contract signing with respect to the stage of a player's career, or the level of a player's performances. However, there was a weak negative relationship seen with respect to the consistency of performances, whereby the more consistent performers are less likely to see a drop in performance post signing a contract.

Discussion

The aim of this study was to analyse the extent to which the player performance, defined as AFLPR, differs pre- and post-contract signing within AFL players, dependent on the status and timing of their contract. A model of "expected performance" was compiled allowing for an exploration into the differential with actual performance, to assess whether there is any association with the timing of player contract signings.

The purpose of assesing performances surrounding the timing of player contract signings was to gain an improved understanding of a predicament common within professional sporting organisations; being the ability to recontract a player at the optimal time within the cycle of their existing contract. In most cases, the timing of when to recontract a player is the result of a cost-benefit analysis by the organisation. Regardless of the decision, organisations either choose to risk that a players value will continue to increase by delaying the recontracting process (and thus potentially having to pay more), or risk a performance regression/decrement in a player, or lack of

performance through injury if they choose to advance earlier (and thus potentially having payed more than necessary). Whilst proceeding with a contract signing is a two-way arrangement (i.e., both the player and organisation need to agree), the capacity to comprehend the extent to which performance may differ dependent on the current status of a player's contract is inherently valuable to professional sporting organisations, and could be used to support their decision of whether to engage the player regarding recontracting.

The AFLPR distributions outlined in Figures 4 and 5 give a visual indication that the ensemble model for expected performance appropriately adjusts for player experience and position, respectively, when estimating actual performance. In both of these figures the distribution for actual performance is far more dispersed than that for expected performance. This is apparent as these figures visualise game-by-game performance, and the nature of the methodologies for expected performance does not forecast for the extreme variable performances which exist in actual performance, as a way to minimise overall prediction error. As a result, the variance in expected performance is lower.

