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**The Prevalence of Within-Sport Specialization in Track and Field Athletics, and its
Consequences for Participation and Retention**

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Abstract

Purpose: The aim of this study was to provide an in-depth analysis of the prevalence and consequences of within-sport specialization in track and field in the United Kingdom.

Method: The competition histories of top 100 ranked athletes from four representative events (100m, 800m, long jump and shot put) were recorded from a publically-accessible database.

Athletes were drawn from Under 20 (U20), U15 and U13 populations from the 2014/15 season, U15 populations from the 2009/10 season, and U13 populations from the 2007/08 season. Athletes' specialization status was defined based upon the number of event groups

(sprint, endurance, jump, throw) in which they had recorded at least one performance. Chi-squared tests were used to examine the association between level of specialization at U13 and U15 and both performance and retention at subsequent age grades. **Results:** Within-sport

specialization was rare among U13 and U15 track and field athletes, with approximately 10% of top 100 ranked U13s and 25% of top 100 ranked U15s competing in a single event group only. However, less than 35% of participants competed in sprinting, endurance running,

jumping and throwing events (i.e., diversification). There were no sex differences in the extent of specialization. Top ranked U20 female athletes were more likely to have diversified

at U13 than their peers. There was no association between specialization at U13/U15 and

subsequent retention. **Conclusion:** Administrators and coach educators should provide more sophisticated guidance for coaches and parents in relation to within-sport specialization.

Keywords: adolescents, youth sport, sport participation, diversification

The Prevalence and Consequences of Within-Sport Specialization in Track and Field Athletics

An extensive body of research has investigated the developmental histories of successful athletes (Güllich, 2018; Haugaasen, Toering, & Jordet, 2014). Such research has emphasized a breadth of factors which influence athlete development, including the balance between different types of sporting experiences (i.e., informal play, structured practice; Berry, Abernethy, & Côté, 2008; Hendry & Hodges, 2018), and the range of sports that a young athlete participates in (Bridge & Toms, 2013; Coakley, 2011). Consequently, organizations such as the International Olympic Committee (Bergeron et al., 2015) and the American Orthopaedic Society for Sports Medicine (LaPrade et al., 2016) have issued position statements proposing guidelines for best practice in youth sport.

One of the key recommendations contained within the guidelines for youth sport is the rejection of early sport specialization (Bergeron et al., 2015; LaPrade et al., 2016). Sport specialization refers to intensive, year-round training in a single sport with the exclusion of other sports (Jayanathi, Pinkham, Dugas, Patrick, & LaBella, 2013). In contrast to the opinions of many parents (Padaki et al., 2017) and athletes (Brooks et al., 2018), the available research clearly indicates that early specialization is not a prerequisite for later success (Anderson & Mayo, 2015; Güllich, 2014, 2018; Moesch, Elbe, Hauge, & Wikman, 2011). Furthermore, there is accumulating evidence that early sport specialization may increase the risk of physical or psychological issues (Horn, 2015; Post et al., 2017; Waldron, DeFreese, Pietrosimone, Register-Mihalik, & Barczak, 2019), and provides less protection against future non-participation than sampling a variety of sports (Gallant, O'Loughlin, Brunet, Sabiston, and Bélanger, 2017).

There is a paucity of research on specific features of youth sport specialization (Smith et al., 2017; Weiss, 2015). One such feature is within-sport specialization; that is, focusing

upon a single position within a sport such as soccer, or on a single discipline in a sport such as swimming. Track and field athletics offers a particularly interesting domain for the investigation of specialization, as it consists of a number of relatively unrelated discipline areas (throwing, sprinting, endurance running, jumping), while both national (e.g., Grace, 2014; United Kingdom Athletics, 2010) and international federations (Thompson, 2009) advocate delaying specialization in a single discipline until at least late adolescence. Indeed, the United Kingdom Athletics Athlete Development Model (United Kingdom Athletics, 2010) goes further, explicitly recommending that all Under 13 and Under 15 athletes should both train and compete across the full spectrum of athletic disciplines (i.e., Run, Jump and Throw). Two reasons are generally provided for this preference for a multi-event approach (Grace, 2014; Sanderson, 2003; Shibli & Barrett, 2011): firstly, that exposure to multi-events would produce more well-rounded athletes who would then be better placed to succeed as specialists within a single discipline. Secondly, the multi-event approach is suggested to avoid excessive repetition, which could dull an athlete's enthusiasm for the sport.

