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Detecting and developing youth athlete potential: Different strokes for different folks are warranted

Haresh T Suppiah, Chee Yong Low, Michael Chia

Abstract
Sport talent identification and development (TI and TD) in youth continues to attract strong interest among coaches, sport scientists and sport administrators. TI for sport in youth with the anticipation of future elite level sport achievement is both an art and a science, and is strongly influenced by within athlete and extraneous-to-athlete factors (ecosystem of support or the lack of). The returns from investment on current TI and TD models of sport in youth are subpar in that few continue in the sport to achieve podium positions at the elite sport level in adulthood. Why, where and how one succeeds in sport, and what that success means to the athlete and stakeholders are dependent on the culture and context of the country. We advocate harnessing the power of sport to help in youth development, to be holistic in its nurturance, to allow for individual idiosyncratic expressions of the athletes, to provide for talent transfer across sport, and to facilitate key stakeholders to ‘join’ hands to work for the common interest and understanding for as many youth and adults so as to provide them with opportunities through support and coaching to compete at the different levels of competition in sport. Governments, policy makers and administrators of sport must decide, within their specific circumstances, if TI and TD in sport in youth is serving a meaningful purpose and is a viable return on investment; in short, is it mission possible or is it… a quest for the Holy Grail for a podium finish in elite level sport competition?

Introduction
Talent identification and development (TI and TD) of youth in sport, in the quest for international or professional athletic success in early-to-mid-adulthood, are perennial issues that face major sporting bodies. The non-uniform use and lack of universal agreement on the nomenclature selected to describe sport talent, its' potential and success further complicate an already complex issue. TI is defined as the process of recognising current participants with the potential to excel in a particular sport, while TD provides the required learning environment to maximise this potential. In professional sport, the early selection and signing of sport contracts of talented youth or even child athletes further fuels the haste to detect and identify sport talent at too early an age.

How early TI occurs is fraught with potential errors and uncertainties, and for many countries, the return on investment is subpar. The attempt to distil the complex development of an elite athlete to a singular, universally accepted framework is problematic. The inimical consequences are a high attrition rate in terms of drop-outs and underperformance in the ‘early identified talent’ and the high opportunity cost of undiscovered real talent. Some cogent evidence affirms the non-linear advancement of youth sport talent from playground to podium due to a variety of inter-individual differences (biological, psychosocial and emotional
dispositions), which are magnified by yet indeterminate differences across country, culture and context. TI and TD of sport in youth with the anticipation of future elite-level sport achievement are both an art and a science, and are strongly influenced by within athlete and extraneous-to-athlete factors.

The purpose of this review is to provide insights into the key challenges surrounding TI and TD, and to suggest potential areas for consideration in the future. It examines the critical need to deliberately focus on sport-specific development in a particular sport at an early age (ie, early specialisation and deliberate practice). Additionally, alternative pathways to success in elite sport are presented to highlight the need to adopt a flexible approach to athlete development, and to step away from prescriptive paradigms of sport's talent development. This commentary also emphasises the cultural and contextual perspectives of the youth athlete's development, and highlights the idiosyncratic traits of adolescent-athletes, as seen across individual and team sports; these issues have so far not received sufficient attention.

Talent identification and talent development of sport in youth—is it fallacious, fallible or a fantasy?

What makes for an elite sport champion is a combination of many factors that interact with each other in a certain time and space, often in immeasurable ways, which may never be replicated again even when similar conditions come together, but at a different time or place. There is an expectation that resources (funding, coaching and sport science expertise, time) funnelled to TI and TD systems are a viable investment where competition successes at progressive levels of competition are secured and repeated. Success in TI and TD is determined by a plethora of bio-psychosocial factors and transferring of apparently successful athlete development systems across countries and contexts is foolhardy.4

