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Citation:

Till, K and Cobley, S and Wattie, N and O'Hara, J and Cooke, CB and Chapman, C (2010) The prevalence, influential factors and mechanisms of relative age effects in UK Rugby League. *Scandinavian journal of medicine & science in sports*, 20 (2). 320 - 329. ISSN 0905-7188 DOI: <https://doi.org/10.1111/j.1600-0838.2009.00884.x>

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1 Running head: Relative Age Effects in Rugby League

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5 The Prevalence, Influential Factors and Mechanisms of Relative Age Effects

6 in UK Rugby League

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By

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25

1 Abstract

2 Relative Age Effects (RAEs), reflecting observed inequalities in participation and
3 attainment as a result of annual age-grouping policies in youth sport, are common in
4 most team sports. The aims of this study were to determine if and when RAEs become
5 apparent in Rugby League, determine how influential variables (e.g., gender) lead and
6 clarify whether player retention at junior representative levels can explain persistent
7 RAEs. Player data were collected for the male and female community game ranging
8 from Under 7s to Senior ($N=15,060$) levels, junior representative selections (i.e.,
9 Regional) and professional players ($N=298$). Chi-square analyses found significant
10 ($p<0.05$) uneven birth date distributions beginning at the earliest stages of the game
11 and throughout into senior professionals. In junior representative selections, 47.0% of
12 Regional and 55.7% of National representative players were born in Quartile 1, with
13 RAE risk increasing with performance level. Gender and nationality were also found
14 to moderate RAE risk. When tracking representative juniors, over 50% were retained
15 for similar competition the following season. Findings clearly demonstrate that RAEs
16 exist throughout Rugby League with early selection, performance level and retention
17 processes, appearing to be key contributing factors responsible for RAE persistence.

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25 | **Key words: Talent, ~~birth date~~rugby, age effects, gender, development, tracking.**
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1 Introduction

2 In youth sport, governing bodies organise participants into chronological age
3 groups (Barnsley et al. 1992; Musch and Grondin, 2001) using specific cut off date
4 criteria (e.g., 1st September in UK Rugby League). Whilst with honourable intentions,
5 this procedure allows within year chronological age differences between individuals
6 in an annual cohort to remain. This consequently leads to a sports participation and
7 selection inequality, known as Relative Age Effects (RAEs; see Musch & Grondin,
8 2001; Cobley et al. in press). Previous investigations in the popular sports of ice
9 hockey (e.g., Barnsley and Thompson, 1988; Boucher & Mutimer, 1994; Sherar et al.
10 2007), soccer (Helsen et al. 1998; Simmons & Paull, 2001), tennis (Edgar &
11 O'Donoghue, 2006) and basketball (Esteva et al. 2006) have identified significant
12 overrepresentations of players born in the first quartile (i.e., the three months after a
13 cut off date) of the selection year. However, not all contexts have been examined with
14 research in Rugby League limited to only one descriptive study. Abernethy & Farrow
15 (2005) examined relative age trends in a sample of senior Australian players,
16 establishing that 37% of professional and 40% of representative players were the
17 relatively oldest members of their respective annual age group cohorts. Thus, Rugby
18 League appears to be an appropriate context for further investigation.

19 Maturation differences have been stated as a primary cause of RAEs (Brewer
20 et al. 1995; Musch and Grondin, 2001), with the relatively older in junior years (i.e.,
21 11-16 years old) deemed more likely to have advanced physical and maturational
22 characteristics compared to relatively younger peers. It is established that physical
23 performance is related to biological maturation (e.g., Phillipaerts et al., 2006) and
24 specifically, greater height, strength and endurance are advantageous for sport
25 performance (e.g., soccer). Recently, advanced maturation relative to similar aged

1 peers was found to increase the likelihood of selection opportunities in youth ice
2 hockey (i.e., Sherar et al., 2007). However, Sherar and colleagues also identified that
3 the likelihood of RAEs increased alongside the level of selection, with higher
4 performance levels associated with coaches being more likely to select relatively older
5 players. The processes and consequences of selection have been previously associated
6 with RAE occurrence in junior sport and used to account for RAEs at the senior
7 professional level. For example, one mechanism suggests that selected relatively older
8 players are more likely to be prescribed higher quality training by higher skilled
9 coaches (Helsen et al. 1998); a factor often regarded as critical toward long term
10 sporting attainment (e.g., Baker and Horton, 2004). While access and benefits from
11 quality training are likely, other and related mechanisms may also account for RAEs
12 persisting into senior years. For example, player retention through repeated selection
13 may also account for RAE propagation in sports.

14 | Rugby League Football originated in the North of England in 1895, and is
15 | currently played at amateur (junior and senior) and professional levels worldwide.
16 | Professional teams and game popularity is most profound in Great Britain, France,
17 | Australia and New Zealand (Brewer & Davis, 1995; Meir et al., 2001). The game of
18 | Rugby League is similar to Rugby Union, in that the objective is to advance the ball
19 | into the opposition's territory and score a try (~~Gissane et al., 2002~~Gabbett, 2005a).
20 | However, the number of players, scoring system and continuity of play differ. For
21 | example, in Rugby League, teams consist of 13 players~~some basic game principles~~
22 | ~~differ from Rugby Union, in that teams consist of 13 players per side~~ with 4
23 | substitutes allowed to interchange a maximum of 12 times during the course of a
24 | professional 80 minute game (Gabbett, 2005a). A tackle is followed by a 'play the
25 | ball', involving the player rolling the ball backwards between their legs to a team

1 member, before the commencement of another attempt to score ‘a try’. When in
2 possession a team has six consecutive attempts (tackles) to score ‘a try’ (Gabbett,
3 2005a). In running toward the ‘try line’, the ball can only be passed backwards to
4 team members, nevertheless the ball can be kicked forward at any point. The ball is
5 normally kicked on the ‘sixth attempt’. On completion of six tackles (or the ball is
6 kicked) the defending team now obtains ball possession and likewise begins to attack.
7 The successive interchange of ball possession means players are required to attack
8 and defend throughout the game (Gabbett, 2005a).

