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Talent Identification and Development Programmes in Sport

Current Models and Future Directions

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Abstract

Many children strive to attain excellence in sport. However, although talent identification and development programmes have gained popularity in recent decades, there remains a lack of consensus in relation to how talent should be defined or identified and there is no uniformly accepted theoretical framework to guide current practice. The success rates of talent identification and development programmes have rarely been assessed and the validity of the models applied remains highly debated. This article provides an overview of current knowledge in this area with special focus on problems associated with the identification of gifted adolescents. There is a growing agreement that traditional cross-sectional talent identification models are likely to exclude many, especially late maturing, 'promising' children from development programmes due to the dynamic and multidimensional nature of sport talent. A conceptual framework that acknowledges both genetic and environmental influences and considers the dynamic and multidimensional nature of sport talent is presented. The relevance of this model is highlighted and recommendations for future work provided. It is advocated that talent identification and development programmes should be dynamic and interconnected taking into consideration maturity status and the potential to develop rather than to exclude children at an early age. Finally, more representative real-world tasks should be developed and employed in a multidimensional design to increase the efficacy of talent identification and development programmes.

Talent identification ('TID', i.e. the process of recognizing current participants with the potential to excel in a particular sport) and talent development ('TDE', i.e. providing the most appropriate learning environment to realize this potential) play a crucial role in the pursuit of excellence (figure 1).[1,2] In many organizations and top level teams, science-based support systems (e.g. psychological counselling, physical conditioning, computer-based match analysis) are now fundamental to the preparation of elite athletes. However, due to the lack of scientific grounding for most TID programmes, many scholars have suggested that research efforts should be transferred from TID and detection to TDE and guidance.[3,4] Yet, despite the change in research focus,[4,5] many national federations and club teams, particularly in the professional sports, continue to invest considerable resources in an effort to identify

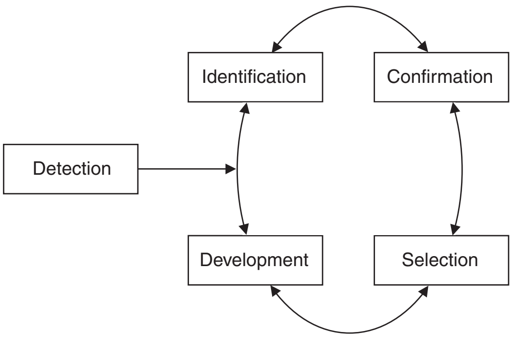

Fig. 1. Key stages in the talent identification and development process. Detection is the discovery of potential performers who are currently not involved in the sport; selection involves choosing the most appropriate (group of) athletes to complete a specific task (in a team) [adapted from Williams and Reilly,[2] with permission of Taylor & Francis Ltd, http://www.informaworld.com].

exceptionally gifted youngsters at an early age in order to accelerate the development process.[2,6-9] In addition to the competitive advantage offered by early recruitment, reliable TID programmes would help guarantee effective financial investment by focusing available resources on the development of a smaller number of athletes. Unfortunately, however, TID models are associated with low predictive value and their validity and usefulness have been widely questioned.[4,5]

This article evaluates recent literature on TID and TDE in sport and discusses some of the difficulties involved when applying this knowledge in a practical context. Due to restrictions of space, it is not the intention to provide an all-encompassing review of research in this area and, consequently, additional reading where appropriate for those interested in extending their knowledge have been highlighted. The current article is structured around the following three major themes: (i) problems related to the dynamic and multidimensional nature of talent; (ii) a conceptual framework for further work in this area; and (iii) avenues for future research.

