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Matthew W. Bridge [a] & Martin R. Toms [a]
[a] University of Birmingham, School of Sport & Exercise Sciences, Birmingham, UK

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The specialising or sampling debate: a retrospective analysis of adolescent sports participation in the UK

MATTHEW W. BRIDGE & MARTIN R. TOMS

University of Birmingham, School of Sport & Exercise Sciences, Birmingham, UK

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Abstract
Whether young people should specialise in one competitive sport at an early age, or pursue a wider range of sports during adolescence is a topic of some debate (Baker, Cobley, & Fraser-Thomas, 2009) and is fundamental within sports policy and coaching practice. The purpose of this retrospective recall study was to identify whether early specialisation or sporting diversification (sampling) throughout childhood and adolescence can influence performance levels prior to adulthood. An online questionnaire was used to collect the sport participation histories of 1006 UK sports people, which were then compared with the developmental framework provided by the Developmental Model of Sport Participation (DMSP, Côté & Fraser-Thomas, 2007). A significant association between the number of sports participated in at the ages of 11, 13, and 15 and the standard of competition between 16 and 18 years was found. Individuals who competed in three sports aged 11, 13, and 15 were significantly more likely to compete at a national compared with club standard between the ages of 16 and 18 than those who practised only one sport. The findings reported here provide some empirical support for the sampling performance pathway DMSP model in a UK context.

Keywords: *sampling, sport, athlete, specialisation, diversification*

Introduction

A key question in the development of individuals in sport is that of whether young people should specialise early in a single sport (as a basis for later competitive success), or sample a number of sports before specialising closer to adulthood. Currently this question lacks conclusive empirical evidence (Baker et al., 2009). This paper makes a contribution to this evidence base by examining the competitive sport participation histories of UK sports people against the framework developed by Côté and Fraser-Thomas' (2007) Developmental Model of Sport Participation (DMSP).

Côté and Fraser-Thomas' (2007) DMSP focuses on the development of young people in sports between the ages of 7 to 18 years and contains three developmental pathways: elite performance through early specialisation in a single sport, elite performance through the sampling of a number of sports, and finally recreational participation through sampling. Each of these pathways contains various phases of development after entry into sports participation with the authors referring to early diversification in their model as the sampling of a number of sports (Côté & Fraser-Thomas, 2007). The expert performance pathways each contain different balances of deliberate play and practice activities throughout an individual's sporting development. The elite performance through sampling pathway involves individuals passing through three developmental phases: the sampling years (6–12 years of age), the specializing years (13–15 years of age) and the investing years (16+ years of age), with a progressive narrowing of sport focus during these stages (Côté, Baker, & Abernethy, 2007). In the sampling years, individuals engage in a wide range of activities, the majority of which are deliberate play activities (Côté et al., 2007). As they move in to the specialising years of development there is an equal balance of deliberate play and deliberate practice in much fewer sports, one of which is ultimately the sport in which they hope to later excel. Finally, the investing years are characterised by extensive deliberate practice in the primary sport with little deliberate play in any other sport. The early specialisation pathway, on the other hand, is one where individuals are engaged in their main sport at an early age with extensive hours of deliberate practice, and little play in other sports. This pathway

Correspondence: Matthew Bridge, University of Birmingham, School of Sport & Exercise Sciences, Birmingham, UK. Email: m.bridge@bham.ac.uk

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is suggested as being important for sports where peak performance is achieved before puberty (Côté et al., 2007). Whilst all of the outcomes and pathways of the DMSP have not been directly tested it provides a framework against which developmental research can be assessed (Côté et al., 2007). It should be noted that there are other existing models of development (e.g. Long Term Athlete Development, Balyi, 2002) but none are as well developed from the literature as DMSP. It is beyond the scope of this paper to describe all the models and for full reviews readers should see Bailey et al. (2010), Collins et al. (2011) and Ford et al. (2011).

The concept of early specialisation involves continual year-round training and development in a single sport between the ages of 6 and 12 years (Wiersma, 2000) and has been shown to be evident as a pathway for some athletes in some sports (e.g. gymnastics – Law, Côté, & Ericsson, 2007; soccer – Ward, Hodges, Williams, & Starkes, 2007) in which it has been suggested that it is a prerequisite for successful elite performance. Early specialisation's focus on deliberate practice is analogous to Wulf and Shea's (2002) definition of learning effectiveness with a concentration on the acquisition of motor skills independent of other psychosocial and physical costs, which are associated with the development of sport expertise (Côté et al., 2007). The justification for this extensive deliberate practice at a young age is based on the proposition that it takes a notional average of 10,000 hours of deliberate practice (Ericsson, Krampe, & Teschromer, 1993) to achieve domain-specific expertise. This justification is often exacerbated through the desire for early elite performance from sports bodies, parents and coaches (Baker et al., 2009) and is something that the privatisation and commercialisation of youth sport, combined with prevailing definitions of good (ambitious) parenting, has been suggested to reinforce (Coakley, 2010).