9 The game demands of Rugby League are intermittent, with frequent bouts of
10 high intensity activity (sprinting, tackling) separated by short bouts of low intensity
11 activity (walking, jogging; Gabbett, 2005b). Due to this intermittent nature, players
12 require high physiological capacities of speed, strength, power, agility and aerobic
13 capacity (Meir et al., 2001). The physical demands required also vary according to
14 playing position (Clark, 2002). Players are generally grouped as ‘forwards’ (i.e.,
15 props, hooker, second row and loose forward) or ‘backs’ (i.e., fullback, wing, centre,
16 stand off and scrum half). ‘Forwards’ are generally involved in a large number of
17 physical collisions and tackles, whilst ‘backs’ spend more game time in free running
18 or ball handling (Gabbett, 2005a). Playing positions can also be classified into four
19 subgroups of ‘Outside Backs’ (i.e., fullback, wingers, centres), ‘Halves and Hookers’
20 (i.e., stand off, scrum half, hooker), ‘Props’ (i.e., prop) and ‘Backrowers’ (i.e., second
21 row, loose forward). ‘Halves and Hookers’ generally spend more time handling,
22 decision making and kicking than any of the other positions.

23 Like other physical contact team sports, UK Rugby League contains tiered
24 selection processes within its junior development structure making physical and
25 maturational characteristics valuable, but also likely to exacerbate RAE trends. Rugby

1 League therefore is an appropriate context in which to evaluate both RAE existence,
2 but also to further assess influential variables and causal mechanisms. The aims of the
3 present study can be considered in two parts. In Part 1, there were three aims. The first
4 aim was to assess the extent to which RAEs were prevalent across the developmental
5 and performance stages of male junior and senior Rugby League. Secondly, we
6 wanted to understand where RAEs first appeared to identify key influential processes;
7 and thirdly, we examined whether variables such as gender and performance level
8 contributed to RAE risk in Rugby League. The second part of our study aimed to
9 determine possible explanatory mechanisms accounting for RAE persistent year on
10 year in junior representation (i.e., Under 13-15 Regional and National levels). Using
11 existing data which tracked player selections for junior representative Rugby League,
12 we examined whether player re-selection, during and across junior age categories,
13 could be one viable explanation for the persistence of RAEs across Rugby League.

14

15

Methods

16 *Participants*

17 To assess the prevalence of RAEs in Rugby League a substantial data-set had
18 to be collected from different sources. The data set included participation and
19 selection information from the community game, junior representative and
20 professional levels.

21 Following local ethical approval, male and female local community
22 participation data ($N=15,060$) for the 2007-08 season was provided by the Rugby
23 Football League (RFL). This data, compiled by the RFL, included players registered
24 with local amateur clubs ($N=196$ clubs) governed by the RFL. Compiled data
25 included information pertaining to gender and birth date (and thus age) of junior male

1 players across the age categories of Under 7's - Under 18's ($N=14,390$) and female
2 players ($N=670$) registered at Under 12 ($n=47$), Under 14 ($n=188$), Under 16 ($n=174$)
3 and senior ($n=261$) age categories.

4 Within the junior structure of Rugby League, representative (i.e., higher
5 performance level) squads are selected. Representative squads in UK junior Rugby
6 League consist of local district, regional and national levels across particular age
7 categories. This data was provided directly by the RFL for Service Areas ($N=1,298$)
8 and National tournaments (i.e., National Carnival; $N=234$) at Under 13, Under 14 and
9 Under 15 age categories for the 2007 competitive season. Data relating to player
10 selections at Regional and National performance camps was directly collected through
11 a sports science support programme provided by Leeds Metropolitan University.
12 Player information was obtained from this data set for the Under 13, Under 14 and
13 Under 15 age categories for the 2005, 2006 and 2007 seasons.

14 To supplement participation and selection data across the developmental
15 structure of UK Rugby League, senior professional player data was also obtained.
16 Data related to current UK professional (Super League) players ($N=298$) for the 2008
17 season was obtained from the league official website (www.superleague.co.uk). Birth
18 date, nationality, Great Britain international representation and playing position
19 information were obtained for each senior professional player. Nationality was
20 classified as either British ($n=192$), French ($n=17$) or from the Southern Hemisphere
21 ($n=89$), while playing position was classified as either: 'Outside-Backs' ($n=56$),
22 'Halves and Hookers' ($n=41$), 'Props' ($n=47$) and 'Backrowers' ($n=48$).

23 *Developmental Stages in UK Rugby League*

24 To understand the possible mechanisms that lead to RAEs, it is important to
25 understand the developmental stages and structure of Rugby League within the UK.

1 Following participation at Under 16 level, players are then either selected to
2 move into the professional game or remain at a lower performance level of
3 involvement (i.e., community/amateur game). Community participation continues at
4 Under 17 and 18 levels, before moving into the senior adult game (i.e., without annual
5 age-groupings). At the Under 18 age category, selection cut-off dates change to the 1st
6 of January, which caters for Under 19 players from January. For development toward
7 the professional game, advanced players compete as part of a professional club's
8 junior (i.e., 16-18 years old) or senior club academy (i.e., Under 21; with some
9 accommodation for overage players allowed). Players are then selected for the senior
10 professional side in Super League, with each team consisting of a squad of
11 approximately 25 players.

12 *Measures*

13 *Part 1 & 2:*

14 To determine the existence of RAEs in UK Rugby League, player birth-dates
15 were firstly recoded to reflect their birth quartile (Q), according to the dates used for
16 creating annual-age groups. September 1st is used as the calendar start date for all age
17 categories and performance levels (except for the Under 18 community males and
18 Southern Hemisphere professional players where a 1st January cut-off date is applied).
19 Therefore, Q1 = birth-dates between September and November; Q2 = December-
20 February; Q3 = March-May; and Q4 = June-August. For Under 18 community level
21 males and Southern Hemisphere professional players, quartiles were adjusted
22 accordingly so that Q1 = January–March; Q2 = April-June; Q3 = July-September; and
23 Q4 = October-December. With player characteristics hypothesised as possible
24 moderators of RAE risk in Rugby League, players' attributes of gender, age category

1 and performance level were considered. Related to the professional sample, the
2 potential influences of nationality and playing position were also considered.

