On the Efficacy of Talent Identification and Talent Development Programmes

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Abstract

The chapter examines the general empirical research evidence addressing fundamental questions; namely: Does early TID assessment correlate with later age performance? Does early participation in talent development programmes benefit long-term senior success? Existing evidence suggests that: many programmes exhibit high annual athlete turnover; earlier age entry correlates with earlier age exit; while late 'side-entrants' are over-represented among senior world-class – often associated with non-specialised training backgrounds. Early programme involvement correlates negatively with later senior success and the senior elite *emerges* via programmes' selections and de-selections across the consecutive age stages. Findings suggest low efficacy of young-age talent identification and development programmes.

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Introduction

Besides the direct competition between athletes, *nations* compete indirectly for *collective* national success (e.g., medal tally) at Olympic Games and other international championships. To facilitate these outcomes, national sport organisations (NSOs) around the world have established organised talent identification (TID) and talent development programmes (TDP), designed to catalyse their most promising young athletes' performance development. Over recent decades, the respective investments in these programmes have increased substantially (e.g., De Bosscher et al., 2008; Oakley & Green, 2001).

NSOs face the challenge to structure TID/TDP programmes efficaciously to regularly develop internationally successful athletes. However, analyses from different national sport systems suggest relatively low 'success rates': Only up to ~2% of young athletes involved in TDP eventually attain international senior success (e.g., Ackermann, 2013; Gray & Plucker, 2010; Güllich, 2014a; Güllich & Emrich, 2005b, 2012; Höner et al., 2015; Hong, 2008; Ljach, 1997; Malina, 2010; Morris et al., 2004; Pion et al., 2015; Sands, 2012; Vaeyens et al., 2009). More or less substantial over-investment is typical of TDP, in terms of athlete numbers selected and interventions applied to them. Also, research-based evidence that definitively informs the design of TID/TDP is still scarce. Policy-makers and researchers alike are thus preoccupied with questions of how to organise TID/TDP efficaciously – for example: At what age to initiate TID/TDP? How many athletes to involve at which age stage? What interventions to apply to them how intensively; and how to best structure TID/TDP institutions?

To better examine these concerns, the chapter first outlines the central 'idea' and structure of TID and TDP, and crystalizes the fundamental premises underpinning early TID/TDP. Then, we provide an overview of empirical research evidence with reference to these premises. Finally, practical implications and future directions are discussed.

'The idea' and structure of TID and TDP

The central 'idea' of TID is to identify and select the most promising young talents from the general population in order to focus TDP delivery and investments on these promising few. TDP, in turn, pursues to support selected athletes' training and competition process by subsidising resources and applying supportive interventions (i.e., providing 'treatment') to thereby facilitate performance progress, and increase their likelihood of long-term international senior success. TID/TDP is provided foremost by NSOs (and their regional sub-divisions), often utilising elite training centres, athlete service centres (e.g., Australian or English Institutes of Sport, German Olympic Support Centres, China's National Training Centre), youth sport academies (e.g., in artistic gymnastics, soccer, tennis), and/or Elite Sport Schools. Programmes are typically sub-divided in age- and performance-related stages: Some talent search and initial talent development during childhood and early adolescence (often operated at a local/regional level); a junior promotion stage; and senior sub-elite and elite promotion (see Figure 1). The typical 'pyramidal' structure implies a larger number of athletes are involved initially, with stepwise reductions at each subsequent stage. Overall, different national structures and elements have been characterised by progressing convergence through recent decades (see Chapter 9); a fact ascribed to the increasing global competition (Houlihan & Green, 2008).