There is little doubt that early specialisation will enable an athlete to accumulate increased hours of domain-specific deliberate practice with the aim of earlier elite performance. However, this approach of learning effectiveness is independent of the psychosocial (e.g. drop out, burn out, see Emrich, Fröhlich, Klein, & Pitsch, 2009) and physical costs (e.g. injury, see American Academy of Pediatrics, 2000; and poor health, see Law et al., 2007) to the young athlete. Intensive practice at a young age may even be counterproductive, reducing the physical potential of an athlete and increasing the later prevalence of injury (American Academy of Pediatrics, 2000). Early achievement is also suggested to result in earlier mortality by the McCann Precocity-Longevity hypothesis, which states that ''those who reach career peaks earlier tend to have shorter lives'' (McCann, 2001, p. 1249) something which has been found in Major League Baseball (Abel & Kruger, 2007), which certainly raises ethical questions for all involved.

The second approach to skill development suggested by Wulf and Shea (2002) is one of learning efficiency, where wider developmental issues are considered alongside the development of skill expertise. It is this approach that Côté et al. (2007) suggest takes the form of the sampling pathways of the DMSP model. The sampling pathways address the importance of play and play-approaches to learning sport during childhood, termed 'deliberate play' (Côté et al., 2007) or 'play practice' (Launder & Piltz, 2006). There is evidence that such an approach has led to the development of high levels of expertise in sports such as hockey, netball, basketball, triathlon, tennis, ice hockey, (Baker, Côté, & Abernethy, 2003b; Baker, Côté, & Deakin, 2005; Carlson, 1988; Soberlak & Côté, 2003) and that the number of practice hours required to attain national team status is inversely related to the diversity of formative sporting experiences (Baker, Côté, & Abernethy, 2003a). It has also been suggested that for sports where peak performance is reached after maturation, early diversification does not hinder performance (Côté, Lidor, & Hackfort, 2009). However, the suggested sampling approach to development is not without criticism, although it has been suggested that it leads to the development of Fundamental Motor Skills (FMS) that provide a foundation for future movement prowess (Côté, Baker & Abernethy, 2003; Payne & Issacs, 1995). These skills include both locomotor (running, jumping, etc.) and object control skills (throwing, catching, striking, etc., see Haywood & Getchell, 2009). It should, however, be noted that a relationship between FMS competence and physical activity whilst being conceptually attractive, has not yet been firmly established (Stodden et al., 2008). The sampling approach also relies to a degree upon successful transfer of skills across sports, of which there is little robust evidence (Baker et al., 2009; Feltovich, Prietula, & Ericsson, 2006).

Whilst there is a growing body of work examining the sport participation histories of individuals and the outcomes of specialisation or sampling, this work is concentrated on North America and Australia and there is little data on UK sports people. The studies that have a UK context are limited to football (Ward et al., 2007), athletics (MacPhail & Kirk, 2006) and cricket (Ford, Low, McRobert, & Williams, 2010; Toms, 2005). Whilst there is a developing body of research on continental European countries (e.g. Moesch, Elbe, Hauge, & Wikman, 2011) the cultural context and organisation of sport is very different between different parts of Europe, something

acknowledged in the EU White Paper on Sport as 'diversity and complexities' (European Commission, 2007) and in the literature (Van Tuyckom & Scheerder, 2010). A clear example of this is that the British Olympic Association only has responsibility for performance during the weeks of an Olympics and at no other time has direct input into sport performance in the UK, whilst on mainland Europe sport bodies normally sit under a country's Olympic association. A second example is UK Sport being concerned with performance sport, whilst separate sporting development bodies exist in each of England, Northern Ireland, Scotland and Wales. It is therefore important that interpretation of research within European countries considers these differences.

As it is unlikely ever to be regarded as ethical to conduct experimental research on young people in this context, the robustness of predictive models such as DMSP is always likely to be questionable. This paper, therefore, sought to retrospectively question UK-based adult athletes about the sports they participated in between the ages of 7 and 18, and to consider the number of sports played at each age against the early specialisation and sampling pathways towards elite performance within the framework developed by Côté and Fraser-Thomas' (2007) DMSP model. The key question was to identify whether early specialisation or sporting diversification (sampling) throughout childhood and adolescence can influence performance levels during the investment phase of the model, prior to adulthood. This approach had the advantage of working with child and youth participation histories in sport, whose outcomes at 18 years of age were already known.