The mid-season signings for those both in- and out-of-contract (at the end of the year) were the only groups to show significant differences between performance in the matches prior to and post signing (visualised in Figure 6). These findings indicate that performance before signing is above expected, with a distinct drop in performance post signing. Whilst the subsequent drop in performance cannot be specifically explained, the preceding higher level of performance is likely symptomatic of why the players' respective
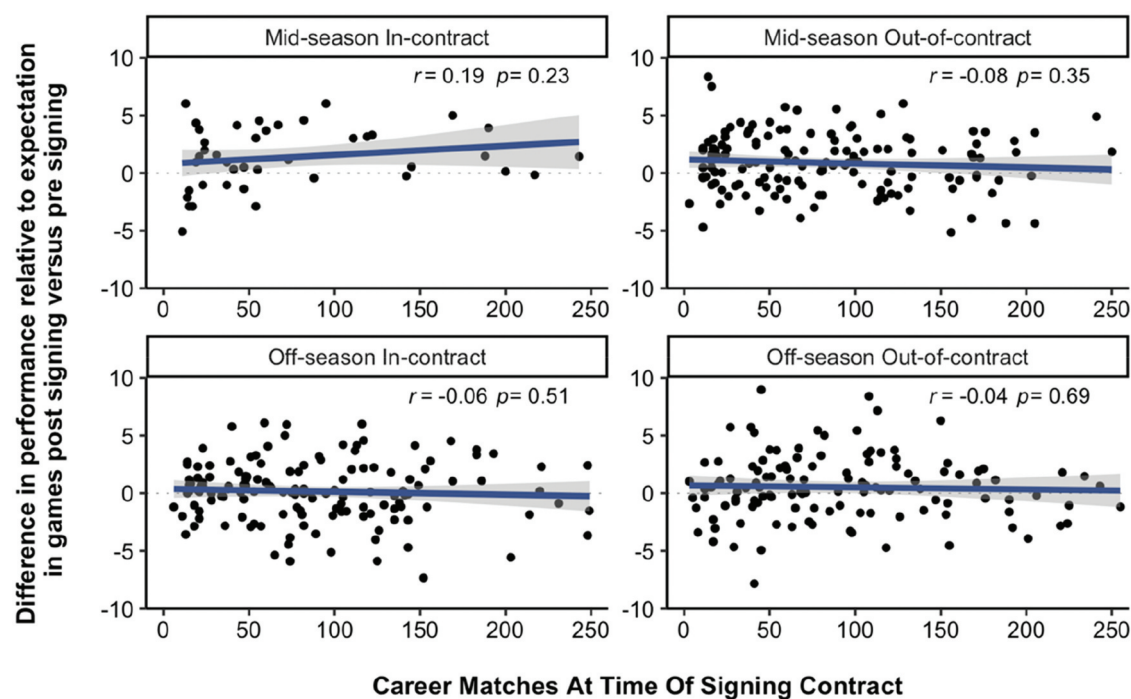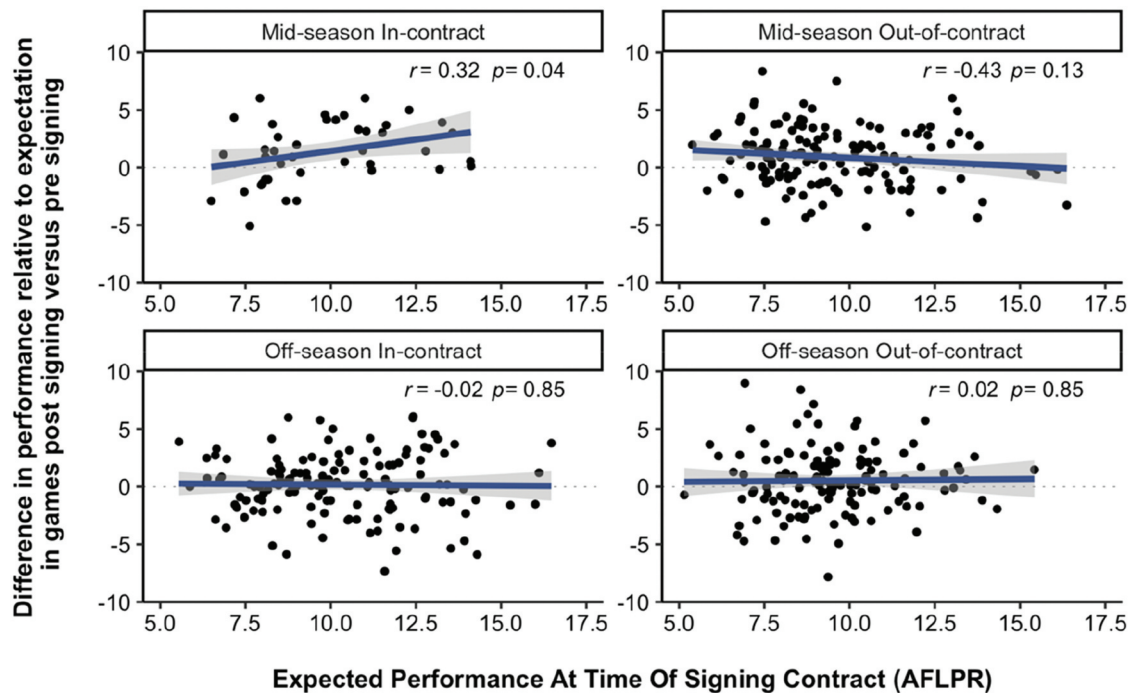