1. Problems with Current Designs

Traditional attempts to employ cross-sectional TID models to predict success in adult competition by measuring the current performance of adolescents on (a combination of) physiological, physical, anthropometric or technical variables within age-specific groups has proven problematic for several reasons. First, researchers employing cross-sectional designs have based their work on the assumption that the important characteristics of success in adult performance can be extrapolated to identify talented youngsters.[8] However, adolescents who possess the required characteristics will not necessarily retain these attributes throughout maturation.[10] Moreover, it is evident that innate or pre-adolescent characteristics do not automatically translate into exceptional performance in adulthood. A number of factors such as maturation and training effects impact upon this development process.[11-15] For example, the high instability in scores for a sample of Scottish children (all p-values in a 1-year test-retest protocol were <0.70) on measures of physical characteristics (e.g. height) and performance (e.g. sprint) during puberty did not reflect the relative stability necessary to predict adult values.[11] It has been suggested that many of the qualities that distinguish top athletic performance in adults may not be apparent until late adolescence, confounding the early selection of performers.[16-21]

Another problem with this approach is that the rate of maturation impacts upon performance characteristics[22-24] including aerobic power,[25-30] muscular strength,[27,31] muscular endurance,[27] motor skill execution[32-34] and general intelligence.[35,36] Since chronological age and biological maturity rarely progress at the same rate,[37-39] children may be (dis)advantaged on performance tests due to their maturity status, especially when comparing results to chronological age-specific norms.[32,40-42] In addition to the variance in physical fitness accounted for by increases in height and weight before or during puberty, sexual maturity has a large influence, especially in boys.[43]

Maturity-related problems are also prominent in TDE programmes. Sport governing bodies routinely allocate youth participants, irrespective of biological age, to chronological age categories in an effort to ensure developmentally equitable competition and opportunity. However, differences in the timing and tempo of maturation provide evidence to exclude chronological age as an accurate index of physical potential[44,45] and can lead to the misclassification of children in relation to their biological maturity.[22] The consequences for sports participation and talent identification are immense. For example, a majority of early maturing children participate in sports characterized by the importance of height, weight, strength or speed (e.g. basketball, ice hockey, rowing and swimming),[23,46] whereas late maturation has been observed in sports where the characteristics associated with early maturation may be a disadvantage (e.g. dance and gymnastics).[23,47,48] Another concern is that comparisons of birth dates in several sports have revealed skewed distributions favouring individuals born early (or late depending on the sport) in the respective selection year.[49] Consequently, those children benefit from selection policies and enhanced practice opportunities.[50]

A third difficulty with cross-sectional research, and to a lesser extent with longitudinal designs, is the dynamic nature of talent and its development. The use of immature or inappropriate markers in a static conception of key variables for long-term talent prediction is problematic because of the dynamic nature of sport performance and its underlying determinants.[5,6,19] This dynamic interaction is present in two ways. On the one hand, inter-individual differences in growth, development and training cause an unstable non-linear development of performance determinants (for example, after peak height velocity, a plateau in the velocity curves is observed for youth soccer players' explosive strength, running speed and upper-body muscular endurance),[51] making one-shot long-term predictions unreliable, particularly at (pre)pubertal stages of development.[11,19,52-56] Beyond these masking effects of dissimilar maturity levels,[57,58] differences in practice history profiles, or even resistance to test stress, question the applicability of performance criteria to identify youngsters with potential.[59,60] There is empirical evidence from sports such as gymnastics, hockey, rugby and soccer to suggest that different performance indicators may characterize success at different age groups.[56,61-65] While kinanthropometric variables are the most discriminating performance determinants around 10 years, these variables decline in significance as late developers mature and catch up with their early maturing peers during late adolescence. Moreover, shifts in task demands are evident in sports characterized by frequent introductions of new trends or rule amendments like judgment sports (e.g. gymnastics, figure skating and judo)[5] or with evolving game characteristics in team sports (e.g. increased tempo in soccer).[66]