Method

Participants

The study sample was recruited through an open call distributed by email communication via coaching networks, national governing bodies and sporting structures in higher education institutions in the UK. 1006 people who lived in the UK between the ages of 7 and 18 responded to the questionnaire and were included in the analyses. Forty-six percent of the sample were male and 54% female, and 76% of the sample were aged 25 or younger. In order to classify the sports that the sample covered, the sport in which an individual's highest playing standard was achieved between 16 and 18 years of age was considered to be their 'main' sport (this age band was chosen as it represents the investment phase of the DMSP for the sampling pathway of elite performance; it also represents the highest age groups that young athletes can compete in before being classed as adults in their sports). Using this segregation, the sample consisted of 362 people whose main sport was an individual sport and 549 whose main sport was a team one. The breakdown of the highest standard of competition aged 16–18 years was: none $n = 65$, school $n = 68$, club $n = 299$, representative $n = 446$, national $n = 128$. The main sports ($n > 50$) covered in the sample were athletics $n = 62$, football $n = 171$, hockey $n = 105$, netball $n = 92$, rugby union $n = 58$, swimming $n = 56$. There were also numerous smaller samples from other sports with the lowest return being for boxing and power lifting (both $n = 2$).

Materials and procedure

An online questionnaire was used to collect retrospective data on the sport practice patterns of sports people raised in the UK to study their effect on competitive performance standard between 16 and 18 years old. The study received ethical approval from the local institutional ethics committee and all participants gave informed consent online.

Instrument. An online questionnaire was developed using the Bristol Online Surveys facility of the University of Bristol, UK. Initial questions collected categorical data using dropdown list options on an individual's background including gender and age. Individuals were then asked to provide information about the number of organised competitive sports that they participated in each year between the ages of 7 and 18 years. They first indicated the sport that they were providing information for from a dropdown list of 37 sports and which included the provision of space to include sports that were not listed. Following this, individuals indicated by ticking radio buttons their highest standard of competition (none, school, club, representative and national) in the sport at each age. There was opportunity to provide information on up to 5 separate sports. The standards of competition were defined as follows, and based upon the UK sporting system: None – no participation in organised competitive sport; School – participation in school team competitive matches; Club – participation in club competitive matches where club competition was at a higher standard than school competition; Representative – participation in geographic area teams that involved a selection process from a wider pool of participants and in which competition was at a higher standard than club (e.g. county or region); National – participation in competitive matches in a national league or at national championships or above and at a level performance level higher than representative. Questions were asked about sports in

which they practised with a view to participation in organised competitive matches, as this was considered to represent purposeful sport. No attempt was made to separate out the activities into the previously described areas of deliberate practice (Ericsson et al., 1993) and deliberate play (Côté, 1999) as it was felt that the questioning required to separate these areas did not suit the use of the online methodology and is more suitably conducted using the suggested interview protocol of Côté, Ericsson, and Law (2005). However, it is likely that as the purpose of individuals' engagement in the sports for which they provided information was participation in competitive matches, the reported data more closely represents an individual's deliberate practice.

Recall error. A concern that arises in any study using retrospective recall data is accuracy of response. The literature suggests that accuracy for recurrent events in lifetime activity, of which sports participation is one, has a high recall reliability (Friedenreich, Courneya, & Bryant, 1998). The potential error in recall and bias in response has been examined by Dex (1991) and Bound, Brown, and Mathiowetz (2001). Both of these papers concluded that accuracy in recall is greater when the recall period is shorter, when the activity being recalled is salient to the individual and when the recall behaviour is habitual over a period of time. Sports participation often involves salient events such as major wins or losses and has a tendency to be structured and habitual over time, both things that have been suggested to improve recall (Dex, 1991). In the current study, 76% of the sample were under the age of 25 upon completion of the questionnaire, with a mean age of 23 $\pm$ 6 years. Therefore, for the vast majority of the sample, recall was over a maximum of 18 years, which is a shorter recall period than that of previous similar studies (e.g. 26–29 years, Baker, Côté & Deakin, 2006). Indeed, similar recall methodology to that used in this study has been used previously by Lunn (2010) over a much longer time course, with recall of sports participation to be reliable over a 10 year period (Butcher, Lindner, & Johns, 2002) and across the lifetime (De Vera, Ratzlaff, Doerfling, & Kopec, 2010). Specific to the years recalled in this study Côté et al. (2005) have found recall from the developmental periods to be reliable and whilst they found some concerns about sports, aside from the main sport, Hopwood, Baker, MacMahon, and Farrow (2011) found recall to be reasonably reliable. Overall, the above studies would suggest that the recall in the current study – whilst containing some errors – is likely to be broadly accurate about an individual's sport participation.