A limitation of sport science research is to investigate measurable variables using valid and reliable tests that intuitively contribute to sport achievement (eg, laboratory or field test performance) when there are other indeterminate variables, such as drive and determination in a specific context, familial circumstances, the interplay with known and unknown determinants,5–8 that may also be strong contributors of sport success. Moreover these variables are dynamic, interact with each other and vary across time, country, culture and context. Often, the complex interplay of physiological, psychological and socioeconomic factors is not considered or quantified in many TI and TD processes even when it is generally accepted that certain psychological traits are characteristics found in a highly successful athlete.9 Abbott and Collins10 called for a continual monitoring system that accounts for psycho behavioural dispositions when identifying potential talent and its efficacy, which was documented in a group of Swiss youth footballers where those who reported a high level of intrinsic-achievement-orientation were more likely to be gain membership in the national team.11

A primary flaw in many TI test protocols is the questionable validity in predicting future performance in sport.12,13 Robertson et al13 noted that only 14% of studies investigated the predictive validity of test protocols. Anecdotal reports of elite Olympic athletes who were rejected from TD programmes based on snap-shot TI assessment tests14 are also instructive of how early TI results in talent wastage where obvious and immediate talent at a certain point in time may not be the talent that is required for elite level performance in adulthood.
Other data show that only 0.14–1.7% of athletes who were involved in an elite sports school programme obtained sporting excellence in the form of a medal at an international senior level. Current methods of athlete identification and development are costly, with arguably inequivalent outcomes. While the economic rationale of TI and TD is to focus limited resources onto athletes with the highest chances of success, paradoxically, this system may contribute to a different set of efficiency problems. Value-proposition: Establish greater predictive validity of performance tests that are used to monitor an athlete's progress during development; use these tests as sources of information rather than for selection or de-selection. Interpret the performance results with discernment and with caution.

Early specialisation, the relative age effect and beyond

The inherent need to win at the youth and adult levels of sport competition drives early specialisation towards a singular sport, which is highlighted as a potential limiting factor for eventual elite-level success in adulthood and is associated with a greater propensity for overuse injuries. Survey findings on Olympians on the effectiveness of TI and TD programmes in the USA reveal that athletes played on an average three sports per year until the age of 14, and only began to focus on a single sport after the age of 19. The Olympians were multisport rather than single-sport athletes in their youth, and they attributed their pinnacle achievements in sport to an early exposure to a variety of sports. Emergent research using mixed longitudinal-retrospective designs acknowledge that reaching the pinnacle of sporting success is far more complex than accumulating sport-specific training hours through early specialisation. Cogent evidence suggests that the acquisition of expertise in sport is malleable to a wide range of training hours that is dependent on the nature of the sport.

Associated evidence demonstrates that the predictability of long-term (adult-aged) success in sport based solely on the talent displayed during adolescence is weak due to the confounding biological effects of maturation and perhaps to other ‘yet-to-be-determined’ variables that account for sport achievement. Early biological maturation that leads to an over-representation of chronologically older athletes in TI is known as the ‘relative age effect’ (RAE). Research informs that RAE was prevalent in all categories of sports during the 2012 Winter Youth Olympic Games, resulting in an over-representation of athletes born shortly after the cut-off date. Within the Summer Olympic Games, there is also evidence to show an RAE in the sport of triathlon in men, and a relationship between birth semester and podium placing. Cobley et al reported that for 253 athletes across 14 sports, the RAE was documented in nearly all sports, in both sexes and across the spectrum of developmental levels. In team sports, a 4-year study tracking player (mean age at baseline: 10.9±0.7 years) rates of improvement on performance measures in soccer from the age of 11, showed higher rates of improvement in late-maturing athletes in running and agility tests when compared to early-maturing players. Team sport research on a single sport club of rugby players revealed that more players whose birth dates were in the last two-quarters of the year demonstrated ‘mental toughness’, thrived in the sport and eventually gained membership into the senior team compared to those who were physically older and who gained early selection because of the RAE. This ability to thrive after experiencing ‘desirable difficulties’ during an athlete development process is a key consideration of sporting talent. Within German football, a retrospective analysis in the years 2001–2013 on the early identification and long-term promotion programmes was conducted. The majority of professional senior players emerged from a process of frequent selection and de-
selection. Most notably, the majority of players who were identified early in the programme failed to remain till adolescence, while many of those who were successful in becoming professionals at a senior level were able to do so without the early interventions of a TD programme. These findings are affirmed by earlier evidence from German elite sports indicating that the earlier the age an athlete is identified into a talent development programme, the younger the age in which the athlete leaves the sports talent development system.\(^3\)

