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Pathway Efficiency and Relative Age in the Australian Football League Talent Pathway

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Abstract: Sporting bodies invest substantial resources into the identification and development of talented junior athletes. However, low retention of junior athletes into senior competition has been reported. One mechanism affecting retention may be selections biased by relative age. This study examined the pathway involvement and birth distribution of athletes (n=2519) selected into the Australian Football League Talent Pathway, over six seasons. Only half of athletes selected into professional teams had any involvement in the talent pathway. Birth distributions at every pathway stage were biased towards relatively older athletes, with relatively older athletes more likely to be de-selected as the pathway progressed. Results from this study found a relationship between poor efficiency of the development pathway and relative age effects. Prospective analyses are required to establish mechanisms of pathway inefficiencies in order to improve return on investment made into developing the professional athletes of the future.

Keywords:
athlete retention, talent identification, talent pathways, maturation, relative age effects

Introduction

Selection and development of talented, upcoming generations of junior athletes is of great importance for the ever-increasing professionalism of elite sport (Vaeyens, Lenoir, Williams, & Philippaerts, 2008). Talent identification programs aim to ensure selection of talented junior athletes into development pathways in order to accelerate development towards their sporting potential (Ericsson, Krampe, & Tesch-Römer, 1993; Ford et al., 2011; Williams & Reilly, 2000). Development pathways provide selected athletes developmental advantages due to greater access to experienced coaches, training resources and competition levels (Helsen, Starkes, & Van Winckel, 1998). However, there is limited longitudinal evidence that suggests that development pathways are an efficient means of producing elite adult athletes (Vaeyens, Gullich, Warr, & Philippaerts, 2009).

Substantial financial and human resources are invested into the identification and subsequent development of talented junior athletes (Williams & Reilly, 2000). However, low retention of junior athletes into professional, senior competition represents significant inefficiencies within development pathways (Barreiros, Côté, & Fonseca, 2012; McCarthy & Collins, 2014). The retention of athletes progressing from junior development pathways has ranged from 28.1-55.6% (Barreiros, Côté, & Fonseca, 2012; McCarthy & Collins, 2014). However, this definition of retention can be misleading as junior squads are typically larger than senior squads and therefore 100% retention is often not possible. Conversely, Barreiros and Fonseca (2012) explored the developmental efficiency of Portuguese national soccer and volleyball teams and found

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that only 38% of national representatives were previously involved in elite pre-junior competitions. These studies provide the first insights into athlete retention in development pathways, however they are restricted to participation in national squads, which only represent a small percentage of a sporting code's talent population. Considering that high financial and human resourcing costs are associated with providing elite athlete development pathways, the poor pathway retention previously documented (Barreiros, Côté, & Fonseca, 2012; Barreiros & Fonseca, 2012; McCarthy & Collins, 2014) represents a significant waste of investment made by the sporting codes. Low retention further highlights that a substantial proportion of elite athletes develop the required skillset to compete at a professional level outside development pathways in subsidiary competitions. Wholesale examination of elite development pathways across entire sporting codes is needed to provide greater scope to previous findings and to highlight problems which affect the efficiency of talent development pathways.

Australian Football is a unique blend of international football codes, such as rugby and soccer, however, it is only played professionally in Australia. The Australian Football League Talent Pathway (AFL TP) is the primary development pathway for talented junior Australian Football players to progress into the Australian Football League (AFL) (see figure 1). The AFL TP is conducted alongside the subsidiary state league competitions. The AFL funds the state representative teams, which comprise the AFL TP and compete at a national level. The AFL funding provides athletes in the AFL TP with greater access to training resources, and the opportunity to train under the tutelage of more experienced coaches. This approach theoretically accelerates athlete development when selected to the AFL TP. The AFL TP has two underage selection stages and a draft. The underage stages are structured similar to other major football codes for example, England's Rugby League's development pathway (Till et al., 2010). Here, representative coaches select players from regional competitions to represent their region at age-restricted (under 16s [U16s] and under 18s [U18s]) national championships. In the AFL TP, the draft is similar to that of American Basketball and American Football, where athletes are selected from semi-professional, or underage competitions into the professional clubs. Athletes can be selected into the AFL TP at any stage of the pathway. That is, involvement in prior stages of the AFL TP is not a prerequisite for inclusion into subsequent stages. This attribute of the AFL TP allows a flux of athletes to drop out and be recruited into every stage of the pathway. Drop out represents wasted resources from the AFL and pathway inefficiency. To date no examination of pathway efficiency has been conducted on the AFL TP. Considering the similarities of Australian Football to other international sporting codes, the AFL TP can provide a unique precedent for wholesale examination of pathway efficiency across an entire sporting code.