Arguments in favour of a multi-event approach to athlete development are supported by retrospective analyses of the development of high performing athletes (Huxley, O'Connor, & Bennie, 2018; Huxley, O'Connor, & Larkin, 2017; Vernacchia, McGuire, Reardon, & Templin, 2000), case studies of successful clubs (e.g., Henriksen, Stambulova, & Roessler, 2010), and interviews with highly experienced coaches (Thomas & Wilson, 2014; Shibli & Barrett, 2011). For example, Huxley et al. (2017) interviewed 73 Australian athletes who had competed at Olympic and/or World Championships; the average (standard deviation) age of specialization within an athletic discipline was 17.7 (3.8) years. In a holistic ecological assessment of a highly successful Swedish athletics club, Henriksen et al. (2010) identified an emphasis on gradual development as an important ingredient in the club's success. One way in which this emphasis on gradual development manifested was the delaying of specialization

within an athletic discipline until approximately 16 years of age. Similarly, interviews with expert coaches from a range of sports (Shibli & Barrett, 2011; Thomas & Wilson, 2014; Voight & Hohman, 2016) consistently advocate within-sport diversification.

In contrast to this extensive support from retrospective and expert opinion sources, there is limited direct study of the impact of within-sport specialization on either performance or retention. One exception was provided by Vorobjev (as cited in Enoksen, 2011), where longitudinal tracking of 80 track and field athletes indicated that athletes who followed a specialized training programme were more likely to dropout and to experience injuries than athletes who had delayed specializing. There is a need for additional research on this topic so that coaches and national governing bodies can be confident in their recommendations. Such research needs to examine factors which might influence within-sport specialization. For example, due to female athletes maturing faster than their male counterparts (Cumming, Standage, Gillison, & Malina, 2008), it is important to establish whether there are any sex differences in the prevalence or consequences of within-sport specialization.

In summary, the United Kingdom Athletics (2010) Athlete Development Model proposes that all young adolescents should experience the full range of athletics events in both training and competition. This proposition is supported by expert coach opinion (Thomas & Wilson, 2014; Shibli & Barrett, 2011) as well as by case studies of elite athletes (Huxley et al., 2018; Vernacchia et al., 2000) and of highly successful clubs (Henriksen et al., 2010). However, empirical investigations of this topic are needed. The www.thepowerof10.info database contains a record of all official competitions completed by an athlete within the UK, provided that they have achieved a minimum standard in one event. As such, it offers an opportunity to investigate both the prevalence of within-sport specialization, and its impact on both performance and retention. Thus, this investigation identified three research questions: (1) What is the current level of within-sport specialization

within a sample of high performing young adolescent track and field athletes? (2) Does the level of specialisation observed during early adolescence influence performance during late adolescence (U17 or U20)? and (3) Does the level of specialisation observed during early adolescence influence the odds of an athlete being retained in the sport through to late adolescence (U17 or U20)?

Method

Participants

To investigate the current level of specialization within track and field athletics in the United Kingdom, the 100 top ranked male and female athletes in each of four events (sprint: 100m, jump: long jump; throw: shot put; endurance: 800m) at two age grades (U13 and U15¹) at the end of the 2014/15 season were identified on the publically-accessible database www.thepowerof10.info. Only participants who had competed at least 10 times were included to avoid participants who competed in very few competitions, and who therefore had limited opportunity to diversify, from biasing the results. Eighty-five percent of top 100 ranked U13 girls, 68% of U13 boys, 90% of U15 girls, and 72% of U15 boys met or exceeded this criterion. Participants who were present on the rankings in multiple events were only counted in their highest ranked event, resulting in a final sample of 305 U13 girls, 243 U13 boys, 321 U15 girls, and 268 U15 boys. The median (interquartile range) number of events that participants in the final sample had competed in was U13 girls 24 (20), U13 boys 22 (14), U15 girls 26 (23), and U15 boys 21 (17).

To investigate the effect of specialization on performance, the 100 top ranked male and female U20 athletes in the same four events at the end of the 2014/15 season were identified, and all of their performances as U13s (2007/08 season) and as U15s (2009/10 season) were recorded. Again, only participants who had competed in 10 or more competitions were included in the analysis, and participants who were ranked in multiple

events were only included in their top ranked event. For example, we started with the 100 top ranked female athletes in each of the 100m, long jump, shot or 800m at U20 for a total of 400 athletes. Thirty of these athletes were ranked in more than one of the four disciplines at U20, which reduced the number to 370 unique athletes. Records of performances at U13 were available for 229 of these athletes; the remainder were either not competing at U13, or not competing at a high enough standard for their performances to have been logged on the database. Of these 229 athletes for whom records existed at U13, only 151 had completed in at least 10 events at U13 and were included in the analysis. To provide a comparison group, the top 100 U13 athletes in each event from the 2008 season, and the top 100 U15 athletes from the 2010 season were also identified and processed in the same manner. If top ranked U20s had also been top ranked at the younger age grade, they were only counted within the U20 sample.