Figure 9. Scatterplots outlining the difference of each players mean performance relative to expectation in games post signing, versus pre signing dependent on the expected level of performance and relative to the context of their signing. Blue line indicates a linear fit and the associated standard error. '*r*' indicates a Pearson correlation coefficient and '*p*' indicate the p-values. Positive values indicate the player performed better post contract signing.
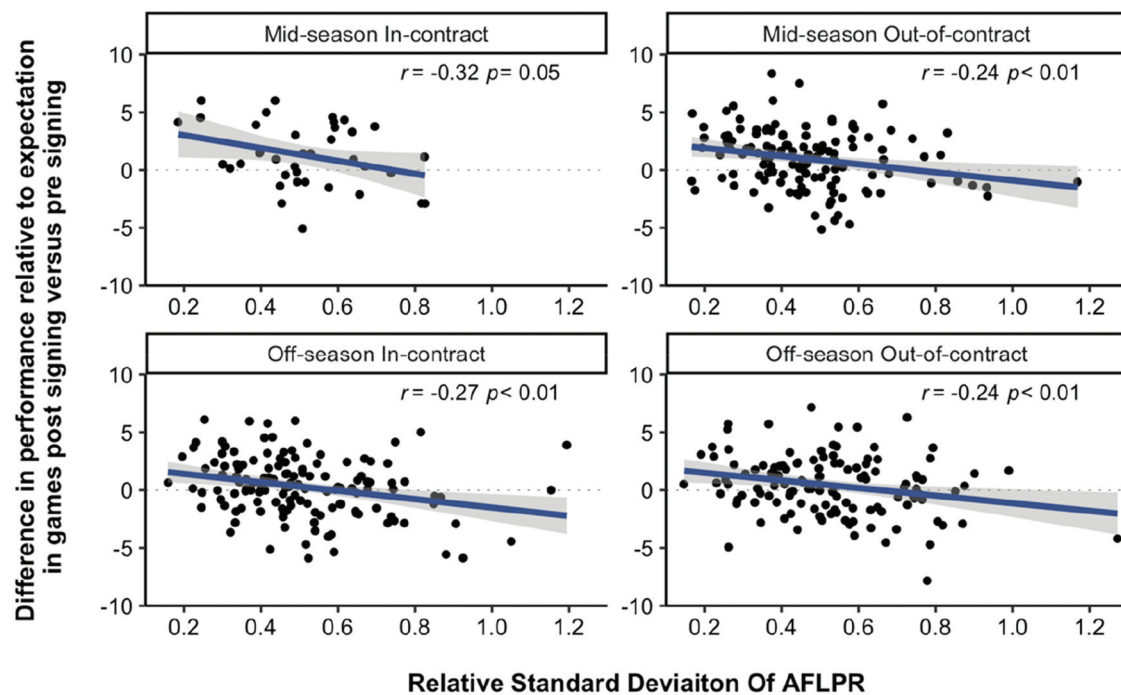
Figure 10. Scatterplots outlining the difference of each players mean performance relative to expectation in games post signing, versus pre signing dependent on the consistency of performances and relative to the context of their signing. Blue line indicates a linear fit and the associated standard error. 'r' indicates a Pearson correlation coefficient and 'p' indicate the p-values. Positive values indicate the player performed better post contract signing.

clubs chose to sign them at that point of the season. These findings are somewhat consistent with those from Della Torre et al. (2018) and Frick (2011) where periods of increased performances are rewarded by re-contracting.

The post-hoc Tukey tests outlined in Figure 7 indicated that there were differences between various levels of players, but only between groups one group who signed mid-season, as compared to those who signed during the off-season. Whilst this finding is notable, there is a small effect likely contributing to this drop in mean performance for those players who signed during the off-season. Specifically, players on average obtain a lower AFLPR in losing matches than in winning matches; and a larger number of teams lose their final game of the season than in any specific round (i.e., seven of the eight teams which make finals lose their final game, and on average 6.6 of the ten non-finals teams also lose their final game). As these residuals are inclusive from the last game prior to signing through to the nth game prior to signing, there is likely a small lasting effect on the performance means.

The weak negative relationship seen in three of the four contract status classifications dependent on the consistency of performances (visualised in Figure 10) gives an indication that external factors such as a player's contract status may be an impetus to performance. Whilst only a weak association was seen; this negative relationship suggests that the consistency of a player's performance leading into a contract negotiation can be used as a refined indicator of expected performance for matches after the signing of their contract, and should be taken into consideration to support decisions related to player contracting.

A delimitation of this study should also be noted. Many of the defining aspects of player contracts are confidential within the AFL (i.e., remuneration amount, incentive based or fully guaranteed), meaning that such information was not used as part of this study. Further to this, many players contracts within the AFL have match- or performance-based incentive triggers, whereby their contract will automatically be renewed for the following season(s). As a result of these factors, the inferences made as part of this study do not attempt to infer about the motivations of the athletes as has been done in related research on other sports (Della Torre et al., 2018; Frick, 2011).