Fourthly, although endowed capacity in sport generally consists of multiple components, TID processes have usually focused on a limited range of variables.[6,19] The majority of researchers still adopt a 1-dimensional approach or concentrate on a combination of anthropometric, physical and physiological measures.[67-80] Although such models may have some success in sports where the majority of variance in performance may be accounted for by a relatively small number of characteristics (e.g. bodybuilding[71,73] or rowing),[69,70,78] their predictive value has proven problematic in the majority of fast ball sports and team ball games. An important issue is that excellence in a sport is not idiosyncratic to a standard set of skills or physical attributes; it can be achieved in individual or unique ways through different combinations of skills, attributes and capacities.[81] This effect has been termed the 'compensation phenomenon' and suggests that deficiencies in one area of performance may be compensated for by strengths in others.[3,82] A potential confound when using this type of approach in TID is that individuals who score low on one specific variable may be deselected from the talent pool and vice versa. The specific positional requirements evident in some sports also dictate that component skills are not equally distributed across all playing positions.[83] However, at the highest level, athletes most likely need to possess a minimal competence level for each component. Additionally, an increasing number of researchers have argued that potentially crucial psychological variables are often overlooked within TID models.[6,8] This observation is somewhat surprising considering that: (i) with increasing age the population of successful athletes becomes

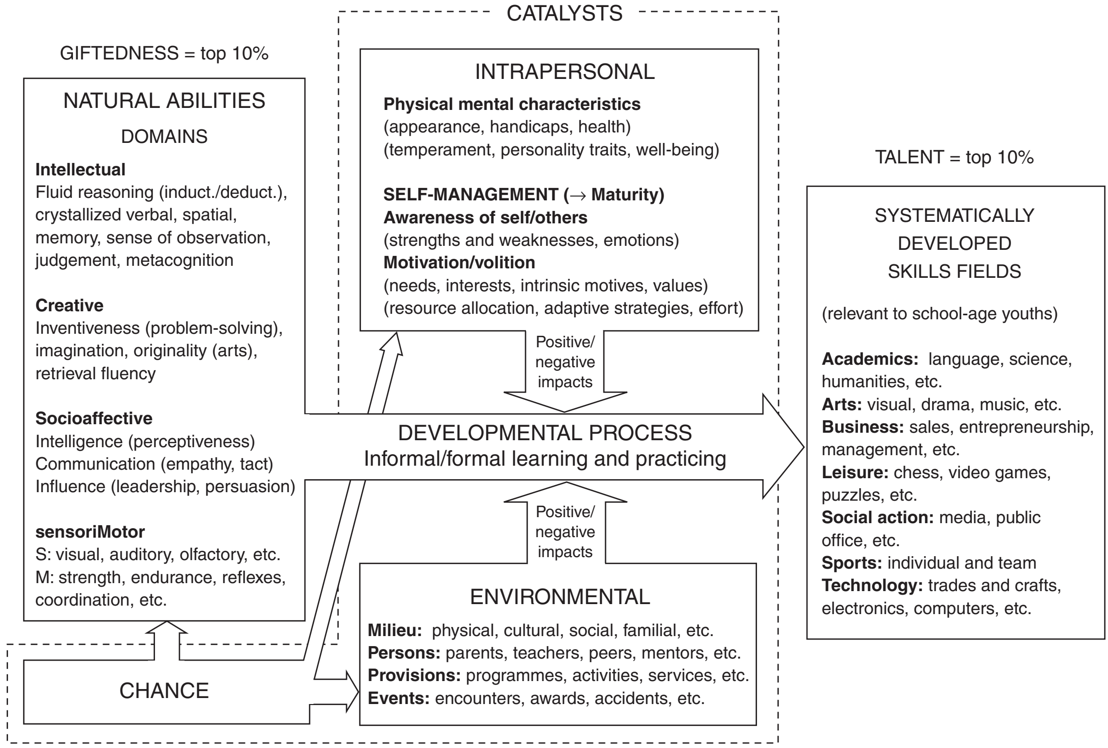

Fig. 2. The Differentiated Model of Giftedness and Talent (reproduced from van Rossum and Gagné,[89] with permission of Prufrock Press Inc., http://www.prufrock.com. Copyright © 2005). **deduct.** = deduction; **induct.** = induction; **M** = motor; **S** = sensory.

more homogenous with respect to their physical and physiological profiles (cf. supra); and (ii) psychological variables have been identified as a (the sole) significant predictor of success (among a range of other physical and technical variables).[84,85]

In summary, this article has provided some arguments to suggest why successful youth athletes do not by definition always develop into elite performers in adulthood. This unpredictability may explain the relative absence of longitudinal research in this area.[86] Clearly, there is a need for a conceptual framework for TID and TDE that rests on the distinction between potential and performance while acknowledging all potential determinants of talent.