To investigate the effect of specialization on retention, the event records of the top ranked U13 athletes from 2008 and the top ranked U15 athletes from 2010, that had been identified in the performance analysis, were used.

Procedure

The www.thepowerof10.info database contains a record of all official competitions in which the athletes engaged. This information was downloaded for each participant into customized Microsoft Excel spreadsheets. Records were filtered so that only competitions during the outdoor season were considered. The raw data set is available at <https://zenodo.org/record/3237106#.XPPegYhKjIU>. Subsequently, performances in individual events were coded into four event groups: Sprints (75m, 100m, 150m, 200m, 300m, 400m), Jumps (long jump, high jump, triple jump, pole vault), Throws (shot, discus, hammer, javelin), and Endurance (600m and above).

Level of specialization was determined by the number of event groups (1-4) that participants had competed in. Participants were classified as Diversified if they recorded at least one performance in each of the four event groups², or if they had competed in a multi-event competition (e.g., pentathlon). Athletes were defined as Specialists if they only recorded performances in a single event group. For example, an athlete who competed in seven 100m races and six 200m races would be classified as a specialist sprinter.

To analyse the effect of level of specialization upon performance, the proportion of top 100 ranked U20 athletes who had competed in one, two, three or four event groups at U13 and U15 was compared to the proportion of their contemporaries who were identified in each classification. Relatively few individuals were present on the top 100 as both U13s and as U20s; these athletes were counted in the Top U20 group only.

To analyse the effect of level of specialization upon retention, the competition histories of the top 100 ranked athletes from 2008 and from 2010 were examined. Specifically, participants were coded as retained if their records showed competitions from their final year in each age grade (U15, U17 and U20) or in the next year, to allow for instances where an athlete might have been injured in their final year at an age grade.

Data Analysis

Chi-squared tests were used to identify the factors that influenced the proportion of athletes who specialized within an event group, and to examine the relationship between level of specialization (number of event groups competed in; 1-4) and performance/retention. Cramer's V provided a measure of effect size, with values of 0.1, 0.3 and 0.5 indicating small, medium and large effect sizes, respectively.

Results

Current Level of Within-Sport Specialization

As illustrated within Figure 1, within the 2014/15 sample, specialization was relatively rare, with approximately 10% of top 100 ranked U13s and 25% of top 100 ranked U15s competing in a single event group only. However, less than 35% of participants achieved the target of competing in sprinting, endurance running, jumping and throwing events. Specialization was more likely to be seen at U15 compared to U13: girls $\chi^2(3, N = 626) = 40.89, V = .26, p < .001$; boys $\chi^2(3, N = 511) = 31.8, V = .25, p < .001$. No sex differences were observed in the degree of specialization at U13 $\chi^2(3, N = 548) = 1.18, V = .05, p = .758$, or at U15 $\chi^2(3, N = 589) = 2.47, V = .06, p = .481$. A minority of athletes had competed in specific multi-event competitions: U13 girls: 18%; U13 boys: 14%; U15 girls: 11%; U15 boys: 7.5%.