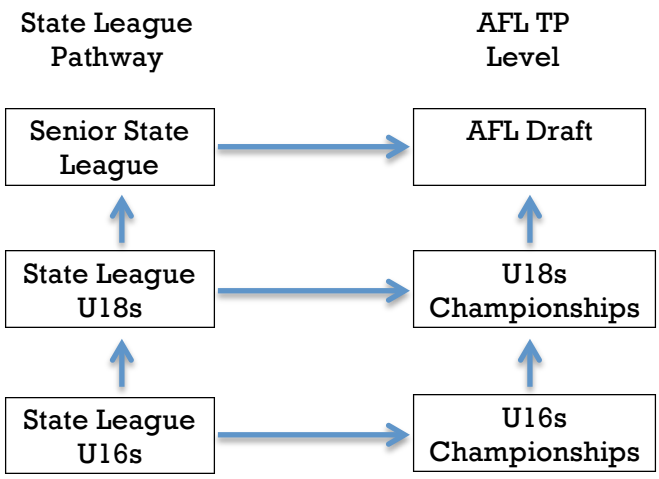

Figure 1. The Australian Football League Talent Pathway (AFL TP).

There are various mechanisms, which may affect athlete dropout and developmentpathway efficiency, such as injury, athletes moving out of the sport, or de-selection from development pathway stages. These factors can be largely outside the control of sporting codes. However, in the interests of efficiency, sporting codes would ideally select athletes that will participate through junior, senior and professional competition. Relative age effects (RAE) refer to age-biased selection of athletes, are evident in many sporting codes and represent a mechanism for athlete dropout and pathway inefficiency (Schorer, Cobley, Busch, Brautigam, & Baker, 2009; Sherar, Baxter-Jones, Faulkner, & Russell, 2007; Till et al., 2010). Selection into junior development pathways, such as the AFL TP, is often dependent on an athlete's ability to perform in short-term age-restricted competitions (Vaeyens et al., 2009). Adolescent athletes who are chronologically older are also likely to be more physically mature than their competitors and have greater physical stature, physiological capacities, motor control and cognitive aptitude (Armstrong, 2007). These attributes are advantageous for performance in the age-restricted competitions that are used in their respective development pathways (Buchheit & Mendez-Villanueva, 2014; Gastin, Bennett, & Cook, 2013; Gil et al., 2013). However, over time, athletes who may have been selected into the initial stages of a development pathway as a result of advanced physical capacities may be at risk of de-selection, as the advantages associated with early maturation diminish into late adolescence and adulthood (Malina, Bouchard, & Bar-Or, 2004). This initial selection and subsequent de-selection of relatively older athletes would contribute to athlete dropout and efficiency of development pathways such as the AFL TP. Despite the suggested relationship between RAEs and development pathway efficiency, no concurrent observation between pathway efficiency and RAE exists across a sporting code.

Conflicting reports of RAEs have been reported in Australian Football by studies focusing only on athletes participating at single levels of the AFL TP (U18s, draft) (Coutts, Kempton, & Vaeyens, 2014; Pyne, Gardner, Sheehan, & Hopkins, 2006; Robertson, Woods & Gastin, 2014). The conflicting results are likely a result of the methodological differences used to compare birth distributions. No research has investigated RAEs at the U16s stage of the AFL TP, nor longitudinally across the entire pathway (U16s, U18s and draft). Examination of fluctuations of RAEs across the AFL TP stages would provide greater insight into the relationship between RAEs and the developmental efficiency of the AFL TP.