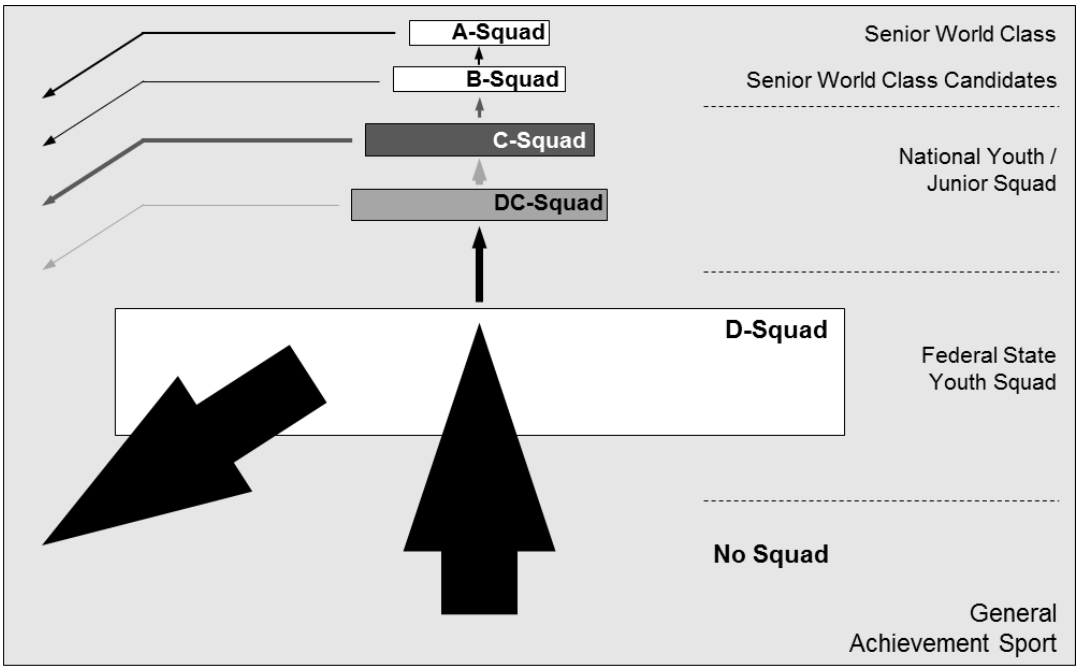

Figure 1: Conceptualised squad structure – annual memberships and transitions between squad levels as conceptualised by seven NSOs (adapted from Güllich & Emrich, 2012).

TID usually draws on youngsters' early performance, performance components and/or performance progress over time. They are commonly assessed by the 'coach's eye' that may involve a holistic multidisciplinary perspective (e.g., Christensen, 2009; Vrljic & Mallett, 2008), and/or specifically assessing anthropometrics, performance in competition, motor/physiological performance tests (sometimes evaluated relative to the youngsters' biological maturation), and – less frequently – psychological tests (see Güllich & Emrich, 2005a for a review; see also Chapters 4 and 5).

TDP ingredients commonly comprise: high-profile coaching, training facilities and equipment; specialist medical, paramedical and scientific service staff; and, support for performance lifestyle and education. Developing outstanding performance requires considerable time investment over many years, and *time* is considered a critical input resource. For this reason, TDP typically pursues to select youngsters during *early* career stages, to enable a long period of progressive nurturing until the expected age of peak performance. In addition, when analysing

the focus and content of TDP interventions generally (Table 1), their primary aim can be summarised as attempting to reinforce *sport-related time economy* (Güllich & Emrich, 2006; Horton, 2012). That is, interventions aim to expand the time available for training and competitions (i.e., *extensive* time-economy) or attempt to achieve efficient time use in terms of increased success gain per time invested (i.e., *intensive* time-economy).

Table 1: Focus and content of TDP interventions applied to athletes involved in talent development programmes (adapted and extended from Güllich & Emrich, 2006).

	Directionality of Effects			
Provision / support of …	Stimulus, incentive [1]	Expansion of training time (extensive time economy)	Intensification of training time (intensive time economy) [3]	Annotations
Training and Competition				
Participation in competitions	+	(+)	(+)	Extensive/intensive time-economy if assuming training effects of participation in competitions
Additional training opportunities		+		E.g., training centres, sport academies, training camps, clinics
Training facilities, equipment	(+) [2]	+	(+)	Intensive time-economy only if facilities/equipment benefit success gain per invested time unit
Coaches	(+) [2]	+	+	Expectation of more training and improved performance progress through coached training
Coaches' education	(+) [2]		+	Intensive time-economy if better educated coaches attain more success gain per training time
Athlete Services				
Consulting for performance lifestyle and educational/occupational career		+		Purpose to manage lifestyle and career compatibly to elite sport; possibly also buffering of individual educational/occupational costs/risks
Nutritional consulting		+	+	Appropriate nutrition shall improve load tolerability and adaptation to training stimuli
Medical care		+	+	Health facilitates load tolerability, more activity per training time, adaptation to training stimuli, and avoids training reduction/interruptions
Physiotherapy		+	+	Health as above; improved recovery enables more training and adaptation to training stimuli
Performance assessment (physiology, biomechanics)			+	Purpose to determine whether and how training time could be used more efficiently
Permanent Concentration				
Elite sport school, residential sport school		+		Purpose to adjust educational time demands to sport time demands, save "dead time" by coordinating school and sport and saving passage time; also provision of extra training