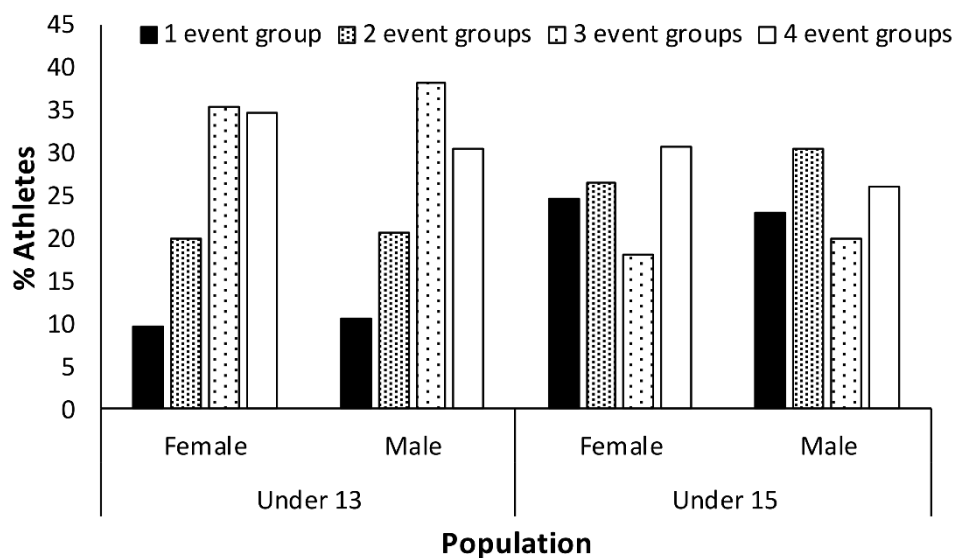


Figure 1. Specialization by age grade

Does Initial Level of Specialization Influence Long Term Performance?

Descriptive statistics are provided in Table 1. The competition histories of top 100 ranked U20 girls revealed that when they were competing at U13, a higher proportion of these individuals were competing across the four event groups (36.4%), and fewer were

specializing (6%), relative to their contemporaries who did not progress to be ranked in the top 100 at U20 (22.6% diversified and 11.5% specialised), $\chi^2 (3, N = 386) = 14.08, V = .19, p = .003$. Similarly, female athletes who progressed to a top 100 ranking at U20 were more likely to have diversified at U15 (32.5%) compared to their contemporaries (23.4%), $\chi^2 (3, N = 538) = 8.88, V = .13, p = .031$.

For male athletes, there was no significant association between progression to a top 100 top ranking at U20 and within-sport specialization status at either U13, $\chi^2 (3, N = 275) = 0.86, V = .06, p = .835$, or at U15, $\chi^2 (3, N = 424) = 3.51, V = .09, p = .319$.

Table 1
Relationship between specialization status at age grade and later performance

	% Female Athletes					% Male Athletes				
	N	1EG	2EG	3EG	4EG	N	1EG	2EG	3EG	4EG
Top U20s at U13	151	6.0	17.9	39.7	36.4	103	11.7	28.2	36.9	23.3
U13 contemporaries of Top U20s	237	11.4	28.7	37.6	22.4	172	13.8	29.1	39.7	17.5
Top U20s at U15	277	19.9	26.4	21.3	32.5	194	23.2	26.3	25.3	25.3
U15 contemporaries of Top U20s	261	19.6	29.5	27.6	23.4	230	25.3	33.3	19.2	22.2

Note: U = Under; N = number of athletes; EG = event group (endurance running, sprinting, jumping and throwing events); thus 1EG = athletes who competed in only one event group (i.e., specialized), while athletes classified as 4EG competed in all four event groups.

Does Initial Level of Specialization Influence Long-Term Retention?

Table 2 provides descriptive statistics relating to multi-event status at youth level and whether the athlete was still competing or had no recorded performances at subsequent age grades. For example, the U13-U15 section illustrates that of the 261 athletes who had competed at least 10 times at U13, 230 of them were still active at U15. The retention rates ranged from 83.9% for athletes who had competed in a single event group at U13 to 94.7% for athletes who had competed across all four event groups. However, the Chi-squared test revealed no association between multi-event status at U13 and retention rates at U15, $\chi^2 (3, N = 261) = 3.43, V = .21, p = .330$. Similarly, there was no association between multi-event status at U13 and retention rates at U17, $\chi^2 (3, N = 261) = 2.43, V = .15, p = .488$; or U20, $\chi^2 (3, N = 261) = 1.61, V = .10, p = .656$. For male athletes, there was also no association between multi-event status at U13 and subsequent retention rates: U15, $\chi^2 (3, N = 189) =$

3.85, $V = .28$, $p = .280$; U17, $\chi^2 (3, N = 189) = 0.359$, $V = .03$, $p = .949$; U20, $\chi^2 (3, N = 189) = 2.06$, $V = .15$, $p = .560$.

For female athletes, multi-event status at U15 was not associated with retention rates at U17, $\chi^2 (3, N = 315) = 3.33$, $V = .19$, $p = .343$; or U20, $\chi^2 (3, N = 315) = 4.12$, $V = .23$, $p = .249$. Likewise for male athletes, there was no association between multi-event status at U15 and retention rates at U17, $\chi^2 (3, N = 261) = 6.25$, $V = .39$, $p = .100$; or at U20, $\chi^2 (3, N = 261) = 6.29$, $V = .39$, $p = .098$.

