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1   **Original Investigation**

2
3   **Full Title:** Positional group significantly influences the offensive and defensive skill

4   involvements of junior representative rugby league players during match-play

5

6   **Running Heading:** Skill involvements during junior rugby league match-play

1 **Abstract**

2 This study examined the skill involvements of three positional groups across a junior

3 representative rugby league season. Data was collected from forty-five rugby league

4 players (mean ± SD; age = 16.5 ± 1.0 years) currently participating in the Harold

5 Matthews and SG Ball Cup. Players were sub-divided into hit-up forwards,

6 adjustables and outside backs. The frequency $(n \cdot min^{-1})$ of offensive, defensive and

7 overall involvements was coded for each group using a notation system and a

8 practical coach skill analysis tool. MANOVA revealed a significant effect of playing

9 position on skill involvements (F = 9.06; P < 0.001; ES = 0.41). Hit-up forwards

10 performed a significantly greater frequency of offensive (0.31 ± 0.10), defensive

11 (0.42 ± 0.15) and overall contributions (0.74 ± 0.19) when compared to adjustables

12 (0.20 ± 0.08, 0.28 ± 0.08 and 0.52 ± 0.15, respectively) and outside backs (0.20 ±

13 0.12, 0.11 ± 0.07 and ± 0.31 ± 0.17, respectively). Further, adjustables performed a

14 significantly greater number of defensive (0.28 ± 0.08) and overall involvements

15 (0.52 ± 0.15) when compared to outside backs (0.11 ± 0.07 and ± 0.31 ± 0.17,

16 respectively). The findings of this study suggest that it is important to consider a

17 junior player's positional group when analyzing their skill involvements.

18 Information gained from this study could assist in the design of specific training

19 methodologies for junior rugby league players in high-level talent development

20 programs.

21

22 **Keywords:** *talent identification, talent development, ,performance analysis, youth*

1   Introduction

2   Rugby league match-play is physically demanding (Hulin, Gabbett, Kearney, &

3   Corvo, In Press; Twist, Highton, Waldron, Edwards, Austin, & Gabbett, 2014) and

4   technically challenging (Sirotic, Coutts, Knowles, & Catterick, 2009; Sirotic,

5   Knowles, Catterick, & Coutts, 2011), requiring players to perform a number of skills

6   under fatiguing conditions. Within a professional rugby league club, considerable

7   resources are invested into recording players' match-play skill involvements, to

8   allow coaches to interpret the technical dynamics of their own team and identify

9   weaknesses in their opposition. Although this is typically completed at the highest

10   level of competition, match-play skill involvement data can also assist in the

11   development of younger players who are progressing through the junior rugby

12   league pathways. While the skill involvements during match play are well

13   documented in other team sports such as soccer (Dellal, Chamari, Wong, Ahmaidi,

14   Keller, Barros, Bisciotti, & Carling, 2011; Russell, Rees, & Kingsley, 2013), there is

15   relatively little data in rugby league (Sirotic et al., 2009; Sirotic et al., 2011). Further,

16   this information is mainly constrained to professional competition.

17

18   Within the junior domain of rugby league, talented players participate in

19   representative state-based competitions (i.e. under-16s and 18s). The competitions

20   are supported by specialist coaching staff from a National Rugby League (NRL) club

21   and are viewed as a key stage in a young players development. If a player excels

22   within these competitions it is possible for them to be recruited on a semi-

23   professional contract to the under-20s National Youth Competition (Cupples &

24   O'Connor, 2011). While it is often difficult to determine what characteristics a player

25   must possess in order for them to make a successful transition (Till, Cobley, O'Hara,

Cooke, & Chapman, 2014; Till, Cobley, O'Hara, Brightmore, Cooke, & Chapman, 2011), it is important for them to be able to withstand the skill demands of higher competitions. Further, it is important recognize that the player match-play skill involvements can significantly influence their selection with a squad on a week-to-week basis. However, there is currently limited information focusing on this key stage of development pathway (i.e. under-16s and 18s). Therefore, it is important for future research to consider the match-specific skills of players in this stage as it may impact on their development