These data indicate the potential for late-maturing athletes, in team and individual sports, to catch up with their early-maturing counterparts on certain performance variables, underscoring the unpredictable nature of TI based on early selection tests and the biased selection outcomes due to the RAE.

Value proposition: Allow young people to sample as many physical activities and sports in the context of play. Allow and encourage wholesome sport experiences in competition settings without too much structured training (imbue variety and fun elements within a single sport or across different sports).

Deliberate practice, deliberate play or early engagement—is there room for a compromise?

Stakeholders in sports justify the need for early sport specialisation because of the need for deliberate practice (DP)-practice that is prolonged, highly structured and with routines that are designed solely for the attainment of expert performance in a particular domain.\(^3\)3 This concept was based on research by Simon and Chase,\(^3\)4 on what differentiated novice and expert chess players in terms of practice time and that 10 000 h of DP was mandatory for an individual to attain expertise. Other studies showed that at least 10 000 h of deliberate training in sports such as gymnastics,\(^3\)5 darts\(^3\)6 and triathlon\(^3\)7 are common. However, yet other data show that less amount of training hours are required for expert-level performance in other team sports\(^3\)8 and in skeleton.\(^3\)9 A counterpoint view of DP is that findings from the HERITAGE Family study show that 50% of baseline \(\dot{V}O_2\text{max}\) is heritable and genetic factors explained 47% of the response to aerobic training. DP also does not account for the possibility of achieving expertise in sport by positive skill transfer\(^4\)0–\(^4\)2 or through physical attributes\(^1\)5,\(^3\)9 obtained by competing in multiple sports. Finally, research on DP is criticised for its methodology\(^4\)3 and is suggested in a meta-analysis to explain only 18% of expert skill acquisition in sport.\(^4\)4 The position that outstanding performance is the result of years of DP, and not because of any innate talent or skill is no longer tenable.\(^4\)5

Long-term engagement in a single sport is shown to increase participant dropout rates in sport prematurely\(^4\)6,\(^4\)7 and also increases the risk of injury, psychological stress and burnout.\(^1\)9,\(^2\)0 This is confirmed in a comparative study on the developmental characteristics between subelite and elite gymnasts.\(^3\)5 While early specialisation and a greater DP time was reported by Olympic (elite) gymnasts compared to their international level (subelite) counterparts, the elite athletes also reported poorer health ratings and greater injuries in addition to lower ratings and fun during training.

In contrast to deliberate practice and its underpinning of early specialisation is the concept of deliberate play that promotes participation in a plethora of inherently enjoyable, playful and unstructured activities that allow for the early sampling (diversification) of sporting experiences followed by a funnelling towards a single sport at the age of 16 (late
specialisation). Some data show that early diversification of multiple sport produces more athletic successes. In a retrospective, cross-sectional analysis by Moesch et al., on Danish national (elite and subelite) athletes (aged 9–21) who were involved in centimetres, grams or seconds (CGS) sports, findings show that 62–63 months of the athletes’ development, when they were between the ages of 9–21, were spent practising other sports. Furthermore, the elite-level national athletes spent less practice hours in their specialised sports before the age of 15 compared to their subelite counterparts, and only increased the specialised practice hours from the age of 18. The elite athletes also delayed the start of their initiation, development and perfection stages of sport, and did not participate in their first national and international competitions till later in their development years. This evidence is congruent with reports on Olympic athletes from the USA and professional German football players, where diversification in other sports early in youth development followed by subsequent specialisation to a single sport are characteristics of successful elite athletes of team and individual sport.