3 *Data Analysis*

4 *Part 1*

5 To analyse the prevalence of RAEs across the junior and senior male game,
6 SPSS Version 15.0 for Windows was used to perform both Chi-square and Odds
7 Ratio (risk) analyses on all player data. Chi-square analyses assessed quartile
8 asymmetry (significance set at $p < 0.05$), while logistic regression analyses determined
9 the risk size of RAEs. Most previous investigations examining RAEs have used chi-
10 square tests (e.g., Brewer et al. 1995; Sherar and Bruner, 2007; Simmons and Paull,
11 2001) to compare observed quartile frequency count and that of an expected (and
12 often equal) distribution. To improve the accuracy of this assumption, the present
13 analysis made direct comparisons against national (UK) birth population distributions
14 (Office for National Statistics, 2008) for each year, corresponding to participant age
15 categories. For example, Under 7 players in the competitive season of 2007 were
16 compared with the distribution of national births between September 2000 and August
17 2001. For senior men and women, birth dates were compared with the UK
18 distributions between the years corresponding to the oldest and youngest players
19 respectively (e.g., oldest senior male birth-date = 10/03/1973, while the youngest
20 senior male = 08/07/1990). A summary of the UK national birth distributions used for
21 each age category is detailed in Table 1.

22 *Insert Table 1 about here*

23 Odds ratios (OR) and 95% Confidence Intervals (CI) were calculated by
24 comparing quartiles (e.g., Q1 vs Q4, Q2 vs Q4, Q3 vs Q4) and half year distributions
25 (H1 vs H2). During such comparisons, Quartile 4 and the second 6 month categories

1 were used continuously as the referent group. These procedures of data analysis are
2 effective in showing participation inequalities and the risk size of RAEs (Cobley et al.
3 in press). These tests were used to identify where RAEs became established. To
4 evaluate whether other variables (e.g., gender) moderated RAE risk, these analysis
5 procedures were repeated on the female community players, junior representative
6 (i.e., Service Area, Regional, etc.), British and Southern Hemisphere professional
7 levels, with further consideration of playing position in the professional player
8 sample.

9 *Part 2*

10 To assess whether player retention in selection was a possible mechanism
11 accounting for persistent RAEs, the representative data for a junior cohort of male
12 players was examined (i.e., Under 13 – Under 15s). The analysis conducted was
13 descriptive and included calculating the percentage (and number) of players that were
14 repeatedly selected at Regional and National representative levels. Birth date
15 distributions of players selected for the competitive seasons 2005, 2006 and 2007
16 were then examined using similar procedures as applied in Part 1. The distributions
17 of both retained players (i.e., those selected again from a previous competitive season)
18 and new players (i.e., players not selected the previous year) were also examined, with
19 comparisons made against the quartile distribution of players selected for
20 representative teams the previous competitive season.

21

22

Results

23 *Part 1: Prevalence of RAEs Across Male Rugby League*

24 Table 2 shows the quartile distributions, Chi-square (χ^2), Odds Ratios (OR)
25 and 95% Confidence Intervals (CI) analysis for all male community, junior

1 representative and professional players when directly compared against UK national
2 birth distributions for each respective year. Results identify that a general significant
3 participation inequality exists, considerate of cut-off dates used for annual-age
4 grouping in the junior and senior structures of male Rugby League.

5 *Insert Table 2 about here.*

6 Chi-square analyses found significant uneven birth date distributions in male
7 community Under 7 to Under 18 age categories (except Under 8s; $\chi^2 = 5.76, p=0.124$).
8 Significant uneven distributions also occurred in senior professional players at Super
9 League ($\chi^2 = 8.26, p=0.041$) and international (i.e., Great Britian squad; $\chi^2 = 13.21,$
10 $p=0.004$) levels. However, significant odds ratios were only found at the Under 7
11 level for Quartile 1 v Quartile 4 (Q1 vs Q4 OR: 2.28, 95% CI: 1.04-5.05) and half
12 year comparisons (H1 vs H2 OR: 1.80, 95% CI: 1.02-3.17). The results identified that
13 RAEs were prevalent across male Rugby League starting as young as Under 7 level.

14 *Junior Representative Selections*

15 Table 2 identifies significant (i.e., $p<0.001$) uneven distributions for all
16 representative levels of junior Rugby League, except at the Under 14 National Camp
17 selection ($\chi^2 = 7.547, p=0.056$), when compared against the UK national birth
18 distributions. Odds ratios analyses identified significant risk of RAEs in the
19 comparisons between Quartile 1 and 4; Quartile 2 and 4 and half year distributions at
20 each selection level (i.e., Service Area to National Camp) and at each age group (i.e.,
21 Under 13 to Under 15). Figure 2 summarises the quartile distributions of junior Rugby
22 League players by combining the Under 13-15 age groups and by categorising
23 according to performance level.

24 *Insert Figure 2 about here.*

25 *Female Players*

1 No significant uneven distributions were found for female players at Under 14,
2 16 and senior levels with odds ratios analyses identifying no significant risk of RAEs
3 in the female sample for any age group. However, a significant and surprising uneven
4 distribution was found for the Under 12 age category ($\chi^2 = 7.863, p=0.049$) with
5 71.2% of players born in the second half of the selection year (March to August).

6 *Influence of Nationality & Playing Position at the Professional Level*

7 When players were categorised according to birth origin, with corresponding
8 annual-age grouping dates applied, uneven distributions occurred (i.e., British players
9 $\chi^2 = 23.39, p<0.001$; Southern Hemisphere players $\chi^2 = 10.41, p=0.015$). Odds ratios
10 analysis identified similar significant RAE risks for British professional players (Q1
11 vs Q4 OR: 2.59, 95% CI: 1.15-5.83) and Great Britain International players (Q1 vs
12 Q4 OR: 3.00, 95% CI: 1.36-6.61; H1 vs H2 OR: 1.99, 95% CI: 1.13-3.52).