To further consider issues of recall, the questionnaire was additionally given to volunteers from two cohorts of university students who participated in sport, this enabled the authors to ensure the appropriate data were collected. The sample was students on sports-related degree programmes at a university and consisted of 21 male and 19 female students aged 19 $\pm$ 2 years with a range of playing standards between the ages of 16 and 18 years (None $n = 3$; School $n = 2$; Club $n = 14$; Representative $n = 13$; National $n = 8$). Each student completed the online questionnaire twice with the second completion being a minimum of 10 days after the first (12.0 $\pm$ 2.5 days). Additionally, a subset of individuals ($n = 10$) within the two cohorts provided verbal feedback to two questionnaires about the ease of completion and recall for the questionnaire. Responses were all positive in that that they had little difficulty in recalling their sport participation at each age or in understanding the questions asked. Further to this, percentage agreement (PA) and intraclass correlations (ICC) were calculated to assess test–retest reliability of the responses provided for the data on the number of sports competed in at each age between 7 and 18 years. These showed good reliability with PA ranging from 75.0–87.5% and ICC(3,1) from 0.61–0.92. For the categorical data on standard of competition, PA and Kappa coefficients (κ) were calculated which again showed good reliability with values of PA being 72.5–90.0% and κ being 0.61–0.85.

Data analysis

The data analyses presented here examine the number of sports in which respondents competed at each age in relation to the highest playing standard reached between the ages of 16 to 18 years. All individual responses were screened for obvious data inaccuracies in entry and those that were considered to be uncertain in their reliability, e.g. sporadic participation in single years, were excluded from the data set. Only five individuals reported data on five sports. As a result of this low value, the number of sports practised was categorised as follows: none, 1, 2, 3 and 4 or more at each age group, these categories have previously been used by Leite, Baker, and Sampaio (2009). Chi-squared tests were carried out to analyse the effect of the number of sports practised each week at the ages of 7, 9, 11, 13, and 15 on the highest playing standard achieved in any sport between the ages of 16 and 18 years old. This 16–18 range was chosen as it represents the investment phase of the DMSP model, when individuals are focused on performance and future elite athletes are likelier to be specialised in their main sport (Hopwood, Farrow, Baker, & MacMahon, 2012). It is also an age range when 81% of future national senior squad athletes from Olympic sports have been found

to be in national or international competition (Vaeyens, Güllich, Warr, & Philippaerts, 2009), which corresponds to the 'National' category in the questionnaire. Finally, it also represents the beginning of the transfer from youth to adult sport. These ages were chosen on the basis of providing measurements within the sampling (6–12 years) and specializing (13–15 years) years in the DMSP model of development proposed by Côté et al. (2007). The *P* value of Fisher's Exact statistic was calculated where possible but in the event of computational problems, a Monte Carlo approximation based upon 200,000 samples was used to determine the *p* value with 99% confidence. Previous work looking at retrospective sport participation often focuses on individual sports (e.g. Moesch et al., 2011) or team sports (e.g. Hopwood, Farrow, MacMahon & Baker, 2011) and sports participation patterns have been shown to be different in individual and team sports (Lunn, 2010). Therefore, in further analyses the data were split by type of sport (individual/team) based upon an individual's main sport to allow for comparison to this work.

Where a Chi-squared test showed a significant association between the number of sports practised at a given age and the competitive standard between 16–18 years old, odds ratios were calculated to quantify the change in the likelihood of an individual performing at a higher standard (national/representative) compared with the club standard. Comparisons for participation in 2, 3 and 4 or more sports were always made to the practice of one sport at each age. Ninety-five percent confidence intervals for odds ratios were calculated in the manner described by Bland and Altman (2000) and effect sizes are reported as Cramer's V. All analyses were performed on PASW 18.0 with α set at 0.05.

Results

The data on the number of activities practised per annum at each age is presented in Figure 1. The plot shows clear separation between all but those competing at national and representative standards between the ages of 16 and 18 years.

Individuals' participation in their main sport at each age is presented in Figure 2. At 11 years of age, participation in their main sport was 66% for individuals who would later compete at national level. The figure shows that not all individuals are in the sport in which they achieved the highest playing standard between 16–18 years at an early age.

