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Original research

A comparison of game-play characteristics between elite youth and senior Australian National Rugby League competitions

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ABSTRACT

Objectives: To compare game-play characteristics between elite youth and senior Australian National Rugby League (NRL) competitions.

Design: Longitudinal observational.

Methods: The dataset consisted of 12 team performance indicators (e.g., 'all runs', 'offloads' and 'tackles') extracted from all 2016 national under 20 (U20) competition (elite youth; n = 372 observations) and National Rugby League (NRL) (elite senior; n = 378 observations) matches. Data was classified according to competition (Two levels: U20 and NRL) and modelled using two techniques. Firstly, non-metric multidimensional scaling resolved multivariate competition (dis)similarity, visualised using a two-dimensional ordination. Secondly, a conditional interference (CI) classification tree was grown to reveal the performance indicators most capable of explaining competition level.

Results: Non-metric multidimensional scaling revealed high competition dissimilarity, with U20 and NRL teams orienting distinctive positions on the first dimension of the ordination surface. Five team performance indicators were retained within the CI tree ('all runs', 'tackle breaks', 'tackles', 'missed tackles', and 'kicks'), which correctly classified 79% of the U20 observations and 93% of the NRL observations.

Conclusions: Multivariate differences between elite youth and senior rugby league competitions were identified. Specifically, NRL game-play was classified by a greater number of 'all runs', and 'tackles' and a lower number of 'missed tackles' relative to the U20 competition. Given the national U20 competition is purported to assist with the development of prospective NRL players, junior coaches may consider training interventions that primarily aid the tackling capacities of players. This may subsequently assist with talent development and player progression in Australian rugby league.

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1. Introduction

Developing talent is a complex and typically non-linear process,¹ influenced by a range of intrapersonal, environmental and situational catalysts.² In an attempt to positively augment this process, it is common for national sporting organisations to establish talent development academies or 'pathways', intended to offer longitudinal player development opportunities for talent identified juniors.^{3,4} The unifying goal of these development pathways is often to bridge performance discrepancies between junior and

senior competitions, creating an expedited developmental transition for participants towards the elite senior level.^{5,6}

Talent development in team sports, such as rugby league, is often further complicated given their innate multidimensionality (i.e., physical, technical and perceptual requisites).^{7–9} Accordingly, it is unsurprising to note the quantity of work that has investigated a range of performance qualities discriminant of developmental level specific to rugby league.^{8,10,11} Till et al.⁸ identified the anthropometric and physical fitness characteristics of English academy rugby league players in relation to their career attainment (professional or academy). Their results demonstrated differences (lower body strength) and changes (10m momentum) in the physical characteristics of players as they progressed through the academy according to career attainment level, with these observations being

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Table 1
Descriptive and between group effects relative to developmental level.

Performance indicator	NRL	U20	<i>d</i> (90% CI)	Size
All runs [*]	170.2 ± 19.8	147.2 ± 17.4	1.22 (1.09–1.35)	'Large'
Line breaks [*]	4.0 ± 2.3	5.6 ± 2.5	0.64 (0.51–0.76)	'Moderate'
Try assists [*]	2.8 ± 1.8	3.4 ± 1.9	0.34 (0.22–0.46)	'Small'
Offloads [*]	10.3 ± 4.4	7.0 ± 3.3	0.82 (0.69–0.95)	'Moderate'
Tackles [*]	325.0 ± 39.7	283.4 ± 35.6	1.10 (0.97–1.22)	'Moderate'
Missed tackles [*]	27.6 ± 8.4	35.7 ± 10.9	0.82 (0.70–0.95)	'Moderate'
Errors [*]	9.2 ± 2.7	10.4 ± 3.2	0.39 (0.27–0.51)	'Small'
Total kicks [*]	19.0 ± 3.8	14.7 ± 3.6	1.13 (1.00–1.26)	'Moderate'
Line break assists [*]	3.0 ± 2.0	3.6 ± 2.0	0.30 (0.18–0.42)	'Small'
Dummy half runs	11.1 ± 4.5	10.3 ± 4.6	0.15 (0.03–0.27)	'Trivial'
Tackle breaks [*]	27.6 ± 8.4	35.7 ± 10.9	0.83 (0.70–0.95)	'Moderate'

^{*} Denotes $P < 0.05$.

of use for the establishment of training interventions assistive with talent development.⁸

In Australia, the premier youth rugby league competition is the national under 20 (U20) competition; currently referred to as the Holden Cup. Fundamentally, the premise of this competition is to provide talent identified youths with a pathway into the elite senior competition, the National Rugby League (NRL). Accordingly, each of the 16 NRL teams has a representative U20 team who competes within a 26-week competition. Although statistics regarding player progression from the U20 to the NRL competition are not available, it is widely known within the NRL community that this national youth competition offers a critical developmental environment for prospective NRL players. However, despite this, the game-play characteristics (e.g., ball carries and tackles) between competitions has yet to be compared. Resolving this competition difference would likely provide coaches at the U20 level with an objective basis to minimise performance gaps between the U20 and NRL competitions and aid player progression and development within Australian rugby league.