The primary aim of this study was to examine the efficiency of the AFL TP by examining the participation of players across the different AFL TP stages (U16s, U18s and draft). A secondary aim was to examine if a concurrent RAE exists across the AFL TP from the U16s level through to the draft.

Method

Participants

The involvement and birth dates of 2519 athletes across the 2006-2012 seasons and stages of the AFL TP were collated. This enabled the tracking of five individual cohorts of athletes across the three AFL TP stages (U16s, U18s & draft). All players included in this study participated at least once in the U16s (n=1331) or U18s (n=1454) national championships, or were drafted (n=911) during this time. The 2006, U18s and draft

datasets were removed, as were the 2012 U16s participants, as the dataset did not enable these athletes to be tracked through the entirety of the AFL TP. All information was provided by the AFL. Ethical approval for the study was granted by the University's Human Research Ethics Committee (013113F).

Data management

Efficiency of the AFL TP was assessed for the U18s teams and the draft. Efficiency was defined as the percentage of senior listed athletes that had been involved in the AFL TP junior development squads. Player involvement at each stage of the pathway (U16s, U18s, and draft) was recorded. Some players participated multiple times in the same stage of the pathway, however, the analysis for this study was delimited to an athlete's first appearance at each level.

To assess the existence of RAEs in the AFL TP, athletes' birth dates were re-coded into birth quartiles (Q1: Jan–Mar; Q2: Apr–Jun; Q3: Jul–Sep; Q4: Oct–Dec). The AFL TP birth quartiles were then compared to all births in Australia between 1988 and 1993 (Australian Bureau of Statistics, 1994). Athlete de-selection was defined as the percentage of athletes that did not progress from one stage of the AFL TP into a subsequent stage. Birth quartiles of de-selected athletes were also compared across the AFL TP pathway stages; the birth distributions of the de-selected athletes at the U18s and draft stages were compared against the birth distributions of all athletes involved in the U16s and U18s respectively.

Statistical analysis

To examine pathway efficiency, analysis was conducted in SPSS version 22 (IBM, Chicago, IL, USA) with a binary coding system used to track involvement or exclusion from pathway stages. RAEs were assessed using chi-squared ($\chi 2$), odds ratios (OR) and associated 95% confidence intervals (CI) to test the birth quartile distribution for each stage of the pathway, as well as for athlete de-selection across the pathway stages. When comparing birth distributions, the relatively youngest group (Q4) was used as the reference group for odds ratio analysis (Coutts et al., 2014). Chi-squared, OR and 95% CI were calculated in Microsoft Excel (Microsoft, Redmond, WA, USA). SPSS was used to calculate descriptive statistics examining retention rates between pathway stages. Significance for all analyses was set at $p<0.05$.

Results

Of the drafted athletes, 50.5% had participated in at least one stage of the AFL TP. Further, 27.7% of drafted athletes had participated in the U16s, 47.9% of drafted athletes were involved in U18s, and 25.1% were selected for both the U16s and U18s teams. Of the athletes selected into the U18s, 47.5% had been selected into the U16s.

Table 1 shows the quartile distribution, chi-squared, OR and 95% CI for all levels of the AFL TP when compared to Australian national birth distributions. Odds ratios revealed a consistent bias towards the relatively oldest participants at every stage of the pathway. Chi-squared analyses reported significantly ($p<0.001$) uneven birth date distributions (biased towards relatively older athletes) at every stage of the pathway. However, the strength of these RAEs reduced at each subsequent stage: U16s ($\chi 2=254.3$, $p<0.001$), U18s ($\chi 2=99.6$, $p<0.001$), and for the draft ($\chi 2=19.1$, $p<0.001$).