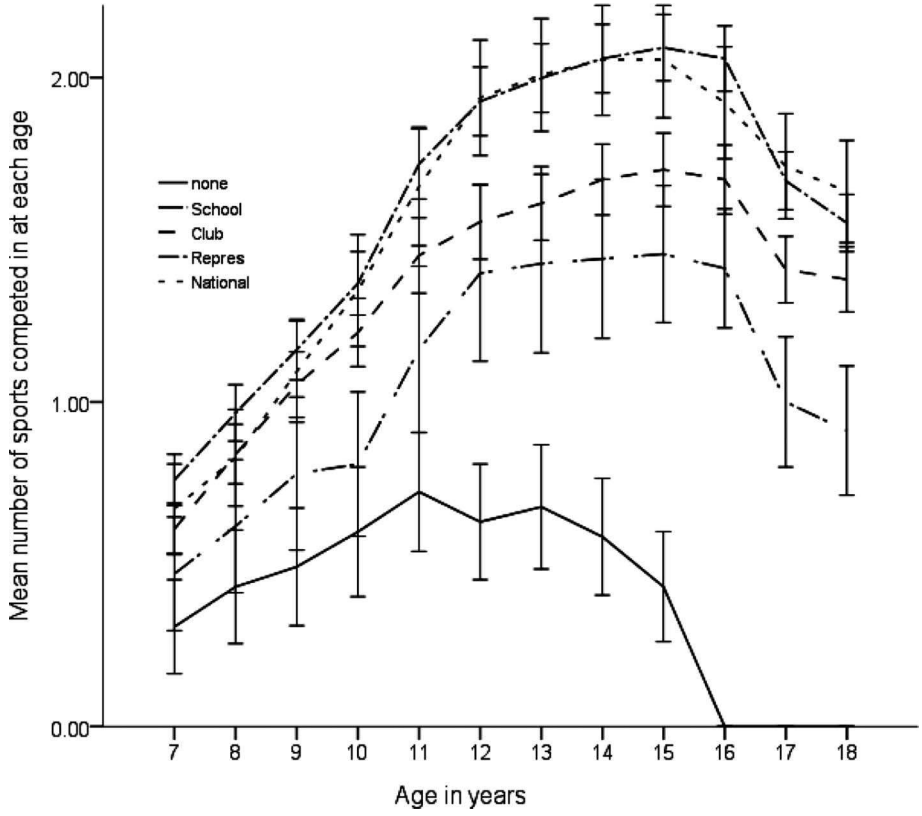

Figure 1. Mean number of sports competed in at each age by highest playing standard aged 16–18 years old. Bars show 95% confidence intervals.

All sports

There was a significant association between the number of sports (0, 1, 2, 3, ≥4) practised at all ages and the highest standard of performance aged 16 to 18 years; age 7 ($\chi^2(16) = 41.5$, $P < 0.001$, $V = 0.10$), age 9 ($\chi^2(16) = 62.3$, $P < 0.001$, $V = 0.13$), age 11 ($i^2(16) = 74.3$, $P < 0.001$, $V = 0.14$), age 13 ($\chi^2(16) = 136.0$, $P < 0.001$, $V = 0.21$), age 15 ($\chi^2(16) = 228.8$, $P < 0.001$, $V = 0.32$. Calculated odds ratios for comparisons are shown in Table I.

The engagement in three sports as opposed to one at the ages of 11, 13 and 15 significantly increased the likelihood of playing in national versus club level competition between the ages of 16 and 18 years of age. The likelihood of playing at representative or national level compared to below this was also significantly higher in an individual who was competing in more than one sport at the same ages (11, 13, 15 years). When the likelihood of competing at national level compared to any level below this was examined, individuals competing in three sports at the age of 13 were significantly more likely to compete at national level. This effect was also close to significance at the age of 15 with the confidence interval just spanning one (0.99–2.70, Table I).