2. Towards a Clear and Undisputed Theoretical Framework

Talent is an extremely complex concept that is hard to define and lacks a clear theoretical framework. A key factor in this lack of consensus is the perennial debate regarding the relative contribution of nature and nurture in the development of talent. There is evidence to highlight the importance of both innate and environmental characteristics, suggesting that neither account can exclusively describe talent.[4,87] This ongoing debate coupled with the inconsistent use of terminology has restricted development of knowledge and occasionally moved the focus away from the main issue of how talent can be identified and maximized. In response to the ambiguity caused by the 'one term fits all' use of talent, Gagné[13] suggested a clear distinction between constituent elements (giftedness) and an end product of development (talent) via the Differentiated Model of Giftedness and Talent (DMGT). 'Giftedness' designates the possession and use of high levels of natural abilities (aptitudes) in at least one of four ability domains (figure 2), to a level that places a person among the top 10% of same-age peers. 'Talent' is the superior mastery of systematically developed abilities (competencies) in any field of human activity to a level that the individual belongs to the top 10% of peers active in that field. Although developed in the domain of education, the DMGT presents a constructive conceptual framework with clear definitions that has recently met with initial approval in the sport sciences.[13,88,89] The six components of the DMGT bring together in a dynamic way all the recognized determinants of talent and describe how it emerges from natural gifts through a complex choreography between various causal influences (figure 2).[89]

The DMGT proposes four broad domains of 'natural abilities': intellectual, creative, socio-affective and sensorimotor. While the key aptitudes in sports are seen to be predominantly physical,[89] the multidimensional nature of sport talent suggests that an individual should also have constituent elements from domains other than sensorimotor abilities (e.g. leadership or problem-solving gifts). These aptitudes, which are partly genetic, can be observed more directly in young children because environmental inputs and systematic learning may have only had a limited moderating influence. However, these gifts may still manifest themselves at older ages and may be measured by the ease and pace with which individuals acquire new skills. van Rossum and Gagné[89] offer a valuable contribution for the impasse of potentiality; giftedness can be recognized by the rate of learning, rather than a level of ability. The development process is described as the transformation of gifts into talent (i.e. the outstanding skills developed in a particular sport, through a process of maturation, learning, training and practice). In the motor learning literature, practice is uniformly regarded as the variable having the greatest influence on skill acquisition. Ericsson and colleagues[12,90-92] concluded that the level of attainment in any domain is directly (i.e. monotonically) related to accumulated practice. A minimum of 10 years (≈10 000 hours) of intensive practice is necessary to acquire the skills and experience required to achieve expertise in any domain. However, there remain many unanswered questions in relation to what constitutes the ideal environment for talent development and the nature, type and frequency of practice activities that lead to expert performance.[93]

A trio of catalysts (intrapersonal, environmental and chance) may help or hinder this developmental process. Intrapersonal catalysts are almost endless and include personal traits (physical and mental characteristics) and self-management processes (volition and personality). Environmental catalysts take many forms including locations, people, provisions and events. In contrast to many other theories, the DMGT recognizes that chance can play an important role in the talent process. Apart from the belief that gifts have a partial genetic origin, uncontrollable events (e.g. injuries, family income, quality of instruction, birth place and date) ensure that talent development is not a probabilistic enterprise.[89] However, those involved in the TID process can help minimize the potentially negative impact from 'chance' factors. For example, preventive training and knowledge of risk factors can reduce the chance of injuries occurring.[94-96]