The Developmental Model of Sport Participation (DMSP) accounts for both potential pathways (deliberate practice and deliberate play) of progress towards expert sport performance. Some evidence show that the dichotomous model lacks fluidity in elucidating alternative pathways to development. Researchers acknowledge that neither polarised concepts (DP or DMSP) can be applied to all sports. Ford et al. offer an early engagement hypothesis to explain the development and evolution of sport success. They examined the development pathways undertaken by recreational, ex-elite and still-elite English football players. Essentially, they reported higher amounts of play in soccer, with low-to-high amounts of practice and competition in soccer, and minimal engagement in other sports in the most successful group of soccer players. This dynamic balance between domain-specific practice and play in a single sport, what we refer to as ‘productive play-practice or practice-play’, provides a flexible compromise between the dualistic tenets of deliberate practice and deliberate play, and is efficacious in explaining the developmental pathways of elite football players.

Value proposition: Attaining sport expertise does not happen in the absence of practice and play, in a deliberate form or otherwise. Acknowledge that a diverse exposure to sport, and the intricate details of the developmental route undertaken by a successful elite athlete largely depends on the nature of the sport, and the culture and context of the country. Caution is warranted in adopting a dichotomous or a ‘one-model-fits-all’ approach to developing sport expertise in youth and beyond.

The need for flexibility, porosity of talent transfer and a reframing of sport success

The talent transfer or crossover approach is another consideration towards the development of successful elite athletes and is well documented in the literature. Vaeyens et al. cite several examples of Olympic medallists who went on to win additional medals in a different sport later in their careers. The Australian Institute of Sport (AIS) handpicked top-level athletes from the sports of surf life-saving and track and field, and successfully groomed them towards medal winning performance in the winter sport of skeleton within 14 months. Talent transfer at the highest levels is not exclusive to the AIS. UK Sports and the Japan Sport Council have already established talent transfer programmes. The talent transfer programme in the UK also allows for transfer of talents across different government
agencies in its TI practices by allowing female athletes who are regulars within the British Army to try out for the Olympic squad in a variety of sports.56

The Australian Institute of Sport (AIS)57 put forward the FTEM (Foundations, Talent, Elite, Mastery) framework which provides a flexible and porous platform that recognises the unstable nature of elite athlete development. This framework provides a non-prescriptive scaffold that takes into account the entire athlete development pathway, which can be adapted to a variety of contexts and sports. However, the validity and applicability for this framework outside of its country of inception has yet to be determined. Prototypical athlete development models frequently provide neat and coherent athlete development pathways that tend to be overly simplistic and do not account for the intricate and non-linear trajectories that are often undertaken towards sporting excellence. Stakeholders in sport need to move away from prescriptive chronological models, and instead work towards systems that incorporate a high degree of flexibility and porosity.

A reframing of the term ‘athletic success’ is warranted in the context of athlete development in which success is not just limited to becoming the best in the world in a sport (ie, Olympic and World Championships), but rather a celebration of successes at different developmental phases of an athlete’s career. Research in track and field, and swimming58,59 suggest that only a 2.6–5-year window in the third decade of an athlete’s life is available to achieve peak performance. Rushing to peak within such a narrow window ignores the fact that different athletes may peak at different times, depending on their developmental pathways. The earlier onset of sport-specific training results in earlier success during adolescence, but limits an athlete’s potential to becoming successful at a senior level and beyond.25 After all, beyond the Olympic Games, there are also World Championships at the Master levels of competition.

Value proposition: Allow, expect and encourage transfers of talent across sport. Anchor sport as youth development and allow youth to find joy and meaning in the pursuit of excellence in sport throughout the athlete lifespan.