While it is important to recognize the overall skill demands of competition, successful performance during match-play is often determined by a player's ability to perform skills specific to their positional group (Gabbett, Kelly, & Pezet, 2008; Sirotic et al., 2011). Generally speaking, players are allocated to one of three positional sub-groups: hit-up forwards (i.e. lock, prop and second row), adjustables (i.e. hooker, half-back and five-eighth) and outside backs (i.e. fullback, wing and center). These sub-groups are assigned different tactical roles within a match (Meir, Newton, Curtis, Fardell, & Butler, 2001). One of the roles of a hit-up forward is to run into the opposition's defensive line with the goal of progressing the ball down the field. In contrast, outside backs use their evasion skills and speed on the fringe of play. As a result of the differences in the tactical roles of each group, it is important to identify their skill involvements during match-play. While examining the technical skill-involvements of professional rugby league players, Sirotic et al. (2011) observed significant differences between five positional groups (i.e. backs [winger and center], forwards [prop and second row], fullback, hooker and service players [half-back, five-eight, lock]). Offensively, the hooker exhibited the highest

number of touches of the ball, and the fullback the greatest number of support runs when compared to all other positional groups. With respect to defensive involvements, the forwards, hooker and service players displayed a significantly greater number of tackles made when compared to the backs and fullback. While this provides preliminary evidence for differences between positional groups within professional senior competition, future research is required to examine if these results are representative of junior players.

The improvement and refinement of match specific skills is essential for the development of junior rugby league players. Because of the time constraints and the opponent pressure placed on players during match-play, competitive matches act as an important source of specific skill involvements in youth players. If positional differences are evident, certain groups might miss out on the opportunity to refine their skill and this could potentially influence their development. Therefore, it is imperative to understand positional differences in skill involvements during matches so that practice activities can be modified to accommodate for a potential lack of exposure to certain skill involvements during match-play. It is important to not only consider the junior rugby league players' skill involvements during a single match, but across a competitive season. In doing so, coaches and support staff are able to continually monitor the overall skill stimuli placed on junior players, rather than taking an isolated measurement. The aim of the current study was to determine whether the skill involvements across multiple junior rugby league matches differed between three positional groups; hit-up forwards, adjustables and outside backs. It was hypothesized that playing position would significantly influence the skill involvements of junior players during match-play.

1

Methods

Participants

Data was collected from forty-five rugby league players (mean ± SD; age = 16.5 ± 1.0 years) participating in two Australian junior representative competitions (Harold Matthews and SG Ball Cup, New South Wales [NSW] Country Rugby League, Australia). All players were registered with the same National Rugby League club and were classified as competing under the guidance of a high-level talent identification program. Players were sub-divided into three positional groups: (a) *hit-up forwards*: lock, prop and second row (mean ± SD; n = 23, age = 16.6 ± 1.0 years); (b) *adjustables*: hooker, half-back and five-eighth (mean ± SD; n = 9, age = 16.1 ± 1.1 years); and (c) *outside backs*: fullback, center and wing (mean ± SD; n = 13, age = 16.8 ± 1.0 years). Prior to the commencement of this study, all players were informed of the aims and requirements of the research, and consent was obtained from a parent or legal guardian. The Institutional Human Ethics Research Committee approved all experimental procedures.

Performance analysis procedures

Video footage from both the home (*n* = 3) and away (*n* = 5) matches for each competition (*n* = 2) was obtained from the NRL's media department and passed onto the research team. To assist in the coding of the player's involvements, a practical skill analysis tool was developed by the talent identification program's nationally accredited coach (Table 1). Skills that were deemed as important in influencing the outcome of a match (based on subjective professional experience) were included in

the tool. The selected skills aimed to provide an overall quantification of the open-play and ruck characteristics of competitive junior match-play.