The DMGT is a framework that merits future research. It recognizes the potential respective influences of nature and nurture and takes into account the dynamic and multidimensional features of sport talent. Providing a clear distinction between potential and accomplishment, the DMGT acknowledges that physical maturity and previous experience can influence performance and encourages scientists and practitioners to focus more on the individual's capacity to learn. The complexity of the numerous interactions between the five components is evident in the fact that these interactions act differently from one athlete to another (cf. multidimensional nature and compensation phenomenon) and from one stage to the next in a sports career (cf. dynamic nature), leaving the question 'what is the most important component to achieve the highest level of talent in sports?' unresolved at present.[89] This issue remains key for scientists and practitioners.

3. Future Research: Some Recommendations

3.1 Long-Term Development Instead of Early (De)Selection

In response to growing criticisms of traditional performance and physical TID models, a number of researchers have emphasized the need to move away from early (de)selection based on one-off performance testing and instead to focus on offering the most appropriate development opportunities to a larger pool of youngsters.[6,8,11,97] It is recognized that gifted individuals will only realize their full potential when appropriate and stimulating development opportunities are provided.[6,12,17,92,98] In this respect, a stage-specific, individualized and balanced approach is desirable for optimal TDE. Therefore, we recommend a revised developmental model that accounts for the varying needs of young, developing athletes as they progress through different developmental stages and that their training programme is modified accordingly.[17,59,99,100] The revised developmental model of sport participation suggests different trajectories of participation according to the type of sport.[101] The different stages within the developmental process (cf. DMGT) are based on changes in the type and amount of involvement in sport activities such as deliberate play and deliberate practice.[101,102] The Long-Term Athlete Development model provides an example of how practice and play may be organized differently at various stages of athlete development.[103,104] Whilst a variety of factors such as flexibility, strength, endurance, and other mental, physical, technical and decision-making skills should be included, TDE programmes must have long-term aims and methods, implying the need to focus on those skills that: (i) are important at senior level; and (ii) enhance a youngster's ability to learn, develop and progress successfully in the future. In contrast, if programmes over-emphasize immediate performance as opposed to learning, these individuals may miss fundamental development experiences.[59,105] Consequently, early achievers may end up ill-prepared to successfully transfer from youth to senior level. Talented young athletes already experience difficulties progressing from youth to senior level.[104,106-108] On the other hand, development-focused coaching is likely to inhibit short-term (test) performance and as such has important implications for TID.[60,93,100]

In summary, the dynamic nature of talent necessitates that TID and TDE processes should be interrelated. We discourage the traditional practice where potentially gifted young athletes are deselected out of, or on a more positive note selected into, a TDE programme solely as a consequence of performance-based TID. Ideally, those involved should de-emphasize identification and selection procedures at the start and ascertain that children can benefit from suitable support and training to maximize their potential. Unfortunately, in reality the scarcity of available resources often constrains practitioners to focus on a restricted number of athletes. This latter observation should not provide a reason simply to use age-specific performance norms as a basis for (de)selection at an early age. Next, some recommendations that can help researchers and practitioners in designing and developing effective TID models are presented.

3.2 Measure Progression Instead of Performance: Longitudinal Design

Since the priority for club teams and national federations is to ensure that athletes can successfully perform at the highest level in adult competition, it is crucial that talent models have the ability to differentiate between an athlete's adolescent performance level and potential for progression. However, evaluation of TID models reveals that this distinction is rarely recognized and that talent is typically evaluated in terms of outstanding performance.[11,52,109] Several researchers have emphasized that only through exposure to the specific training and practice environment can it be determined if a youngster possesses the required attributes to succeed.[52-55,110] Abbott and Collins[11] recently stated that in order to predict future accomplishments successfully, it is necessary to identify 'which characteristics indicate that an individual has the potential to develop in sport and become a successful senior athlete'. Such a strategy demands a longitudinal approach. However, the majority of researchers working in this area have relied almost exclusively on cross-sectional designs. An interesting exception to this trend is provided by UK Sport which recently implemented a 'talent confirmation' process (i.e. a 3- to 6-month programme in which individuals identified as talented are confronted with the training requirements of elite sports competition). The exposure to systematic training is designed to support and validate the initial talent selection process (figure 1).