13 Table 3 shows the percentage distribution according to quartile, chi-square and
14 odds ratio results for British professional players according to their designated playing
15 position. When considering playing position, chi-squares identified significantly
16 deviated distributions for 'Outside-backs' ($\chi^2 = 9.51, p=0.023$) and 'Backrowers' ($\chi^2 =$
17 $15.55, p=0.001$). Odds ratios identified greater likelihoods of relatively older
18 professional players in the positions of 'Halves & Hookers' (H1 vs H2 OR: 1.83, 95%
19 CI: 1.04-3.23) and for 'Backrowers' (i.e., Q1 vs Q4 OR: 10.42, 95% CI: 3.30-32.89;
20 Q2 vs Q4 OR: 5.19, 95% CI: 1.58-17.05).

21 *Insert Table 3 about here.*

22 *Part 2: Player retention in junior representative Rugby League*

23 Figure 3 illustrates the percentage (and number) of players retained or not
24 selected again at Regional and National levels for the Under 13 - Under 15 age
25 categories for the 2005-2007 competitive seasons. The figure shows that over 50% of

1 players are successfully retained in the selection system each year for Regional and
2 National level selections. As important, it seems 36.8% (Under 13s to Under 14s) and
3 39.6% (Under 14s to Under 15s) of players are not selected for subsequent
4 competitive seasons. This suggests the possibility of player retention is generally
5 evenly matched with the possibility of new players being selected in subsequent years.

6 *Insert Figure 3 about here*

7 Table 4 represents the birth date distribution of players selected at Regional
8 and National representative levels. Further, it examines the quartile distributions of
9 players retained and new selections that entered the junior representative development
10 pathway during 2005-2007. Results illustrate consistent selections in that players both
11 retained and newly selected reported a similar skewed birth date distribution to the
12 players originally selected in the previous competitive season. Again this favours the
13 selection of relatively older players within the annual cohort of players.

14 *Insert Table 4 about here.*

15

16 Discussion

17 Whilst RAEs can be expected in a physical contact sport such as Rugby
18 League, only limited data examining Australian professional players exists
19 (Abernethy and Farrow, 2005). The aims of this study were to determine if and when
20 RAEs became apparent across Rugby League; examine potential influencing variables
21 (e.g., performance level) and examine player retention at junior representative levels
22 to possibly explain persistent RAEs.

23 Findings demonstrated that RAEs were evident in male junior and senior
24 Rugby League; consistent with findings in other team sport contexts such as ice
25 hockey (Boucher & Mutimer, 1994; Sherar et al., 2007) and soccer (Helsen et al.

1 1998; Simmons & Paull, 2001). Chi square analyses showed significant frequency
2 deviations from expected distributions across the male junior and senior game.
3 Further, odds ratio analyses showed that the risk of RAE inequalities increased as the
4 number of months away from the referent groups (Quartile 4 / 2nd half of selection
5 year) also increased, similar to the meta-analytical findings reported by Cobley, et al.,
6 (in press). More substantial however, was the finding that RAEs increased with each
7 and every performance level, where selection for a smaller number of places on a
8 representative squad occurred.

9 In male junior competitive sports, such as ice-hockey and soccer,
10 chronological age grouping provides an advantage to boys born earlier in the selection
11 year (Vaeyens et al. 2005), resulting in consistent participation and attainment
12 inequalities (Barnsley and Thompson, 1988; Helsen et al. 2000). Similar participation
13 disparities were apparent in the present sample from the very earliest stages of the
14 community game, notably the Under 7 age category. These findings resonate with
15 Helsen et al.'s (2000) analysis of soccer, who identified RAEs as young as 6 and 8,
16 with the relatively older more likely to be labelled as talented. Collectively, these
17 findings suggest developmental advantages (e.g., greater height and body mass)
18 provide performance advantages in the game context, potentially explaining why
19 participation inequalities become manifest so early in competitive sport.

20 Based on their meta-analysis, Cobley et al. (in press) suggest that RAE risk is
21 inflated during mid to late adolescence (i.e., 14 to 18 years) and when representative
22 levels of competition (i.e., national representation) occur. To date, and with notable
23 recent exceptions (e.g., Sherar et al. 2007), few studies have been able to assess these
24 propositions. However, findings from the present study, examining the structured
25 developmental pathway across Rugby League, do demonstrate an increased risk of

1 RAEs when selection steps and performance levels increase, which become an
2 integral aspect of the game from the Under 13 category onwards. These findings
3 emphasise how processes associated with player performance evaluation, assessment
4 and selection are also likely to be a key causal mechanism leading to the heightened
5 RAE inequalities.

6 Numerous previous studies (e.g., Brewer et al. 1995; Musch and Grondin,
7 2001) suggest maturational differences as the primary cause for RAEs, especially at
8 the time period associated with puberty. During this period, one year chronological
9 age differences can be substantial (Musch and Grondin, 2001), leading to greater
10 variability in physical attributes such as height, body mass, speed and strength
11 (Malina, 1994; Malina et al. 2004). As performance demands of Rugby League
12 advantage players with exceptional high physiological capacities (Meir, 1994; Meir
13 et al. 2001), it is perhaps not surprising that increased selection opportunities exist for
14 the relatively older athlete. However, early identification and selection could permit a
15 more long-term attainment advantage, as this has been suggested to increase an
16 individuals chance of selection in subsequent competitive seasons (Simmons and
17 Paull, 2001) and possibly be retained within a development system. Likewise, Dudink
18 (1994) adds that this may permit an increased likelihood to access advanced quality
19 training and gain more beneficial experiences obtained from advanced competition.
20 Whilst, our data indicated that over half of the tracked players are retained across age
21 categories at representative levels, results also identified that RAE risk tapers at the
22 adult professional stage, when compared to RAE risk in representative junior players;
23 a trend also consistent across previous sports examined (Cobley et al. in press). There
24 may be several possible reasons for this trend, relating to the removal of maturation as
25 an influential variable, greater likelihood of injury and withdrawal in the relatively

1 older players. Nonetheless, such reasons remain speculative until investigations
2 examine this trend in more detail.