* Insert Table 1 around here *

Using the aforementioned tool, the frequency of skill involvements for each positional group was manually recorded using a notation system in a customized excel spreadsheet, During an offensive phase of play, it was possible for a participating player to receive an involvement for all of the following skills: ball carry, offensive miss, line break/line break assist. Alternatively, an isolated skill involvement may have occurred (e.g. a support run). Defensively, all players who were involved in a tackle effort received an involvement. For analysis purposes, skills were divided into: (a) *total offensive involvements*: sum of the number of ball carries, support runs, fast play the balls, offensive misses, line breaks and line break assists across the season; (b) *total defensive involvements*: the sum of the number of completed and not-completed tackles across the season; and (c) *overall involvements*: the sum of the seasonal involvements for offensive and defensive skills. To accommodate for the differences in the total seasonal playing duration of each positional group (mean ± SD; hit-up forwards = 228.8 ± 144.1 min; adjustables = 340.8 ± 187.4 min and outside backs = 366.4 ± 128.0 min), the number of involvements were expressed per minute of match-play.

Reliability of the performance analysis procedures

To determine the intra-rater reliability of the performance analysis procedures, the first half of 8 rugby league matches was analysed twice (Sirotic et al., 2009). Re-test

trials were conducted one month apart to decrease the retention of information and the affect of learning on the analysis procedures. A student's paired t-test revealed no significant ($p > 0.05$) variance between the re-test trials for all variables (Table 2). The precision of the skill analysis procedures was determined by the change in mean, technical error of measurement (TEM) and intraclass correlation coefficient (ICC) (Hopkins, 2002). The strength of the correlation coefficient was determined to be strong (offensive miss and line break) to very strong (ball carry, support run, line break assist, tackle completed and tackle not completed) for all variables (Table 2) (Dascombe, Reaburn, Sirotic, & Coutts, 2007).

Insert Table 2 around here

Statistical analysis

Data distribution was assessed for normality using the Kolmogorov-Smirnov test and further visually analyzed using histogram and box plots. After assuring that age was not a significant covariate, a Multivariate Analysis of Variance (MANOVA) was used to examine the effect of positional groups (hit-up forwards x adjustables x outside backs) on skill involvements (offensive x defensive x overall). Alpha (*P*) was set at < 0.05. Partial Eta Squared effect sizes were evaluated, with the magnitude of effect set as small (0.01), moderate (0.06) and strong (0.14) (Cohen, 1992). If significant main effects were identified, Bonferroni *post hoc* analyses were conducted for each playing position. All statistical analyses were conducted using SPSS software V22.0 (IBM Corporation, Somers, USA).

Results

1   The mean ± SD was calculated for all data. MANOVA revealed a significant

2   multivariate effect for playing position on skill involvements ($F = 9.06$; $P < 0.001$;

3   $ES = 0.41$). Strong univariate effects of playing position were evident for offensive

4   ($F = 6.67$; $P < 0.001$; $ES = 0.24$), defensive ($F = 29.57$; $P < 0.001$; $ES = 0.59$) and

5   overall ($F = 24.51$; $P < 0.001$; $ES = 0.54$) skill involvements. Pairwise comparisons

6   revealed that hit-up forwards performed a significantly greater number of offensive,

7   defensive and overall skill involvements when compared to all other positional

8   groups (Figure 2). Further, adjustables performed a significantly greater number of

9   defensive and overall involvements when compared to outside backs.

10

11   * Insert Figure 1 around here *

12

13   **Discussion**

14   Currently, no peer-reviewed research has documented the skill involvements of

15   different positional groups across multiple matches in a high performance junior

16   rugby league season. The results from this study demonstrate that hit-up forwards

17   perform the greatest number of offensive, defensive and overall skill involvements

18   across a season, when compared to adjustables and outside backs. In addition, the

19   adjustables display a significantly greater number of defensive and overall skill

20   involvements when compared to outside backs. These results can potentially have

21   important implications for the design of specific training methodologies, which

22   present players with the opportunity to perform game-specific skills in their

23   positional roles.