Table Notes: [1] Incentives may generally benefit motivation and thereby facilitate expansion of training time and effort during training. [2] Coaches, in particular better educated coaches may exhibit incentives by designing more enjoyable training and/or greater performance progress; likewise, high-quality facilities and equipment may imply incentives. [3] Intensive time economy may imply saving time spent on certain activities and thereby enable expansion of time for other training activities.

The ‘ideal-type’ of TID/TDP implies that future high-performers are identified and selected at an early age based on signs or facets of early exceptionality. TDP programming continuously facilitates extensive and intensive time economy of their sport-specific training process. As the duration of involvement extends, training volume and performance increase, the athlete ascends progressively through the consecutive stages of the TDP system, and TDP interventions are gradually intensified. As a consequence, it can be stated that early TID/TDP rests on three fundamental premises:

- Talent can already be identified at a young age.
- Top senior performance results from long-term continuous development within a sport. Success increases with progressive duration of involvement, together with extended training volume and intensified supportive interventions.
- Long-term development of excellence can be positively affected by TDP interventions at a young age, implying expansion and intensification of the time used for sport-specific training and competitions.

However, empirical examinations of world-class athletes’ participation histories raise some doubts about the validity of the three premises (see state of research below), and targeted TID/TDP research has begun to examine whether TID and TDP exhibit empirical correspondence to these pre-assumptions. This comprises investigating the questions of: (Q1) To what extent do characteristics assessed in early TID correlate with later performance? (Q2) Does early selection and involvement in TDP correlate with later senior success? This also implies, (Q3) does early TID/TDP preferentially draft (selection) young athletes exhibiting the types of developmental participation patterns likely to benefit long-term development of senior success, and does it facilitate (intervention/socialisation) those patterns?

Individualistic vs. collectivistic approach

From a national level perspective, it is important to note that the ultimate target of TID/TDP is *collective* success, specifically the *aggregation* of individual athletic attainments compared to other countries' aggregated achievements. Exactly which athletes achieve those attainments is of subordinate relevance. This is significant in so far as a number of future 'top performers' may not have been identified at a young age, and may have developed outside TDP. In the field, talent selection may therefore not be a 'one-off' procedure, but repeated possibly annually through all age ranges. Previous selection may sometimes be revised, in that TDP members are replaced by 'side-entrants' who are now ascribed greater potential (e.g., Cobley et al., 2012). In this context, governing bodies can pursue the development of collective success through two complementary but different approaches (Güllich & Emrich, 2012):

- The *individualistic* approach: The future high-performers are identified and selected into TDP at a young age, and a set of TDP interventions are applied to them. The interventions facilitate their performance progress, eventually leading them to increased senior performance. Their enhanced senior performances aggregate across these individuals, leading to improved collective success. According to this approach, future senior elite athletes will have developed exactly from the ranks of the early selected youngsters, while later side-entrants are infrequent. The 'idea' of early TID/TDP along with its fundamental premises rest on this approach.
- The *collectivistic* approach: The collective of the successful senior performers is composed of either athletes entering TDP early or late, where the later entrants develop outside TDP over longer periods. The collective of outstanding senior athletes *emerges* gradually in the course of recurrent procedures of selection, de-selection, and replacement through all age periods and stages. According to this approach, it is essentially irrelevant who exactly become the successful senior performers. There may be considerable fluctuation within the TDP population, and later side-entries may occur quite often. A country's

population size, the popularity of a sport, mass participation in competitive sport, and general local training environments are significant social-ecological factors affecting the 'talent pool' that talented athletes can be drawn from.

Based on these approaches, the additional question arises: (Q4) To what extent does the population of senior elite athletes develop from those selected early and their long-term continuous nurturing (*individualistic* approach), or rather emerge via the course of repeated selection, de-selection and replacement across the different age categories (*collectivistic* approach)? We now address these questions, based on the research evidence available.