3.3 Biological Maturation and its Impact on Talent Evaluation

The problem of using immature values to identify future talent because of their unstable non-linear development has been highlighted. A prominent confound here is presented by the relative age effect, which reveals skewed birth date distributions favouring individuals born early in the selection year.[49] Although recent findings suggest that players born late in the selection year were less represented at senior level, their chance of being drafted or playing were similar to that of players born in the first half of the selection year.[111,112] These results suggest that those players who are selected early or achieve success at junior level may also be disadvantaged at senior level when late maturers catch up.[14,22,24,59,105,107,108,113] As many of the physiological and physical components used to determine sport performance change with growth, it is clear that biological maturity should be considered in the evaluation of performance capacity more so than chronological age.[22,45] Unfortunately, due to problems associated with collecting these data, TID models have rarely accounted for biological maturity. Nevertheless, new insights have provided non-invasive, practical methods to assess maturity status.[114,115]

3.4 Use Representative 'Real-World' Tasks in a Multidimensional Design

In agreement with the first stage of the expert performance approach, people involved in TID and TDE need to capture the essence of expertise within the specific sport.[116] This information should then be used to design representative tasks that allow superior performance to be reliably identified. In certain sports (e.g. swimming and running) these performance criteria may be fairly self-evident and easily captured in a single test. However, in the majority of sports, expertise is the product of various sub-skills or components.[21] Recently, researchers have acknowledged this issue and adopted a multidimensional approach.[9,56,60,63,117] In these studies, competency is usually assessed in a group of elite and sub-elite (or novice) athletes by measuring performance on several key components separately. A discriminant function analysis may then be employed to identify the variables that differentiate skill groups. Using such an approach, there is evidence to suggest that, when compared with anthropometric and physiological profiles, perceptual-cognitive and technical skills are more likely to discriminate performers in a team ball sport such as soccer or field hockey as they progress.[2,117] There is increasing appreciation that the skilled athlete's superior performance is underpinned by a number of perceptual-cognitive skills that are seamlessly integrated during task performance across a range of domains.[118] Recent research in youth soccer demonstrated that these measures could successfully discriminate between various skill levels.[9,119] However, a review of TID literature reveals that psychological (personality and perceptual-cognitive skills) and technical predictors are frequently ignored in TID programmes.[6,8] Clearly, these skills need to be included in any parsimonious and reliable model of TID.

It is also recommended that researchers develop performance measures that better simulate the demands of actual competition. This move towards more realistic test protocols should improve the predictive utility of the measures employed. However, due to the endless number of formulae for talent in any domain, TID models that attempt to correlate success in a domain with individual component scores may be unsuccessful.[6,19] The challenge is to create a device that can objectively evaluate 'total' performance during actual competition. The advent of increasingly more sophisticated measurement systems may enable such a device to be developed at some stage in the future.

3.5 Usefulness and Constraints of Talent Identification

The primary aim of TID is to recognize current participants with the greatest potential to excel in a particular sport.[1] An increase in financial pressure and competition has motivated sports teams and organizations to attempt to identify future stars at a very early age. However, the prediction accuracy of such models would appear inversely related to the length of time over which the prediction is intended to span. This observation questions the reliability of TID models aiming to predict success far into the future (e.g. in 10–15 years time). A key question is 'what is the ideal age for TID?'. It would appear unrealistic to impose a standard time frame for TID for all sports due to differences in the age of peak performance and developmental stages across sports. Sports where specialization occurs early (e.g. soccer) or those were peak performance occurs at young age (e.g. gymnastics) require a different approach when compared with sports that emphasize late specialization (e.g. rowing) or when peak performance is achieved at a later age (e.g. triathlon). Similarly, the success ratio of TID depends on the sport in two ways. Sports where one or two variables have a high predictive value will be more suitable for effective TID in contrast to multi-skilled disciplines.[5,71,73] Furthermore, the prediction of success is likely to be easier in more 'closed' rather than 'open' sports because in the former movements are less affected by the environment and fewer components are likely to impact on performance. These constraints most likely explain why national federations have invested more resources in TID models within more closed sports (e.g. rowing, cycling, athletics, canoeing and weightlifting)[120] and are now recruiting potential medal winners at later stages (e.g. Talent Transfer or Sporting Giants).[121-123]