3 Gender was examined as a potential moderator of the RAE as little is known
4 about the effect of gender on RAEs in sport. No RAEs were identified in female
5 community level players at the Under 14, 16 and senior players. However, an uneven
6 distribution favouring participation for the relatively younger player was identified in
7 the Under 12 age category. A possible explanation for this uneven distribution may
8 be the onset of puberty occurring at approximately 12 years of age in girls. Therefore
9 the relatively younger player would be less likely to have started menstruation with
10 girls opting out of physical competition until regular menstruation has occurred.
11 Overall, the general pattern of female data provides no evidence for RAEs, so gender
12 does therefore act as a moderator variable. The discrepancy between gender remains
13 unclear, however it has been suggested that the depth of participation and intensity of
14 selection and competition between the male and female game may be accountable
15 (Vincent and Glasmer, 2006; Wattie et al. 2007). This is evident in the current study
16 when the male (N=14,390) and female (n=670) sample sizes are compared.

17 Player nationality was examined in professional Rugby League due to the
18 large number of overseas players (n=106) contracted with clubs in the UK Super
19 League. RAEs were evident in British and overseas players, considerate of the
20 alternative dates used for annual age-groupings in respective development systems.
21 Similar to Abernethy and Farrow (2005) who found that 37% of Australian
22 professional Rugby League and 40% of representative level players were the
23 relatively oldest (i.e., January to March born), 38.1% of British and 48.9% of British
24 international professionals were the relatively oldest (i.e., Quartile 1). Specific, to

1 Southern Hemisphere international players, 38.2% of players born were Quartile 1
2 categorised. Thus, nationality acts a potential moderator for RAE.

3 The potential influence of playing position on RAEs has rarely been examined
4 in previous studies (e.g., Edwards, 1994; Schorer et al. in review). For the present
5 study, players were classified into four subgroups of positions, 'Outside backs',
6 'Halves and Hookers', 'Prop' and 'Backrowers'. Significant uneven distributions
7 were found for 'Outside backs' ($\chi^2 = 9.51$, $p < 0.05$) and 'Backrowers' ($\chi^2 = 15.55$,
8 $p < 0.005$) for British professional players, with sample size limitations possibly
9 preventing associations to be made with remaining positions. Considering these
10 observations, it is difficult to accurately determine whether playing position acts a
11 moderator of RAEs in senior Rugby League players. Although the backrow position
12 require size and strength and are involved heavily in the physical aspects of ball
13 carrying and tackling, the 'Props' position also possess similar qualities. Further
14 assessments at the junior and representative levels may provide the necessary data and
15 evidence to make a better assessment of RAE variations according to playing position
16 and associated performance demands.

17 Research on longitudinal tracking of players in sport development systems is
18 generally limited, and certainly not evident in previous RAE literature. In this study,
19 the tracking of player selections across a three year period at the Under 13-15
20 category was done to determine if player retention was a possible mechanism
21 explaining consistent RAEs across youth sport, as observations are often made based
22 on repeated cross-sectional data. Findings show that over 50% of players were
23 retained each year, demonstrating a probable selection advantage or preference for
24 subsequent competitive seasons. Likewise though, a significant minority were not
25 selected again with varied reasons possible. These findings do on the one hand

1 demonstrate a possible bias in player retention, but also show that opportunities do
2 exist for players to still enter the representative levels of performance. Nonetheless, it
3 remained more likely that those entering the representative level after the Under 13
4 age category were relatively older; with probable preferred physical characteristics
5 which underpin performance requirements for Rugby League. Thus, at the junior
6 representative level, despite some degree of change in squad composition, RAE biases
7 remain consistent from year to year due to both retention and selection of relatively
8 older athletes.

9 | Perspectives 10

11 The present study identifies that relatively older males, in all tiers of Rugby
12 League (i.e., junior participation, junior representative and senior professional) have a
13 greater likelihood of participation and selection than their relatively younger peers,
14 commencing at the earliest stages of the game. Risk of RAEs increased with each
15 performance level (i.e., from community to National levels), where selection for a
16 smaller number of places on a representative squad occurred. This suggests that
17 present coaching practices, without direct awareness or probable intention, bias
18 selection toward relatively older players, possibly as the result of physical and
19 cognitive variability within annual age-cohorts. Gender and nationality were both
20 found to moderate RAEs, while an influence for playing position is also probable. The
21 retention of players in representative samples and their repeated selection during
22 adolescence are likely reasons accounting for maintained and inflated RAE risks in
23 junior sport.

1 Acknowledgements

2 The authors would like to thank the Rugby Football League (RFL), especially Chris
3 Chapman without whom these studies would not have been possible.

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1 Table 1: UK birth-distributions according to quartile, matching participants in the
 2 sample.

Age Group	Relevant Dates for Sample Matching	% in Quartile (Q1)	% in Quartile (Q2)	% in Quartile (Q3)	% in Quartile (Q4)
Under 7s	Sept 2000 - Aug 2001	25.30	24.33	24.96	25.41
Under 8s	Sept 1999 - Aug 2000	25.22	24.48	24.94	25.35
Under9s	Sept 1998 - Aug 1999	25.34	23.97	25.12	25.57
Under 10s	Sept 1997 - Aug 1998	24.76	24.43	25.02	25.79
Under 11s	Sept 1996 - Aug 1997	25.47	24.22	25.03	25.28
Under 12s	Sept 1995 - Aug 1996	25.18	24.17	24.58	26.07
Under 13s	Sept 1994 - Aug 1995	25.11	23.96	25.19	25.74
Under 14s	Sept 1993 - Aug 1994	25.06	24.14	25.51	25.29
Under 15s	Sept 1992 - Aug 1993	25.04	23.79	25.15	26.01
Under 16s	Sept 1991 - Aug 1992	24.85	24.38	25.20	25.57
Under 17s	Sept 1990 - Aug 1991	25.24	24.13	24.88	25.75
Under 18s	Dec 1989 - Aug 1990	24.17	25.75	25.92	24.16
Male Senior	Sept 1972 - Aug 1990	24.65	23.90	25.78	25.68
Female Senior	Sept 1952 - Aug 1991	24.24	24.20	26.19	25.37

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1 Table 2: Relative age effects according to age-group and performance level in UK Rugby League.