24

An interesting finding from the current study was that hit-up forwards performed the highest number of offensive skill involvements of all positional groups during a match. This is inconsistent with past research in professional players that has demonstrated that the fullback typically completes the greatest number of offensive skills (Sirotic et al., 2011). However, it is important to take into consideration that the current study classified the fullback as an outside back, whereas past research used a distinct group. Further, as the fullback is a highly specific position it could be put forward that a greater degree of variance would be observed between levels of competition (i.e. junior and senior). The observed finding may be the result of a higher number of ball carries in the hit-up forward positional group, which would have significantly influenced their offensive skill involvements (unpublished observations). However, future research investigating the frequency at which each positional group performs individual offensive skills in junior match-play is warranted to support this hypothesis. It is important to highlight that hit-up forwards generally display a higher work rate during match-play when compared to other positional group, albeit for a short period of time (Gabbett et al., 2012). It is therefore possible that as the hit-forwards are frequently interchanged their offensive involvements may have been over-represented. Overall, the outside backs displayed the lowest frequency of offensive skill involvements during competitive match-play. This may be a result of being situated on the fringe of play or their tactical roles within a match. Furthermore, with the lowest time in possession of the ball, a lower number of offensive skill opportunities is somewhat expected (Meir, Arthur, & Forrest, 1993).

1   During rugby league match-play, it is imperative that the defending team minimizes

2   points scored by opposing players. Consequently, defending players must endure

3   multiple physical collisions in an increasingly fatigued state (Gabbett, Jenkins, &

4   Abernethy, 2011a; Gabbett et al., 2012). Previous research by Waldron, Worsfold,

5   Twist, and Lamb (2014a) identified similar frequencies of defensive involvements

6   across different age groups of elite youth rugby league players. However, the

7   researchers highlighted that future investigations are required to document whether

8   position specific differences exist. The results from this study show that when

9   compared to adjustables and outside backs, the hit-up forward positional group

10   performed the greatest number of defensive involvements during a match. This

11   supports Sirotic et al. (2011), who observed similar results in professional rugby

12   league players across two NRL seasons. A possible explanation for this finding is

13   that hit-up forwards are traditionally characterized by a high body mass and

14   significantly greater muscular strength than other positions (Gabbett, Kelly, Ralph,

15   & Driscoll, 2009). Consequently, this positional group is utilized in the middle of the

16   field, to reduce the meters gained by an attacking player in possession of the ball.

17   Furthermore, their higher body mass assists in the development of momentum and

18   impact force to affect an opponent during a physical collision (Gabbett, Jenkins, &

19   Abernethy, 2011b). Interestingly, the adjustables also recorded a significantly greater

20   number of defensive involvements per minute of match-play than the outside backs.

21   This is possibly the result of dissimilarities in defensive positioning, with adjustables

22   located inside the outside backs. Furthermore, as the adjustable group is pivotal to

23   the success of a team offensively, opposing teams often target these players in

24   defence in order to develop a greater state of fatigue. However, future research is

1 required to examine the inter-positional differences in defensive skills in junior

2 rugby league players.

3

4 A novel aspect of this research is the investigation of the total skill involvements of

5 junior rugby league players over multiple matches. The results from this study

6 suggest that a player's positional group significantly influences their overall skill

7 involvements during match-play. Specifically, skill opportunities occur at a rate of

8 approximately once every minute, two minutes and four minutes for hit-up forwards,

9 adjustables and outside backs, respectively. These findings add to those of Waldron,

10 Worsfold, Twist, and Lamb (2014b) who suggested that youth rugby league players

11 have limited exposure to traditional "key" match skills. Collectively, a lack of

12 exposure may hamper a player's development of technical abilities under pressure

13 and fatigue, especially for the outside backs. Therefore, it is possibly that certain

14 positional groups may require an additional skill stimulus during training to ensure

15 they are adequately prepared for higher competitions, where the demands may be

16 greater. Future research in this area may aim to quantify the overall skill demands of

17 competitions under the same developmental pathway (i.e. the National Youth

18 Competition). In doing so, coaches will be able to determine which players are

19 suitable to meet the skill demands of higher competitions.