Other considerations in talent identification and development

The interplay of the influences of stakeholders, culture and context of sport in the country

Baker and Horton60 stressed the important roles of stakeholder involvement (coaches, parents and national sport associations) within TI and TD. The need for an ecosystem of development and nurturance is another major contributory factor not to be neglected. Current evidence indicates a lack of support from stakeholders on the research philosophies underpinning TI and TD, as well as incompatibility between stakeholder beliefs on appropriate practices.61 This lack of coherence in ‘stakeholder’ expectations vary across country, culture and context of the sport.

The contextual environment within which an athlete develops is argued to be associated with sporting success. Côté et al62 reported that overly small and overly large region sizes in North America were not ideal for the development of high-level athletes. Additionally, data on North American and European Olympic and professional athletes showed non-significant associations between birth location and athletic success; instead researchers suggested a potential link between the developmental contexts rather than the geographical location as a factor in determining sporting excellence.63
In comparing country-specific elite sport development environments, researchers have posited 9 pivotal pillars that influence international sporting success, but a follow-up investigation showed that the chances of success would not increase by focusing on specific pillars. It appears that some permutation of the 9 pillars for sporting success and a tailoring to the specific requirements of a country would be necessary to gain a competitive advantage. For example, despite meeting many of the pillars theorised to elicit sporting success, athletes representing the city state of Singapore struggled to experience greater Olympic level success purportedly due to the country's long-standing emphasis on economic advancement, a lack of sporting culture and military conscription for men at age 18. In 1993, the nation introduced the Foreign Sports Talent (FST) Scheme which allows sporting bodies to identify foreign athletes to represent Singapore by expediting their citizenship status. This scheme paid dividends for Singapore in the 2008 and 2012 Olympic Games, when athletes under the FST Scheme won 3 medals, bringing the nation's total medal tally at the Games to four. While the policy of having naturalised athletes in competition is also replicated by other nations, it puts in perspective alternative approaches in which nations address their contextual idiosyncrasies in applying TI and TD in sport to produce podium winners in elite sport.

Genetically built for success

An athlete's genetic predisposition is a contributory factor in the pursuit of sporting success. The ability to distil an individual's physical traits using a non-invasive and commercially available test kit is highly appealing as it seems to eliminate a large degree of predictive uncertainty, allowing for a more efficient TI system. There are also apparent advantages in genetic testing for a predisposition to sports injury. Owing to these benefits, much interest is shown on the potential role of genomics in identifying traits for elite sporting performance, with even documentation of its use in professional sport to tailor training programmes to match the genetic ability of each athlete.

To date, 214 gene entries have been included in the human gene map for performance. In a review on the current state of affairs in sports genetics and its role in the future, Pitsiladis et al highlight the ACE and ACTN3 genes as potential candidates that are associated with human physical performance. However, the authors categorically clarify the infancy of the field in determining elite success based on gene analysis and further, state its absence of predictive power in TI. This lack of predictability was evident in a case study involving an elite Spanish Olympic long jumper, with a history of international accolades in this event, who was ACTN3 deficient, which is widely reported to be unfavourable for speed and power events, and more suited for endurance performance. While an individual's genetic predisposition contributes to their talent ceiling, inferring future performance based on genetics alone ignores the complex synchrony of other prevalent factors.

Sleep

Chronic sleep loss among elite athletes is a problem with shortened sleep reportedly associated with increased risk of injury and reduced sport performance. The hormonal and neurological alterations that occur around puberty alter the homeostatic and circadian regulation of adolescent sleep. The natural tendency for later bed and wake times in adolescents is established in the literature, and is a key developmental characteristic of adolescence. These changes and the significance of sleep for youth sport performance
have not received much attention till recently. Currently, only the Canadian Long-Term Athlete Development programme acknowledges the importance of sleep in athlete development. As it is well-established as a vital component of an athlete's physiological and cognitive processes, both acutely and in the longer term, the reduction of sleep quality or quantity is suggested to be associated with the development of over-reaching or over-training among athletes. In addition, skill acquisition and complex motor learning are crucial to achieve elite status in sport, both critical elements to the development of sporting talent. As improvements in these factors are enhanced following requisite durations of sleep due to ‘offline’ learning, the chronic premature truncation of optimal sleep durations may hinder a youth athlete's potential.