Figure 3 illustrates how these three constraints (time, number of essential components and closed or opens skill sport) and their interaction are likely to affect the predictive value of TID models. The lighter colour symbolises lower prediction accuracy. For example, the prediction accuracy to identify talent in rowing (closed sport and low number of essential performance components) will be higher than for field hockey (open skilled sport and high number of essential performance components). Additionally, lower predictive utility will be evident when attempting to foresee talent 15 years from now compared with months or a year into the future. This model could be validated by implementing multidisciplinary, longitudinal research designs so that the actual predictive value of talent identification models can be retrospectively examined.

The perceived inefficiency and ineffectiveness of current TID models suggest that scientifically based observations should complement intuitive coaches' judgments. In line with this observation, we suggest that objective TID may be best utilized in reinforcing the subjective opinion of coaches. A crucial

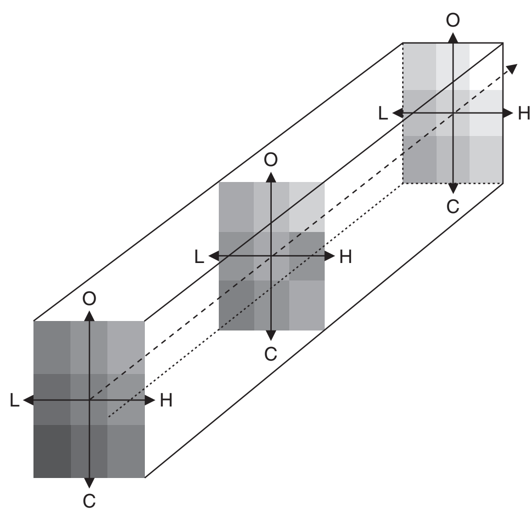

Fig. 3. The impact of three constraints (time, number of essential components and 'closed' [C] or 'open' [O] skill sports) on prediction accuracy in talent identification. The x-axis represents the number of essential performance components. The y-axis represents a continuum from O to C skills. The z-axis represents the time component. The lighter the colour the lower the prediction accuracy. **H** = high; **L** = low.

aspect is to educate the practitioners; they should be aware of the numerous processes that influence and interact with proficiency during adolescence and the development of talent. Alternatively, the testing of athletes is valuable to identify weaknesses, which could in turn be addressed through the development of individualized training programmes.

4. Conclusions

The literature shows that due to the dynamic and multidimensional nature of sport talent, traditional TID and TDE models are likely to exclude many, especially late maturing, ‘talented’ children from support programmes and available resources may be invested inappropriately. Typically, these TID procedures focus on a limited range of (physical) parameters and select based on ‘one-off’ proficiency measures that fail to acknowledge that physical maturity and previous experience can influence performance. In preference to the traditional view where TID is perceived as a predecessor of, and a selection criterion for TDE, TID and TDE processes should be combined. A theoretical model that can serve as a framework for those interested in extending knowledge of TID and TDE in sport has been presented. The advantage of the DMGT is encapsulated in its dynamic and multidimensional approach, encouraging greater effort to identify an individual’s capacity to learn rather than what they have already learned. In future, researchers employing TID models should consider growth and maturity status, and the potential to develop, whereas the need to design more reliable and sensitive measures of performance remains paramount. The unique requirements of each sport demand for sport-specific rather than general TID models.

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