Conclusion

The methods outlined in this study allowed for an examination of player performance with respect to the timing of player contract signings. The results indicated that the first of the two preconceived hypotheses were upheld, but not the second. Specifically, players who signed mid-season saw performances before signing as above expected, but showed a substantial drop in post signing. Furthermore, consistent performers were less likely to see any drop in performance post signing a contract. The findings outlined as part of this study could be used as an example of associations worth investigating to identify refined indicators of expected performance for matches pre and post the signing of a contract in the AFL. As an example, there may be more confidence to sign an player mid-season when they show consistant above-expected performances, as opposed to a more erratic performing player who has achieved some recent above-expected performances. Whilst there are various considerations specific to player contracting in each team sport (i.e., salary caps, amount of other competing professional leagues, non-sporting incentives), the findings of this study could have implications for use within other team sports.

Disclosure statement

Funding

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References

Akaike, H. (1987). Factor analysis and AIC. In *Selected Papers of Hirotugu Akaike* (pp. 371–386). Springer. https://doi.org/10.1007/978-1-4612-1694-0_29

Australian Football League. (2020). *Australian Football League Rules*.

Bates, D., Mächler, M., Bolker, B., & Walker, S. (2015). Fitting linear mixed-effects models using lme4. *Journal of Statistical Software*, *67*(1), 1–48. https://doi.org/10.18637/jss.v067.i01

Browne, P., Sweeting, A., Davids, K., & Robertson, S. (2019). Prevalence of interactions and influence of performance constraints on kick outcomes across Australian football tiers: Implications for representative practice designs. *Human Movement Science*, *66*, 621–630. https://doi.org/10.1016/j.humov.2019.06.013

Davids, K. (2012). Learning design for nonlinear dynamical movement systems. *The Open Sports Sciences Journal*, *5*(1), 9–16. https://doi.org/10.2174/1875399X01205010009

Della Torre, E., Giangreco, A., Legeais, W., & Vakkayil, J. (2018). Do Italians really do it better? Evidence of migrant pay disparities in the top Italian football league. *European Management Review*, *15*(1), 121–136. https://doi.org/10.1111/emre.12136

Fahey-Gilmour, J., Dawson, B., Peeling, P., Heasman, J., & Rogalski, B. (2019). Multifactorial analysis of factors influencing elite Australian football match outcomes: A machine learning approach. *International Journal of Computer Science in Sport*, *18*(3), 100–124. https://doi.org/10.2478/ijcss-2019-0020

Frick, B. (2011). Performance, salaries, and contract length: Empirical evidence from German soccer. *International Journal of Sport Finance*, *6*(2), 87–118.

Gómez, M., Lago, C., Gómez, M., Furley, P., & Sampaio, J. (2019). Analysis of elite soccer players' performance before and after signing a new contract. *Plos One*, *14*(1), e0211058. https://doi.org/10.1371/journal.pone.0211058

Harrell, F. E., Jr. (2017). Package 'Hmisc'. *R Foundation for Statistical Computing* .

Jackson, K. (2009). Football numbers man brings players to account. In M. Marino (Ed.). *Swinburne Venture Magazine*. Swinburne University of Technology.

Jackson, K. (2016). *Assessing player performance in Australian football using spatial data*. Doctor of Philosophy), Swinburne University of Technology.