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Age Group	Skill Level	N	%Q1	%Q2	Q3%	Q4%	χ^2	<i>P</i>	OR (CI) Q1vQ4	OR (CI) Q2vQ4	OR (CI) Q3vQ4	OR (CI) H1vH2
Under 7s	Community	316	38.92	25.00	18.99	17.09	36.36	<0.001	2.28 (1.04-5.05)	1.53 (0.67-3.50)	1.13 (0.48-2.66)	1.80 (1.02-3.17)
Under 8s	Community	468	27.78	27.14	23.72	21.37	5.75	0.124	1.31 (0.59-2.88)	1.31 (0.59-2.91)	1.13 (0.50-2.52)	1.23 (0.71-2.15)
Under 9s	Community	771	33.07	21.92	21.66	23.35	22.50	<0.001	1.43 (0.67-3.07)	1.00 (0.45-2.24)	0.94 (0.42-2.11)	1.26 (0.72-2.19)
Under 10s	Community	1311	27.88	27.57	23.17	22.63	16.69	0.001	1.28 (0.59-2.81)	1.29 (0.59-2.82)	1.06 (0.47-2.35)	1.29 (0.74-2.24)
Under 11s	Community	1305	27.82	26.82	22.38	22.99	12.82	0.005	1.20 (0.55-2.62)	1.16 (0.53-2.53)	0.98 (0.44-2.19)	1.22 (0.70-2.13)
Under 12s	Community	1251	28.54	25.10	22.22	24.14	10.65	0.014	1.12 (0.59-2.10)	1.08 (0.49-2.35)	0.98 (0.44-2.17)	1.19 (0.68-2.07)
Under 13s	Community	1469	28.18	24.57	24.71	22.53	11.74	0.008	1.28 (0.59-2.80)	1.17 (0.53-2.60)	1.12 (0.51-2.48)	1.16 (0.67-2.02)
	Service Area	425	43.53	26.59	18.59	11.29	100.52	<0.001	4.06 (1.73-9.56)	2.47 (1.01-6.02)	1.63 (0.65-4.10)	2.67 (1.48-4.80)
	Regional	138	52.17	26.81	15.22	5.80	67.49	<0.001	9.08 (3.27-25.18)	4.84 (1.68-13.93)	2.60 (0.86-7.84)	3.88 (2.09-7.22)
	Nat. Carnival	75	62.67	25.33	10.67	1.33	66.72	<0.001	47.55 (7.83-288.9)	19.95 (3.20-124.5)	7.95 (1.21-52.35)	7.57 (3.69-15.55)
	National Camp	40	60.00	27.50	10.00	2.50	31.68	<0.001	24.22 (6.09-96.32)	11.52 (2.81-47.19)	3.97 (0.89-17.61)	7.23 (3.55-14.71)
Under 14s	Community	1428	31.09	25.77	23.18	19.96	41.37	<0.001	1.57 (0.71-3.46)	1.35 (0.60-3.03)	1.15 (0.51-2.60)	1.36 (0.78-2.38)
	Service Area	435	33.33	31.72	21.61	13.33	49.44	<0.001	2.59 (1.12-6.01)	2.60 (1.11-6.07)	1.68 (0.70-4.02)	1.95 (1.11-3.44)
	Regional	139	44.60	29.50	17.99	7.91	42.52	<0.001	5.86 (2.30-14.91)	4.08 (1.56-10.67)	2.35 (0.87-6.39)	3.00 (1.65-5.44)
	Nat. Carnival	80	46.25	30.00	15.00	8.75	27.62	<0.001	5.49 (2.22-13.60)	3.75 (1.47-9.56)	1.77 (0.65-4.81)	3.36 (1.84-6.16)
	National Camp	24	45.83	29.17	12.50	12.50	7.54	0.056	3.81 (1.66-8.75)	2.55 (1.07-6.06)	1.03 (0.40-2.69)	3.14 (1.73-5.72)
Under 15s	Community	1932	28.47	26.71	24.28	20.55	38.71	<0.001	1.44 (0.65-3.17)	1.42 (0.64-3.16)	1.22 (0.55-2.73)	1.29 (0.74-2.24)
	Service Area	438	43.38	24.66	19.41	12.56	95.13	<0.001	3.55 (1.54-8.20)	2.06 (0.86-4.95)	1.57 (0.64-3.85)	2.20 (1.24-3.90)
	Regional	140	44.29	28.57	15.71	11.43	38.43	<0.001	3.99 (1.70-9.36)	2.62 (1.08-6.33)	1.39 (0.54-3.57)	2.77 (1.53-4.99)
	Nat. Carnival	79	45.57	26.58	16.46	11.39	22.42	<0.001	4.12 (1.76-9.65)	2.45 (1.01-5.95)	1.47 (0.58-3.73)	2.67 (1.49-4.81)
	National Camp	24	58.33	29.17	4.17	8.33	18.01	<0.001	7.21 (2.89-17.94)	3.67 (1.42-9.49)	0.51 (0.14-1.86)	7.22 (3.55-14.69)