Chi-squared analyses showed a significant RAE for athletes de-selected between U16s to U18s ($\chi 2=168.8$, $p<0.001$) and from the U18s to the draft ($\chi 2=161.2$, $p<0.001$) (see Table 2). Athletes de-selected from the U18s and born in the first quartile were 1.96 times more

likely to be de-selected than athletes born in the fourth quartile. A similar trend was seen for athletes de-selected between the U18s to the draft, with athletes born in the first quartile 1.61 times more likely to miss selection than athletes born in the fourth quartile.

Discussion

There were two main aims of this study: (a) to assess the efficiency of the AFL TP, by examining the involvement of drafted athletes in the underage stages of the pathway; and (b) to concurrently examine the presence of RAEs across the entire AFL TP. Half of the athletes drafted had previous involvement in the underage stages of the AFL TP. However, only 25.1% of drafted athletes had participated in the U16s and U18s stages of the AFL TP. Strong RAEs were evident in each level of the pathway. This RAE weakened as the pathway progressed with relatively older athletes significantly less likely to transfer between stages than their relatively younger counterparts.

This research confirms that a substantial proportion of elite athletes across an entire sporting code, develop the required skillset to compete at a professional level in subsidiary development pathways and competitions. Such findings have direct implications for elite development pathways similar to the AFL TP. For instance, development pathways are typically funded to a greater extent than subsidiary pathways, with athletes gaining greater access to training facilities, experienced coaches and support staff. It appears that additional resourcing provided to the AFL TP by the AFL results in little benefit by way of professional senior selection as half of the athletes drafted in this study came from subsidiary state league competitions. This finding highlights a wastage of development pathway resources, as half the athletes drafted into the AFL did not benefit from the additional resourcing provided to the AFL TP.

Pathway inefficiencies can impact the standard of athletes drafted into the AFL. It may take longer for athletes with limited or no exposure to the AFL TP to reach the tactical, technical and physiological standards required to compete at the senior level. Ericsson, Krampe, and Tesch-Römer (1993) suggested that gifted athletes would only attain their full adult potential when appropriate and stimulating development opportunities are provided. Further, providing these appropriate training stimuli during maturational "windows of opportunity" may accelerate and enhance physical development (Ford et al., 2011). Achieving this potential after these periods may take longer or be harder to attain (Balyi & Hamilton, 2004). Therefore the standard of the professional AFL competition may be reduced as a result of the selection of athletes that drop out from the AFL TP or non-selection of athletes into the AFL TP that are drafted later in adulthood.

This is the first paper to examine the efficiency of an entire development pathway and the concurrent RAE. Strong RAEs were evident in every stage of the pathway, with relatively older athletes significantly more likely to be de-selected as the pathway progressed. The strong RAE evident, especially in the initial stage of the pathway, supports the argument that athlete selection focused on acute physical capacities or performance outcomes rather than long-term athlete potential occurs in junior age-restricted competitions such as in the AFL TP (Schorer et al., 2009; Cobley et al., 2009; Sherar et al., 2007; Till et al., 2010). During adolescence, relatively older athletes are more likely to benefit from advanced physical and psychological capacities (Gil et al., 2013; Thompson, Barnsley, & Battle, 2004). In Australian Football, these advantages are likely to translate into greater performance in matches, as advanced maturity is linked to increased match running intensities (Gastin et al., 2013) potentially resulting in greater match involvements (e.g.

Table 1. Birth-date distribution, chi-squared ($\chi 2$), odds ratio (OR) and confidence intervals (CI) of selected adolescent and drafted athletes.

	Q1 (% Total)	Q2 (% Total)	Q3 (% Total)	Q4 (% Total)	Total	$\chi 2$	p-value	OR (CI) Q1 v Q4	OR (CI) Q2 v Q4	OR (CI) Q3 v Q4
U16s	549	364	254	164	1331	245.3	<0.001	3.34	2.18	1.50
	(41.2%)	(27.3%)	(19.1%)	(12.3%)				(2.81-3.98)	(1.82-2.63)	(1.23-1.82)
U18s	501	397	311	245	1454	99.6	<0.001	2.04	1.61	1.23
	(34.5%)	(27.3%)	(21.4%)	(16.9%)				(1.76-2.39)	(1.37-1.89)	(1.04-1.45)
Draft	256	258	221	176	911	19.1	<0.001	1.30	1.38	1.21
	(28.1%)	(28.3%)	(24.3%)	(19.3%)				(1.07-1.59)	(1.14-1.67)	(0.99-1.48)
Australian Population	379086	384749	391680	378316	1533831					
	(24.7%)	(25.1%)	(25.5%)	(24.7%)						