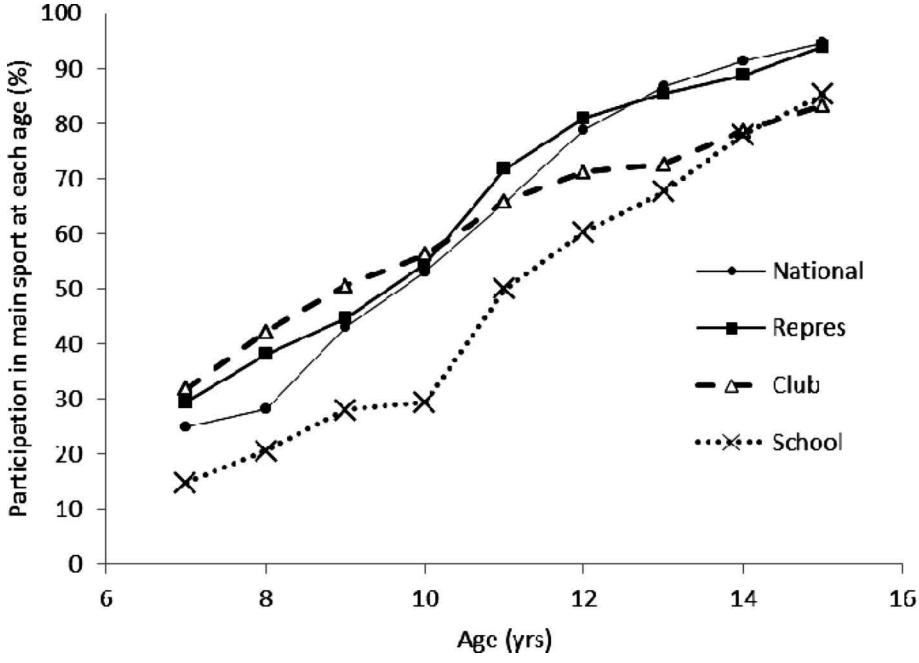

Figure 2. Percentage participation of sample at each age in the sport in which they achieved the highest playing standard ages 16–18 years.

Table I. Effect of number of sports practised on odds ratios of playing at different performance levels aged 16–18 years old. Numbers represent the odds (times more likely) of playing at the higher performance level in comparison to an individual playing one sport. 95% confidence intervals are given in brackets. * indicates a significant odds ratio $P < 0.05$. †At 7 years of age no individuals participated in four or more sports.

	National against club			National against below national			Representative / National against below		
Age (yrs)	2 sports	3 sports	≥4 sports	2 sports	3 sports	≥4 sports	2 sports	3 sports	≥4 sports
7	1.54 (0.72–3.39)	3.47 (0.75–16.09)	–†	0.93 (0.48–1.79)	1.56 (0.51–4.76)	–†	1.41 (0.90–2.22)	4.18* (1.21–14.42)	2.09 (0.22–20.26)
9	1.03 (0.57–1.86)	1.47 (0.64–3.42)	0.47 (0.05–4.12)	0.76 (0.45–1.28)	1.11 (0.53–2.27)	0.32 (0.04–1.44)	1.22 (0.85–1.74)	1.66 (0.93–2.94)	0.59 (0.59–4.25)
11	1.31 (0.79–2.17)	2.09* (1.09–4.02)	1.01 (0.37–2.72)	1.09 (0.69–1.69)	1.49 (0.86–2.63)	0.76 (0.31–1.85)	1.59* (1.16–2.18)	2.20* (1.41–3.43)	2.10* (1.17–3.77)
13	1.06 (0.65–1.75)	2.15* (1.19–3.89)	1.71 (0.66–4.47)	1.04 (0.67–1.64)	1.69* (1.02–2.78)	0.84 (0.38–1.89)	1.43* (1.05–1.95)	2.10* (1.41–3.14)	3.23* (1.78–5.84)
15	1.22 (0.75–2.01)	2.01* (1.13–3.60)	1.89 (0.79–4.52)	1.10 (0.70–1.72)	1.64 (0.99–2.70)	1.06 (0.51–2.22)	1.60* (1.18–2.18)	2.09* (1.42–3.09)	3.69* (2.05–6.63)

Individual and team sports

When the data were split by the type of sport played (individual/team, Table II) between the ages of 16 and 18 years then the effect of number of sports practised at the age of 7 was removed ($\chi^2(16) = 22.4$, $P = 0.19$, $V = 0.11$, individual; $i^2(16) = 21.3$, $P = 0.23$, $V = 0.09$, team). The effect was also removed for individual sports at the age of 9 ($\chi^2(16) = 22.9$, $P = 0.10$, $V = 0.12$) but remained present for team sports ($\chi^2(16) = 31.8$, $P = 0.005$, $V = 0.12$) at this age. For all other ages the effect of the number of sports remained for both individual and team sports; age 11 $\chi^2(16) = 26.0$, $P = 0.03$, $V = 0.14$, individual, $\chi^2(9) = 13.4$, $p = 0.12$, $V = 0.12$, team; age 13 $\chi^2(16) = 31.3$, $P = 0.005$, $V = 0.16$, individual, $\chi^2(16) = 40.6$, $P < 0.001$, $V = 0.14$, team; age 15 $\chi^2(16) = 32.5$, $P = 0.004$, $V = 0.19$, individual, $\chi^2(16) = 38.9$, $P < 0.001$, $V = 0.15$, team.