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1 Table 2: *continued.*

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Age Group	Skill Level	N	%Q1	%Q2	Q3%	Q4%	χ^2	<i>P</i>	OR (CI) Q1vQ4	OR (CI) Q2vQ4	OR (CI) Q3vQ4	OR (CI) H1vH2
Under 16s	Community	1884	30.89	25.96	23.41	19.75	56.96	<0.001	1.61 (0.73-3.55)	1.38 (0.62-3.09)	1.20 (0.53-2.71)	1.36 (0.78-2.37)
Under 17s	Community	1244	31.59	24.68	21.62	22.11	31.14	<0.001	1.46 (0.67-3.16)	1.19 (0.54-2.65)	1.01 (0.45-2.27)	1.33 (0.76-2.31)
Under 18s	Community	1011	28.39	26.71	26.21	18.69	20.19	<0.001	1.52 (0.67-3.42)	1.35 (0.60-3.02)	1.31 (0.58-2.94)	1.23 (0.71-2.15)
Senior	Super League	297	28.62	26.60	25.93	18.86	8.26	0.041	1.58 (0.71-3.53)	1.48 (0.66-3.33)	1.34 (0.60-3.01)	1.30 (0.75-2.28)
	British	192	38.1	21.16	25.40	15.34	23.29	<0.001	2.59 (1.15-5.83)	1.45 (0.61-3.42)	1.62 (0.70-3.73)	1.54 (0.88-2.69)
	Professional											
	S. Hemisphere	89	38.2	19.11	21.35	21.35	10.40	0.015	1.79 (0.83-3.85)	0.90 (0.39-2.05)	1.00 (0.44-2.26)	1.34 (0.77-2.34)
Professional	Great Britain	49	48.94	18.37	18.37	16.33	13.20	0.004	3.00 (1.36-6.61)	1.18 (0.50-2.81)	1.10 (0.46-2.60)	1.99 (1.13-3.52)
	International											

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4 N = Total in sample; Q = Quartile; OR = Odd Ratio calculation; CI = Confidence Interval calculation; H = Half-year (i.e., 6 months)

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1 Table 3: Relative Age Effects of British Super-League Professionals (2008 season) according to playing position category.

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Position	N	%Q1	%Q2	Q3%	Q4%	χ^2	<i>P</i>	OR (CI) Q1vQ4	OR (CI) Q2vQ4	OR (CI) Q3vQ4	OR (CI) H1vH2
'Outside Backs'	56	39.29	10.71	28.57	21.43	9.51	0.023	1.91 (0.89-4.11)	0.52 (0.21-1.32)	1.30 (0.60-2.85)	1.06 (0.61-1.84)
'Halves & Hookers'	41	39.02	24.39	17.01	19.51	5.25	0.155	2.08 (0.96-4.54)	1.31 (0.59-2.96)	0.85 (0.37-2.00)	1.83 (1.04-3.23)
'Props'	47	34.04	27.66	21.28	17.02	3.70	0.296	2.08 (0.93-4.66)	1.70 (0.75-3.87)	1.22 (0.33-2.83)	1.70 (0.97-2.99)
'Backrowers'	48	41.67	20.83	33.33	4.17	15.55	0.001	10.42 (3.30-32.89)	5.19 (1.58-17.05)	7.81 (2.46-24.79)	1.76 (1.00-3.10)

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5 N = Total in sample; Q = Quartile; OR = Odd Ratio calculation; CI = Confidence Interval calculation; H = Half-year (i.e., 6 months)

1 Table 4. Birth date distributions of retained and new Regional and National players between
 2 Under 13 and Under 15 age categories

		U13s	Retained U14s	New U14s	U14s	Retained U15s	New U15s	U15s
Regional	N	95	54	47	101	58	42	100
	% Q1	45.3	46.3	55.3	50.5	48.3	52.4	50.0
	% Q2	25.3	25.9	21.3	23.8	27.6	28.6	28.0
	% Q3	21.1	18.5	17.0	17.8	15.5	9.5	13.0
	% Q4	8.4	9.3	6.4	7.9	8.6	9.5	9.0
National	N	41	16	8	24	14	10	24
	% Q1	56.1	62.5	87.5	70.8	64.3	50.0	58.3
	% Q2	31.7	25.0	12.5	20.8	21.4	40.0	29.2
	% Q3	9.8	6.25	0	4.2	7.15	0.0	4.2
	% Q4	2.4	6.25	0	4.2	7.15	10.0	8.3

3

Figures Captions

1

2 *Figure 1:* An overall model describing the developmental structure in UK Rugby League.

3 *Figure 2:* Quartile distributions of junior rugby players in the Under 13-15 categories

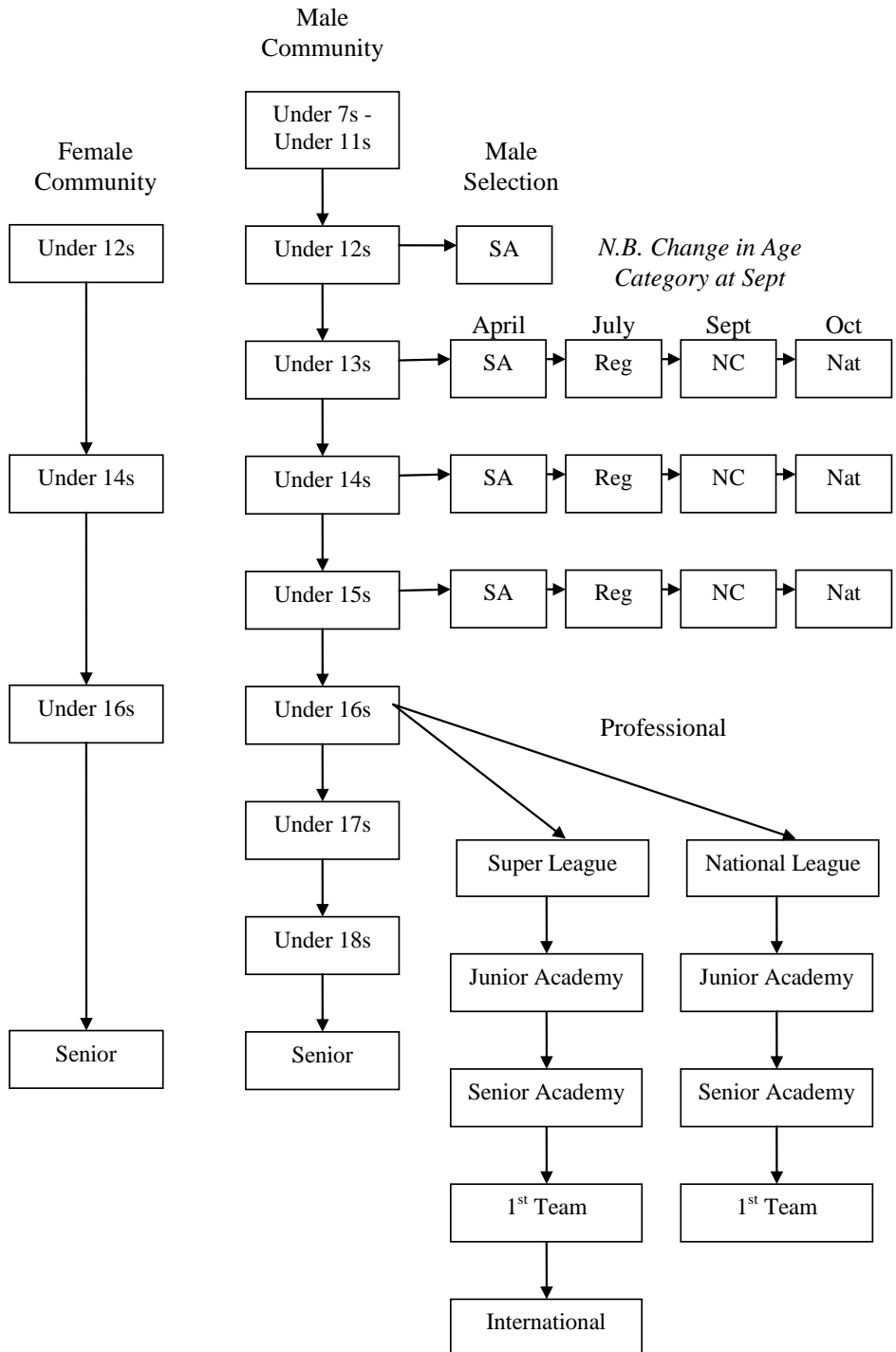
4 (combined) according to performance level.