Table 2
Relationship between specialization status at a younger age grade and retention status at a later age grade

Age Grade	Status	N	% Female Participants				N	% Male Participants			
			1EG	2EG	3EG	4EG		1EG	2EG	3EG	4EG
U13-U15	Still competing	230	83.9	85.5	87.6	94.7	153	69.2	78.2	85.3	84.8
	No recorded performance	31	16.1	14.5	12.4	5.3	36	30.8	21.8	14.7	15.2
U13-U17	Still competing	172	74.2	60.5	64.9	70.2	117	57.7	61.8	64	60.6
	No recorded performance	89	25.8	39.5	35.1	29.8	72	42.3	38.2	36	39.4
U13-U20	Still competing	110	45.2	44.7	37.1	45.6	81	42.3	41.8	48	33.3
	No recorded performance	151	54.8	55.3	62.9	54.4	108	57.7	58.2	52	66.7
U15-U17	Still competing	273	80.6	86	90.8	87.7	218	81.8	77	92	87.9
	No recorded performance	42	19.4	14	9.2	12.3	43	18.2	23	8	12.1
U15-U20	Still competing	192	50	63.4	62.1	65.8	142	45.5	51.7	56	67.2
	No recorded performance	123	50	36.6	37.9	34.2	119	54.5	48.3	44	32.8

Note: U = Under; N = number of athletes; EG = event group (endurance running, sprinting, jumping and throwing events); thus 1EG = athletes who competed in only one event group (i.e., specialized), while athletes classified as 4EG competed in all four event groups.

Discussion

This is the first study to examine the prevalence and consequences of within-sport specialization in track and field. The initial section of the discussion will focus on the prevalence of within-sport specialization; specifically, the extent to which athletes were specializing or diversifying, and whether age and/or sex influenced the degree of specialization. The second section of the discussion will consider the impact of within-sport specialization at youth level on subsequent performance and retention.

At both U13 and U15, within-sport specialization was rare. This finding is consistent with the policy advocated by the IAAF (Thompson, 2009), United Kingdom Athletics (Grace, 2014), the reported experiences of Olympic and World Championship athletes

(Huxley et al., 2018; Vennachia et al., 2000), as well as the recommendations of athletics coaches (Shibli & Barrett, 2011). There were no sex differences in the prevalence of within-sport specialization. These findings are consistent with the absence of gender differences in the prevalence of between-sport specialization identified in retrospective analyses of high performing collegiate athletes (Martin, Ewing, & Oregon, 2017; Post et al., 2017; Swindell et al., 2019) and concurrent analyses of high school athletes (Bell et al., 2016; Gallant et al., 2017). With regard to age, although more U15s had specialized than U13s, the proportion of the former who competed in a single event group was still less than 25%. Again, this finding suggests that coaches are largely operating in line with the guidelines suggested by national and international governing bodies (Grace, 2014; Thompson, 2009). Although within-sport specialization has received relatively little attention in the context of models of development, these results are also consistent with the underpinning principles of the Developmental Model of Sport Participation (Côte, Baker, & Abernethy, 2003; Côte & Vierimaa, 2014), the Composite Youth Development Model (Lloyd et al., 2015), and the International Olympic Committee consensus statement on youth athletic development (Bergeron et al., 2015). However, while the prevalence of within-sport specialization was low, the majority of athletes were not adhering to the United Kingdom Athletics guidelines to compete across the full range of event groups.

The second objective of this study was to determine the consequences of within-sport specialization and diversification on both performance and retention. There was mixed evidence for an association between within-sport specialization and performance; while top ranked female U20 athletes were more likely to have diversified than their fellow competitors at U13 and U15, no such association existed for male athletes. There was no association between multi-event status and subsequent retention for either males or females.

There are a number of possible explanations for these findings. Firstly, within-sport specialization status was allocated on the basis of competitive events. It is possible that an individual who competes within a single discipline may experience multiple disciplines within training, and is therefore inaccurately classified on the basis of competition participation alone. However, the United Kingdom Athletics Athlete Development Model does encourage multi-event engagement in both training and competition. A related explanation for the general lack of consequences of within-sport specialization relates to the quality of training for other events. Athletes may participate in competitions without undertaking thorough preparatory training. Thus, whether an athlete competed or not in an event may be a poor proxy measure for whether an athlete has engaged in systematic training for multiple athletic disciplines. Such systematic training is likely to be necessary to provide long term benefits in terms of participation and performance development. Future research may indirectly explore this question by analysing whether individuals who compete more regularly in multiple events, or who achieve relatively higher performances in multiple disciplines, show an increased long term benefit.