For individual sports, odds ratios revealed no significant effect on the likelihood of competing at national or representative level compared with club level with changes in the number of sports at each age. For team sports, a similar pattern of effects of the number of sports practised on odds ratios was observed as for all sports. Individuals competing in three sports aged 11, 13, and 15 were more likely to play at national level compared with club level. In general, individuals competing in more than one sport aged 11, 13, and 15 were more likely to compete at representative or national level than below, between 16 and 18 years of age (Table II). When the likelihood of competing at national level compared with below this was examined, individuals, aged 15, competing in three sports were more likely to be at national level.

Discussion

The objective of this study was to provide empirical data on the number of organised sports individuals raised in the UK took part in during their developmental years, and to set this against the pattern of sampling and sport involvement suggested in the framework of Côté and Fraser-Thomas' (2007) DMSP model. In the DMSP model the sampling years (6–12) involve a gradual increase in sporting activity that is continued throughout the specialising years (13–15), and this pattern is apparent in the current findings (Figure 1). A similarly shaped figure has also been shown previously by other authors (Berry, Abernethy, & Côté, 2008) looking at sport participation histories in elite Australian Football League players. This shift is supported by there being no significant increase in the likelihood of a later higher standard of competition from increased participation in competitive sport at 7 and 9 years old, and participation in three sports aged 11 increasing the likelihood of a later higher standard of performance. The importance of increasing sport participation is strengthened by participation in three sports during the specialising years (ages 13 to 15) also significantly increasing the likelihood of later participation at a higher competitive standard. These findings are in line with the work of other authors (e.g. Baker et al., 2003b, hockey, netball, basketball; Lidor & Lavyan, 2002, 21 different sports; Vaeyens et al., 2009) who found increased sampling across sports led to a higher standard of competition later. It should be noted, however, that the current study looked at an individual's performance between 16 and 18 years old as a precursor to potential later success, whereas others have measured older athletes who are considered elite, often having competed internationally. The sampling pattern seen here is not a consistent finding across the literature; early specialisation is suggested as beneficial in some sports (e.g. Baker, 2003; Côté et al., 2009; Law et al., 2007) while no differences have been found in the number of sports participated in between elite and near-elite athletes in sports where performance is measured in centimetres, grams and seconds

Table II. Effect of number of sports practised on odds ratios of playing at different performance levels aged 16–18 years old when the main sports aged 16–18 is a team sport. Numbers represent the odds (times more likely) of playing at the higher performance level in comparison to an individual playing one sport. 95% confidence intervals are given in brackets. * indicates a significant odds ratio $P < 0.05$. †At 9 years of age no individuals participated in four or more sports.

	National against club			National against below national			Representative/National against below		
Age (yrs)	2 sports	3 sports	≥4 sports	2 sports	3 sports	≥4 sports	2 sports	3 sports	≥4 sports
9	1.49 (0.63–3.48)	0.92 (0.19–4.46)	†	1.10 (0.50–2.43)	0.65 (0.53–2.27)	†	1.14 (0.72–1.78)	1.49 (0.73–3.07)	1.21 (0.20–7.39)
11	1.22 (0.55–2.72)	3.21* (1.16–8.90)	0.63 (0.07–5.28)	1.04 (0.50–2.15)	1.72 (0.72–4.10)	0.42 (0.05–3.27)	1.50* (1.00–2.24)	2.42* (1.34–4.34)	2.16 (0.97–4.80)
13	0.88 (0.40–1.96)	2.75* (1.13–6.70)	1.38 (0.26–7.24)	0.84 (0.41–1.74)	1.95 (0.91–4.19)	0.63 (0.14–2.79)	1.29 (0.87–1.92)	2.13* (1.24–3.65)	2.81* (1.30–6.08)
15	1.21 (0.53–2.75)	2.60* (1.07–6.31)	1.94 (0.64–8.52)	1.03 (0.50–2.12)	2.22* (1.04–4.76)	1.44 (0.47–4.45)	1.62* (1.09–2.41)	1.67* (1.00–2.76)	3.05* (1.46–6.37)

(Moesch et al., 2011). Whilst the current sample is large it does not contain adequate numbers of responses for each individual sport to allow analysis at this level, as such we cannot examine single sports such as gymnastics, which have previously been found to suit early specialisation and instead present a broader finding across all, team, and individual sports. Investment in one sport is suggested to occur from 16 years of age in the DMSP model (Côté & Fraser-Thomas, 2007). Figure 1 shows agreement with this with a reduction in the number of sports practised occurring aged 16 in all individuals and with the suggestion that this may start to occur at 15 in those who later compete at a national level, a specialisation point that has been seen in basketball players (Leite & Sampaio, 2010, 2012). This investment point in solely one sport may be later than this with recent work showing elite Danish (Moesch et al., 2011) and Portuguese (Leite et al., 2009) athletes not focusing on a single sport until 18 years of age, although they had participated in it prior to this.