5 *Figure 3.* Players retained for Regional and National levels between Under 13 and Under 15

6 from 2005 and 2007

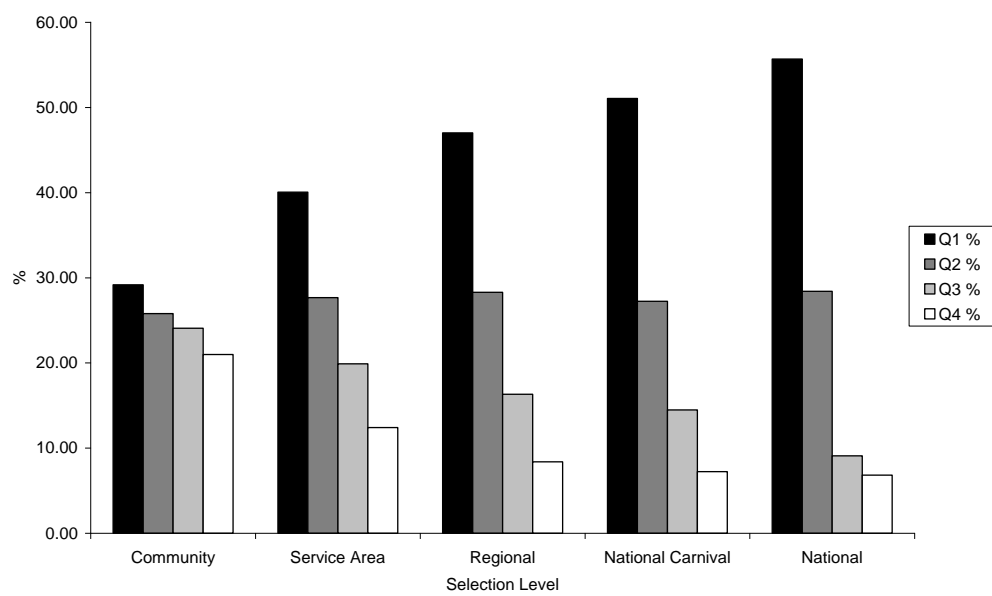
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1 Figure 1: An overall model describing the developmental structure in UK Rugby League.



2
3 SA = Service Area; Reg = Regional; NC = National Carnival; Nat = National Camp.

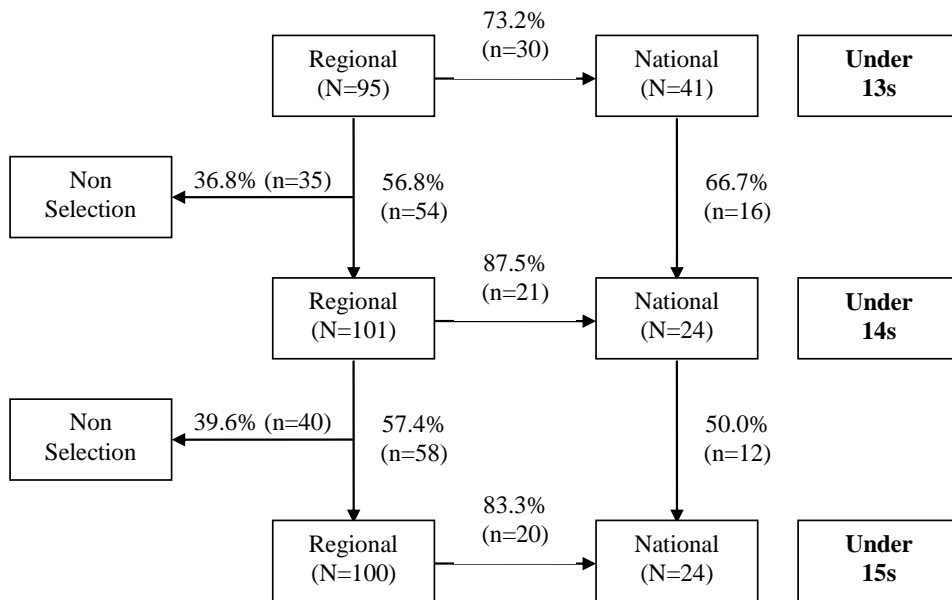
1 Figure 2: Quartile distributions of junior rugby league players in the Under 13-15 categories
2 (combined) according to performance level.



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1 Figure 3. Players retained for Regional and National levels between Under 13 and Under 15
 2 from 2005 and 2007



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