An additional reason why within-sport specialization may not be consistently associated with either performance or retention is due to its relationship with between-sport specialization; a relationship which is not explicitly considered in the United Kingdom Athletics Athlete Development Model. It is plausible that an athlete who is engaging in multiple sports is buffered from the potential negative aspects of within-sport specialization. Moreover, it is also possible that an athlete who competes in all track and field event groups is only engaged in that one sport, and thus with one social group (i.e., set of peers, coach). Engagement in intensive, year-round, deliberate practice at a young age has been associated with increased risk of burnout and withdrawal from the sport (Coakley, 2011; Wall & Côté, 2007; Waldron et al., 2019). Within-sport diversification may not be sufficient to buffer an

athlete from the negative aspects of between-sport specialization. Furthermore, between-sport specialization may be a more appropriate avenue for coaches to pursue to facilitate the long term development of their athletes. For example, an athlete who performs well in throwing or sprinting events, but who does not wish to participate in endurance running, may gain adequate aerobic training through participation in a sport such as basketball which conceals the amount of distance run within game play (Kearney, Comyns, & Hayes, 2020; Lloyd & Oliver, 2012). Therefore, it is important for future research on within-sport specialization to consider the nature of young athletes' experiences in track and field in more depth, examining both the microstructure of training (e.g., MacPhail & Kirk, 2006), as well as interaction of between- and within-sport specialization. Although multi-event participation is a common element of strategies to retain athletes within track and field (Sanderson, 2003; Shibli & Barrett, 2011), and is likely to reduce premature stereotyping by both coaches and athletes (Harrison, 2001), the results of the present study suggest that administrators and coach educators should consider promoting a more nuanced message regarding sport participation. Specifically, stakeholders should receive advice on how the range of sports an athlete engages in outside of track and field may modify their need to experience within-sport diversification.

Limitations

A number of limitations to this study need to be considered. The use of U20 ranking to assess the influence of within-sport specialization on performance is a somewhat basic measure, particularly as peak performance in track and field is typically not achieved until the mid- to late twenties (Hollings, Hopkins, & Hume, 2014). In future, measurement of athlete performances, as well as the tracking of athletes through to senior level, may offer a more precise assessment of the effect of within-sport specialization on development. Secondly, the analysis focused on performances obtained during the outdoor season. Extending the analysis

to consider whether athletes are also competing indoors or during cross-country season (i.e., competing year-round) may deliver a more in-depth picture of youth development. Finally, the analysis focused on the most popular events within each event group. Future research should examine a broader range of events within each discipline, and consider whether specialization is more prevalent in certain events.

Conclusion

In conclusion, examination of competition records revealed that within-sport specialization was rare among U13 and U15 track and field athletes in the United Kingdom. Given that the top ranked athletes studied are arguably those most likely to engage in early specialization, these results suggest that the majority of youth track and field athletes are experiencing at least a partial degree of diversification. However, the proportion of athletes competing across the full range of event groups, as recommended by the United Kingdom Athletics Athlete Development Model, was also low. No consistent association between the extent of within-sport specialization and either performance or retention was observed. Future research needs to adopt a broader approach, examining within-sport specialization in training as well as in competition, and in the context of between-sport specialization. Given that athletes are not following the guidelines advocated by United Kingdom Athletics, administrators should consider either revising their guidelines, or providing additional education to key stakeholders. In particular, administrators and coach educators should consider promoting a more nuanced message regarding sport participation. This message should emphasize that the range of sports an athlete engages in outside of track and field may modify their need to experience within-sport diversification.

What does this paper add?

This paper provides the first analysis of the incidence and impact of within-sport specialization in track and field. The data provides more nuanced guidance to administrators

on current practice with respect to one specific element of youth participation in sport. More importantly, the data provides a critical stimulus for administrators, coach educators and coaches to reflect upon their practice in relation to multi-event participation. These key stakeholders should evaluate the quality of the evidence and the clarity of communications to coaches, athletes and parents about this topic. For example, these stakeholders could audit the messages that are communicated regarding the relationship between between-sport and within-sport specialization at different stages of an athlete's development. Finally, the study has identified a number of important directions for researchers to pursue in relation to within-sport specialization.

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Footnotes

¹ UKA operates under 2 year age groups.

²Although “Run Jump Throw” is a popular appellation for multi-event participation in track and field, sprinting and endurance running are distinctive endeavours, and so for the purpose of our analysis, Run has been divided into these two categories.