Table 2. Birth-date distribution, chi-squared ($\chi 2$), odds ratio (OR) and confidence intervals (CI) of de-selected athletes. Reference groups for $\chi 2$ are the total number of athletes in the U16s and U18s teams as shown in table 1.

Transition	Q1 (% Total)	Q2 (% Total)	Q3 (% Total)	Q4 (% Total)	Total	$\chi 2$	p-value	OR (CI) Q1vQ4	OR (CI) Q2vQ4	OR (CI) Q3vQ4
U16s-U18s	289	162	117	72	640	168.86	<0.001	1.96	1.39	1.28
	(45.2%)	(25.3%)	(18.3%)	(11.2%)				(1.45-2.65)	(1.01-1.91)	(0.91-1.80)
U18s-Draft	380	262	214	162	1018	161.29	<0.001	1.61	1.10	1.05
	(37.3%)	(25.7%)	(21.0%)	(15.0%)				(1.23-2.10)	(0.84-1.45)	(0.79-1.40)

number of disposals) (Mooney et al., 2011). However, such advantages may not reflect true adult potential, as the advantages associated with greater relative age reduce with age (Malina et al., 2004). The strong RAE in athletes de-selected between pathway stages would support the notion that relatively older athletes, at a performance advantage in initial stages of the AFL TP, are at risk of subsequent de-selection, as relatively younger athletes mature, catch up, and ultimately take their place in the later stages of the pathway (Cobley et al., 2009; Schorer et al., 2009; Sherar et al., 2007; Till et al., 2010). RAEs are one of several mechanisms that can influence athlete drop out and pathway inefficiency. The retrospective nature of this study only allows for observation of the concurrent RAE and inefficiencies of the AFL TP and cannot establish causation. This is a result of the inability to prospectively quantify the cause of athlete turnover in the study. Whilst it is suggested that athlete turnover is performance based, it is possible that athletes missed selection due to injury or for other unknown reasons. Further prospective examination of the various factors, which influence selection into the AFL TP, may provide further insight into factors affecting the efficiency of the pathway.

In this study we suggest selection may be associated with biological maturity, which is linked to relative age (Gil et al., 2013). Athletes who are chronologically older are likely to also be biologically older, however, without direct assessments of biological maturity such assumptions are speculative. Another potential limitation of this investigation is a potential methodological bias associated with comparing sporting population data to population norms. Previously it has been suggested that athletic populations may already demonstrate RAEs, thereby potentially confounding results when comparing to population norms (Delorme, Boiché & Raspaud, 2010). The present investigation lacked access to the birth distribution data of all registered Australian Football players, therefore we followed the method of comparing to national population distributions outlined in previous studies (Coutts et al., 2014; Helsen et al., 1998; McCarthy & Collins, 2014).

Conclusion

This study concurrently examined the efficiency and birth date distribution of adolescent athletes selected into the AFL TP between 2006 and 2012. Poor efficiency was observed across the pathway, with only 50.5% of athletes selected in the draft involved in previous stages of the AFL TP. Strong RAEs were also observed in every stage of the AFL TP, with the strength of these RAEs reducing with age. The weakening RAE with age was in part the result of relatively older athletes being more likely to be de-selected at subsequent stages. This is the first study to concurrently observe poor pathway efficiency and RAEs across an entire development pathway. The results of this study suggest a relationship exists between RAEs and development pathway inefficiencies, however, further research is required to confirm this link. Coaches of adolescent development pathways should be aware of performance advantages associated with relative age, as failing to do so may reduce the efficiency of sporting development programs.

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