Given the multidimensional dynamicity of rugby league match play,^{12,13} singular linear statistical approaches may not adequately reveal multivariate patterns within a dataset,¹⁴ constraining the practical utility of the observations.¹⁵ Given this, recent research in rugby league has adopted machine learning approaches to assist with the explanation of match outcomes using a diverse range of performance indicators.¹⁶ As such, it would seem appropriate to consider machine learning approaches when examining differences between elite junior and senior rugby league competitions to assist with the resolution of non-linear interactions between diverse datasets.

The aim of this study was to compare game-play characteristics between elite youth (national U20) and senior (NRL) Australian rugby league competitions. The subsequent results of this work will offer coaches at the U20 level with objective guidance with respect to the establishment of targeted training interventions intended to expedite talent development and player progression in rugby league.

2. Methods

Team performance indicators from the 2016 Holden Cup and NRL seasons were extracted from a publicly available source (<http://www.nrl.com/stats>) (Supplementary Table 1). These 12 indicators were chosen owing to their relevance in the explanation of rugby league match outcomes,¹⁷ as well as their availability at the time of analysis. Both competitions consisted of 26-rounds, equating to 372 observations in the U20 competition ($n = 186$ games) and 378 observations in the NRL ($n = 189$ games). The observational differences were due to the number of match-free rounds ('byes') integrated within both competitions. The absolute game-times were the same across both competitions. The relevant Human

Ethics Committee provided ethical approval prior to data acquisition.

All of the following analyses were performed using the computing environment *R*, version 3.2.5.¹⁹ Prior to modelling, data was classified according to competition (Two levels: U20 and NRL). A correlation matrix was built to assess the level of collinearity between each team performance indicator. Descriptive statistics (mean ± standard deviation) were calculated for each team performance indicator relative to developmental level. A multivariate analysis of variance (MANOVA) was then used to test the main effect of competition (Two levels: U20 and NRL) on each team performance indicator, with the Type-I error being set at $P < 0.05$. Additionally, the effect size and subsequent 90% confidence interval of competition was calculated using Cohen's *d* statistic²⁰ in the 'MBESS' package,²¹ with interpretations being in accordance with established recommendations.²²

To reveal the level of competition dissimilarity, non-metric multidimensional scaling (nMDS) was used. This is an indirect gradient analysis that produces an ordination based on a dissimilarity matrix.²³ This matrix is resolved via isotopic regression, which is a non-parametric form of regression that iteratively searches for a least squares fit based on the ranked dissimilarities.²³ It is the preferred ordination technique when no assumptions are made about the underlying distribution of the data.²³ Aggregates of each team performance indicator were used across the season for this analysis. Further, teams across both competitions were sorted according to their ladder position at the conclusion of the season. This enabled insights into the dissimilarity of dominant and less dominant teams across both competition levels. The team performance indicators were used to build a dissimilarity matrix using the Bray–Curtis measure in the 'vegan' package via the *metaMDS* function.²⁴ This dissimilarity matrix was then plotted in two-dimensions using generalised additive models employing an isotopic smoother via thin-plate regression splines.²³ On the ordination surface, competition was colour coded and teams were labelled, while their subsequent ladder position was denoted via the size of their 'point' using the *geom.label*, and *geom.point* functions in the 'ggplot2' package.²⁵

To determine the combination of performance indicators that provided the greatest competition classification, a conditional interference (CI) classification tree was grown in the 'party' package.²⁶ This type of classification tree was chosen as it estimates a regressive relationship through binary partitioning by testing the null hypothesis between a set of explanatory variables (team performance indicators) and a binary response variable (competition).²⁶ Partitioning ceases when the null hypothesis cannot be rejected ($P \geq 0.05$). A benefit of this analysis is that its fitting algorithm corrects for multiple testing, avoiding overfitting, resulting in the growth of an unbiased classification tree that does not require pruning.²⁶

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