The increased likelihood of reaching a higher level of competition when participating in three sports during the specialising years was repeated when team sports where looked at separately (Table II). Participation in three sports during the specialising years has been found in elite Australian Football League players (Berry et al., 2008) and in ice-hockey players (Wall & Côté, 2007). Although no differences were found in the number of different sports practised between experts and less-skilled performers (Berry et al., 2008), it should be noted that the sample were all elite players, whereas in the current study we were only looking at performance between 16–18 years of age. For sports of an individual nature, whilst the number of competitive sports was still associated with changes in competition standard aged 16 to 18, there were no significant effects on the likelihood of a higher standard of competition. This is in contrast to the literature, which suggests that diversification is important in individual sports such as triathlon (Baker et al., 2005) and swimming (Fraser-Thomas, Côté, & Deakin, 2008). It is likely that the current findings may result from the diversity of different individual sports ($n = 26$) and a low number of these sport being classed as individuals' main sport. Within these sports, 13 of the sports had a sample size of fewer than ten responses; we therefore suggest that this finding must be interpreted with caution, and that more work needs to be done on specific sports themselves.

Early engagement in the main sport has been suggested as being a determinant of later performance in soccer (Ford, Ward, Hodges & Williams, 2009) and has also been seen in young basketball players (Leite & Sampaio, 2010). The current work found the majority of individuals who reached a national level of competition between 16–18 years were not engaged in their main sport at 7 or 9 years of age (25.0% and 43.0% participation). This is in contrast with a frequent start age of 5 years old in individuals who later became professional football players (Ford et al., 2009) and young skilled basketball players where 87.4% were playing by age 10 (Leite & Sampaio, 2010) although the same authors have also found that some 17.6% of elite basketball players start later than this (Leite & Sampaio, 2012). Ford et al.'s (2009) finding may be unique to football and its elite academy systems and is supported by 90.5% participation by age 10 in elite Portuguese footballers (Leite et al., 2009). In the current study, participation in the main sport by later national level competitors was 65.6% at 11 and 86.7% at 13 years of age suggesting that participation in the main sport during the sampling years may be important, but that participation before this is not essential.

When looking at the pattern of individual's sport participation history over time, it is important to consider the influence that schooling may have upon the data. The participation in several sports during the specialising years by individuals who achieve a later higher standard may be the result of school physical educators preferentially selecting individuals who have shown early evidence of higher motor potential in a bid to achieve sporting success for the school. Equally, it may be this early development of motor potential or competence that allows these individuals to cope with participation in a repertoire of different sports (Stodden et al., 2008) this in turn may further strengthen their motor and psychological capabilities and lead to higher sport performance in late adolescence.

The current study relies on the accuracy of individual recollections of sporting activity, and with this type of data there is likely to be a degree of inaccuracy in recall, particularly over longer periods of time. Counter to this is the salient nature of competitive sporting experiences and, for individuals engaged in competitive sport, its nature as a habitual activity. The period of recall in this study was also relatively short (maximum 18 years) in comparison with some other recall work (e.g. Baker et al., 2006; De Vera et al., 2010) and the large sample size here should present a sound indication of sports participatory behaviour. When interpreting these findings it must be remembered that we have looked at the competitive standard between 16 and 18 years as the outcome measure. It is possible that this does not represent the highest standard of competition for all individuals in the sample as the age of peak performance in sports is known to differ (Ericsson, 1993). We have specifically examined individuals' sampling of sport linked to competition

throughout their adolescence against the DMSP model. It should be remembered that this is not the only facet of the model and we present no data on hours of engagement in different classifications of activities such as, deliberate practice and deliberate play. Against this there is evidence that competition time may be key in developing expertise in some sports (Starkes, Deakin, Allard, Hodges & Hayes, 1996).

Conclusion

This work has presented novel data that provide a broad overview of the childhood and adolescent competitive sport participation of individuals in the UK between the ages of 7 and 18 years. It has found an increased likelihood of achieving a higher standard of competition when individuals participate in three competitive sports during the specialising years of the DMSP model (Côté et al., 2007) and supports the pattern of sport sampling proposed in the model. This has important implications for the frameworks used by UK sporting bodies for the development of young athletes who at 18 years of may have the potential to excel in their sporting careers. The data suggest that early specialisation is not a requirement for high standards of performance at 18, and in this regard further work is needed within individual sports to understand and confirm the findings seen here within a UK cultural context.

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