Kalén, A., Rey, E., de Rellán-Guerra, A. S., & Lago-Peñas, C. (2019). Are soccer players older now than before? Aging trends and market value in the last three decades of the UEFA champions league. *Frontiers in Psychology*, *10* (76). https://doi.org/10.3389/fpsyg.2019.00076

McIntosh, S., Jackson, K. B., & Robertson, S. (2021). Apples and oranges? Comparing player performances between the Australian Football League and second-tier leagues. *Journal of Sports Sciences*, *39*(18), 2123–2132. https://doi.org/10.1080/02640414.2021.1921372

McIntosh, S., Kovalchik, S., & Robertson, S. (2018). Validation of the Australian Football League player ratings. *International Journal of Sports Science & Coaching*, *13*(6), 1064–1071. https://doi.org/10.1177/1747954118758000

McIntosh, S., Kovalchik, S., & Robertson, S. (2019). Multifactorial benchmarking of longitudinal player performance in the Australian Football League. *Frontiers in Psychology*, *10*(1283). https://doi.org/10.3389/fpsyg.2019.01283

R Core Team. (2022). *R: A language and environment for statistical computing*. R Foundation for Statistical Computing. https://www.R-project.org/

Robertson, S., Spencer, B., Back, N., & Farrow, D. (2019). A rule induction framework for the determination of representative learning design in skilled performance. *Journal of Sports Sciences*, *37*(11), 1280–1285. https://doi.org/10.1080/02640414.2018.1555905

Sargent, J., & Bedford, A. (2010). Improving Australian Football League player performance forecasts using optimized nonlinear smoothing. *International Journal of Forecasting*, *26*(3), 489–497. https://doi.org/10.1016/j.ijforecast.2009.10.003

Sarlis, V., Chatziilias, V., Tjortjis, C., & Mandalidis, D. (2021). A data science approach analysing the impact of injuries on basketball player and team performance. *Information Systems*, *99*, 101750. https://doi.org/10.1016/j.is.2021.101750

Teune, B., Woods, C., Sweeting, A., Inness, M., & Robertson, S. (2022). The influence of environmental and task constraint interaction on skilled behaviour in Australian Football. *European Journal of Sport Science*, *22* (8), 1–8. https://doi.org/10.1080/17461391.2021.1958011

Appendices

Appendix 1. Descriptions of the four annual AFL drafts and pre-season supplemental period

Draft Type	Description
National Draft	Compulsory draft for each club. Players selected by a club become ineligible to be included on the primary list of any other club for a period of two seasons. For the most part this draft consists of players finishing secondary school, who have been competing in elite junior second-tier competitions. Clubs must adhere to maximum list sizes. Occurs in the off-season.
Pre-season Draft	Non-compulsory draft. Players selected by a club become ineligible to be included on the primary list of any other club for a period of two seasons. For the most part this draft consists of players who missed out on selection in the National Draft. Clubs must adhere to maximum list sizes. Occurs immediately after the National Draft.
Rookie Draft	Non-compulsory draft. Players selected becomes part of the club's rookie list. For the most part this draft consists of players who missed out on selection in the National Draft or older players from second-tier competitions. Clubs must adhere to maximum list sizes. Occurs immediately after the Pre-season Draft.
Mid-season Draft	Non-compulsory draft. Players selected becomes part of the club's rookie list. For the most part this draft consists of players who missed out on selection in the National Draft or older players from second-tier competitions. Clubs can only select players to be added to their AFL list if they either do not have the maximum number of allowed players or have a player(s) whom is/are placed on the long-term injury list.
Pre-season supplemental period	Non-compulsory period. Clubs can only select players to be added to their AFL list if they either do not have the maximum number of allowed players or have a player(s) whom is/are placed on the long-term injury list.

Appendix 2.

Description of the eight positional role classifications used in this study

Player Positions	Description
Key Forward	Tall forward. Is typically the predominant target when moving the ball into the forward line.
General Forward	Small/medium forward. Plays predominantly in the forward half of the ground but with more freedom than a key forward.
Key Defender	Tall defender. Plays on opposition key forwards with the primary role of nullifying their opponent.
General Defender	Small/medium defender. Plays a role on opposition small/medium forwards and usually helps create play from the backline.
Midfielder	Plays a roaming role, with an emphasis on gaining possession of the ball when it is contested after a stoppage in play.
Wing	Is a subset of the midfield position. Typically an endurance player whose role it is play as the widest midfielder.
Midfield Forward	Splits time equally between the forward line and the midfield.
Ruck	Typically the tallest player on their team. Plays a roaming role and has the primary task of competing with the opposition ruck when the ball is thrown into the air after a stoppage in play.