Adolescents require between 8.5 h and 10 h of sleep for optimal functioning. However, research informs of a worldwide prevalence of inadequate sleep among adolescents due to the combination of biological changes and societal demands. Coaches of adolescent-athletes should be aware that delayed sleep and wake routines among youth athletes increase basal sleep requirements which cannot be assuaged because of training or schooling schedules in the morning. The consequences of chronic sleep loss may be greater on youth athlete due to their increased sleep requirements. To ameliorate chronic sleep deficiencies among youth athletes, specially tailored training and schooling schedules that harmonise with the unique sleep patterns of youth athletes could be considered.

Conclusion

Success at elite level sport stems from a combination of numerous factors that vary based on the sociocultural and politicoeconomic context of the country that the athlete lives in. Intrinsic and extrinsic factors work in complex synchrony to ultimately determine or undermine an athlete's success in sport. Stakeholders in sport need to acknowledge and accommodate the complexity of these factors in determining the athlete's level of success in youth and in adulthood, and limit ascribing the development of the elite-athlete to singular attributes. There is a strong need to adopt an integrated approach and understand the importance of various contributory influences that optimise athlete development in youth.

What are the new findings?

It is suggested that early participation in sport, facilitating-support structures, focused training and competition experience are building blocks for mastery in sport. These life-enhancing experiences supposedly consolidate physical strength and the psychological conditioning of the athlete who now becomes more intrinsically motivated to succeed at the elite levels of competition. However, not all successful athletes ‘navigate this route’ and there are many unconventional routes towards sporting success. The uncertainty of the journey from playground to podium is further complicated by the unique and specific interplay of influences that emanate across country, culture and context, which also vary across time. This article provides a current appraisal on the multifactorial issues central to the identification and development of youth sport talent. It also highlights the need to step away from prescribed models of athlete development and paves a variety of pathways leading towards elite-level sporting expertise and success.

How might it impact on practice in the near future?

There are many routes to sporting success in youth and in adulthood. This process and
outcome are largely dependent on the culture and context of the country. A future-forward approach is to be holistic in youth athlete development, allowing for individual idiosyncratic expressions of athletes and facilitating talent transfer across sport. A move away from restrictive and prescriptive models of talent identification and development (TI and TD) may yield more productive results in sport achievement and a more positive ecosystem in sport. Governments, policymakers and administrators of sport must craft to their specific circumstances TI and TD systems that serve a meaningful purpose and provide a viable return on investment.

Footnotes

Narrative review designated for the IPHP edition (Talent Identification and Development of Youth in Sport—IOC).

Contributors HTS researched the available databases and drafted the manuscript. CYL coauthored and critically appraised the manuscript. MC oversaw the approach and concept of the manuscript, provided critical insight and coauthored the review. All authors read and approved the final manuscript.

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i We refer to talent detection as the act of selecting athletes with the immediate ability to be successful at competitions due to the inborn incentive to win. Talent identification, on the other hand, is a predictive endeavour with the aim of future or long-term success. The emphasis to win in youth sport may pressurise coaches to talent detect due to the short-term incentive to win. Thus, talent identification for future success becomes merely rhetorical. In such instances, athletes that make it into talent development programmes (funnelling of resources such as coaching, sports medicine, sports science) are those that outperformed their counterparts during a selection test, rather than those who have the greatest potential for future success.

ii The nine pillars are (1) Financial support, (2) Integrated approach to policy development, (3) Foundation and participation, (4) Talent identification and development system, (5) Athletic and postcareer support, (6) Training facilities, (7) Coaching provision and coach development, (8) (Inter)national competition and (9) Scientific research.

iii See Breitbach et al72 for a more detailed review of this area.

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