20

21 *Limitations*

22 The present study has some limitations that must be considered. Firstly, all players

23 were recruited from the same junior Australian representative team. It is likely that

24 the coaching philosophies of the staff overseeing this program influenced the

25 frequency of skill involvements. Further, the quality of opposition teams could not

be controlled. Consequently, variations in the dynamics of each match may have biased the observed findings. Importantly, the skills analyzed were restricted to those selected by the club's coaching staff. Therefore, it is important that further investigations examine the passing, play the ball and kicking dynamics of junior players along providing a more comprehensive analysis of defensive involvements (e.g. frequency of one-on-one, two-on-one and three-on-one tackles). Finally, it should be acknowledged that the grouping individual positions with distinct roles into a sub-category within a match might have influenced the observed results.

Practical Implications

The findings of this research have some implications for coaches, especially those within a high-level talent development setting. Practically, when designing training programs it is important to consider the overall skill stimuli placed on players. To ensure their adequate development, all players need to be provided with equal opportunity to participate. While discrepancies are evident between the skill involvements of different positional group during match-play, alternative training techniques can assist during training. For example, structured small-sided games (e.g. 'off-side touch) allow players to practice skills in a competitive setting, while not constraining their overall involvements to a positional group. Accordingly, this can assist the players who may experience a hampered skill development due to a lower frequency of involvements during match-play. Although, future research should examine what specific small-sided game methodologies are best suited for assisting in the development of player's technical abilities.

Conclusion

In conclusion, this study determined whether the skill involvements across a competitive junior rugby league season differed between three positional groups; hit-up forwards, adjustables and outside backs. The results of this study show that hit-up forwards perform a significantly greater number of offensive, defensive and overall skill involvements per minute of match-play, when compared to adjustables and outside backs. In addition, adjustables perform a significantly greater number of defensive and overall skill involvements when compared to outside backs. Information gained from this study can be used in the design of specific training methodologies for junior rugby league players participating in a high-level talent development program.

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11

1 **Tables**

2 Table I. The practical coach skill analysis tool used to code the skill involvements of

3 junior rugby league players during match-play.

Skill	Criteria
Offensive involvement	
Ball carry	An attacking player makes a genuine run (greater then two steps) with the ball in hand
Support run	An attacking player runs in support of the ball carrier and pushes through the defensive line
Offensive miss	An attacking player makes a defending player miss a genuine tackle using evasion skills
Line break	An attacking player breaks through the defensive line while in possession of the ball and makes an advancement towards the oppositions try line
Line break assist	An attacking player moves a defending player away from a support runner and delivers a pass that results in a line break
Defensive involvement	
Tackle completed	The defending player(s) makes physical contact with a ball carrier halting their progress and as a result, the ball carrier is required to play the ball
Tackle not-completed	The defending player(s) makes physical contact with a ball carrier, but fails to prevent an offload or the ball carrier is able to break free.

1 Table II. Intra-rater reliability of the skill involvement data between two trials of one

2 half of eight rugby league matches

	Δ mean	TEM	ICC (95% CI)
Offensive involvement			
Ball carry	0.002	0.053	0.98 (0.95-0.99)
Support run	0.006	0.077	0.86 (0.69-0.92)
Offensive miss	-0.004	0.061	0.71 (0.35-0.84)
Line break	0.000	0.007	0.86 (0.69-0.92)
Line break assist	0.000	0.000	1.00 (1.00-1.00)
Defensive involvement			
Tackle completed	0.003	0.064	1.00 (0.99-1.00)
Tackle not-completed	0.000	0.000	0.99 (0.98-0.99)

3

1 **Figure Captions**

2 Figure 1. The skill involvements ($n \cdot min^{-1}$) of hit-up forwards (n = 23), adjustables (n

3 = 9) and outside backs (n = 13) during junior representative rugby league match-

4 play. * denotes a significant difference from all other positional groups ($P < 0.05$). †

5 denotes a significant difference from outside backs ($P < 0.05$). $n \cdot min^{-1}$ = number per

6 minute.