The state of empirical research

Participation history of top athletes

Generally speaking, the analyses of developmental participation patterns of senior world-class athletes (e.g., Güllich & Emrich, 2014; Rees et al., 2016, for reviews) reveal that many athletes are not involved exclusively in one sport, but engage in various sports across childhood and adolescence. Their age of training initiation and main sport specialisation scatters considerably, across and within the different sports, and success often progresses non-linearly. Remarkably, senior world-class athletes do not differ from their less accomplished peers in more time extensive or intensive sport-specific training during childhood and adolescence. On the other hand, variable experience in different sports and relatively late specialisation are over-represented among world-class. These findings from training and competition histories partly deviate from the premises underpinning early TID/TDP logic.

Predictive accuracy of early TID

Early TID pursues to use individual differences in characteristics assessed at a young age to

predict individual differences in future performance exceptionality (i.e., senior success). However, the complex and dynamic nature of talent, and non-linear developmental performance trajectories make the long-term predictive accuracy of early TID extremely difficult. Task demands, performers' characteristics, and environmental factors can all vary; further, they change over time, and they also interact with one another (see Table 2 for an overview).

Table 2: Impediments to the predictive accuracy of early TID.

Task	▪ Success in competition depends on an athlete's / team's performance compared to the competitors' performances, while the latter cannot be influenced.
	▪ High performance can be attained through different individual combinations of skills and physiological-energetic capacities; i.e., different components of performance may be mutually compensable.
	▪ The relative influence of different predictors on performance may vary with increasing age and, most notably, from juvenile to senior performance (for example relative significance of stature, physiological capacities, motor and perceptual-cognitive skills etc.; e.g., Vaeyens et al., 2008; Ziv & Lidor, 2014).
	▪ The structure of performance, the required qualities, and the type of athlete demanded may have changed in the future because the evolution of high-performance sports implies changes in rules (e.g., judgement criteria in gymnastics and figure skating, scoring in basketball, libero in volleyball), material and equipment (carving skies, clap-skate, Nemeth's javelin), movement techniques (Nordic skating technique, ski-jumping V-technique), and playing systems (tempo in soccer).
Performer	▪ The timing of biological maturation varies inter-individually, in particular during the age range of 12–16 years. Biologically accelerated athletes have hormonal advantages within a calendric age-group inducing advanced growth kinetics, physiological-energetic capacities and performance progress particularly among adolescent boys (Pearson et al., 2006; Malina et al., 2015). However, differential influences of biological maturation on performance disappear by reaching maturity.
	▪ Within a calendar age year those relatively older have advantages in stature, physiology and performance particularly in adolescent boys (relative age effect, RAE; Cobley et al., 2009; Helsen et al., 2012). However, this advantage decreases at adult elite level (Carling et al., 2012; Gibbs et al., 2012).
	▪ Psychological qualities relevant to training and competition (such as motivation, resilience, self-regulation) vary over time and inter-individual differences in future development of those qualities are (widely) unknown (e.g., Anshel & Lidor, 2012).
Environment	▪ Prior training experience influences present performance and the scope for future performance development (e.g., intensified specialised training vs. moderate specialised training with diversified experience). Respective inter-individual differences are usually not ascertained in TID.
	▪ Configurations of future training, quality of coaching and their effects on performance vary between athletes and within athletes over time. Respective future inter-individual differences are (widely) unknowable.
	▪ Socio-material environments vary between athletes (coaching, familial support, facilities). Respective future inter-individual differences are (widely) unknowable.
Test quality	▪ Assessments in TID may be imperfectly objective, reliable and valid.

A number of longitudinal studies have actually identified a predictive power of approximately zero for some TID assessment procedures (e.g., Bottoni et al., 2011; Gee et al., 2010; Kuzmits & Adams, 2008; Lidor et al., 2005a). That said, other studies report methods leading to correct assignment of up to 70% of young athletes to higher and lower performing sub-samples over

multiple years (two studies had even higher accuracy rates: Forsman et al., 2015; Pion et al., 2015). These studies typically used multidimensional approaches including anthropometry, early physiology or skill tests (Falk et al., 2004; Gonaus & Müller, 2012; Höner et al., 2015; Le Gall et al., 2008; Lidor et al., 2005b; Till et al., 2015; Vandorpe et al., 2012), and in some cases also psychological skill/trait assessments (Figueiredo et al., 2009; Forsman et al., 2015; Van Yperen, 2009; Zuber et al., 2015). Yet, while those findings appear promising at first sight, they do not necessarily reflect the absolute prediction accuracy when transferred to the field. Importantly, the greater mass of both selected and non-selected athletes (compared to limited subsamples involved in research studies) has to be considered. Thus, two key points need to be considered:

1. Correct assignment is presumably lower at the adjacent margins of the within-group distributions (i.e., between the least promising selected and most promising non-selected athletes).
2. Attempting to predict future high-performers is primarily compromised by the fact that top athletes are extremely rare by definition, relative to the total athletic population, and the relative proportion of young athletes becoming senior top athletes (i.e., the 'base rate') is very low. Ackerman (2013) illustrated the case by a simple calculation. Assuming that 1 out of 1000 youngsters becomes a world-class athlete ('base rate'), and our TID method classifies 70% of future world-class and non-world-class athletes correctly (which is at the upper margin of evidenced accuracy), the probability that a positively identified and selected talent actually becomes a world-class athlete is then ~0.2%. Even with a 90% correct assignment that proportion would only increase to ~0.9%.

The figures correspond to empirical long-term 'success rates' of up to ~2% of early selected athletes observed in the field (see Introduction). They suggest that the low prediction rates in

TID practice originate from the nature of the subject, rather than from deficient scientific substantiation. They also imply that further extended endeavour to refine the scientific sophistication of TID will presumably only improve the rates of accurate prediction to a minimal degree.

Involvement and development within TDP

Only a few studies in the international literature have addressed athletes' *involvement* and *development within* the *TDP* system and whether it is related to athletic outcome attainment (Güllich & Richartz, 2015). The following sections draw upon studies from the research programme "*Efficacy of TDP*" (Table 3), conducted for ~15 years in Germany, still providing correspondence from available international research.

Table 3: Relevant studies within the research programme "Efficacy of Talent Development Programmes". DA = document analysis, QA = questionnaire, CS = cross-sectional, LT = longitudinal, RS = retrospective.

Sample, study design	Relevant studied aspects	Reference
20 *national systems* AUS, USA, 18 East-/West-European countries, DA+QA: CS	Sport system, TID criteria, selection age, elite sport schools, athlete services, success	Güllich & Emrich, 2005a
7 *NSOs' squads* (athletics, cycling, field hockey, rowing, table tennis, weightlifting and wrestling; 4,686 athletes), DA: LT 7 y	Member fluctuation, selection age, stage transitions, exit age, success	Güllich & Emrich, 2012
Soccer *national U15-19 squads* (1,059 players), DA: LT 13 y; 13 *youth academies* (1,420 players), DA: LT 13 y; 624 *Bundesliga players*, DA: RS	Member fluctuation, selection age, exit age, success	Güllich, 2014a
1,558 *squad athletes* all Olympic sports, QA: RS; 244 *squad athletes* all Olympic sports, QA: LT 3 y	Selection age, athlete services, training volume, continuity, success	Güllich & Emrich, 2012, 2013; Emrich & Güllich, 2016
39 *Elite Sport Schools*, DA+QA: LT 3 y; 465 *Olympians*, DA: RS; 199 *Olympians*, QA: RS	Member fluctuation, selection age, athlete services, success	Güllich & Emrich, 2005b; Flatau & Emrich, 2013
246 *sports clubs* nominated by their respective NSO for "exemplary TDP", QA: LT 3 y	Member fluctuation, athlete services, success	Güllich et al., 2005

Stage transitions and member fluctuation within TDP

Transitions between stages within TDP are exemplified in Figure 2. The figure illustrates annual transitions within the squad systems of seven NSOs. Stage transitions were by no means always progressive and seamless. In contrast to the notion of continuous linear careers, downgrades to lower stages, temporary interruptions, 'side-entries' at higher stages, and 'skipping of

stages' often occurred (as suggested by Cobley et al., 2012; Gulbin et al., 2013). Comparisons between more and less successful athletes revealed that 'side-entries', 'skipping of TDP stages', as well as temporary downgrades within TDP, and TDP interruptions were actually more frequent in the highest achieving athletes (Güllich & Emrich, 2012).

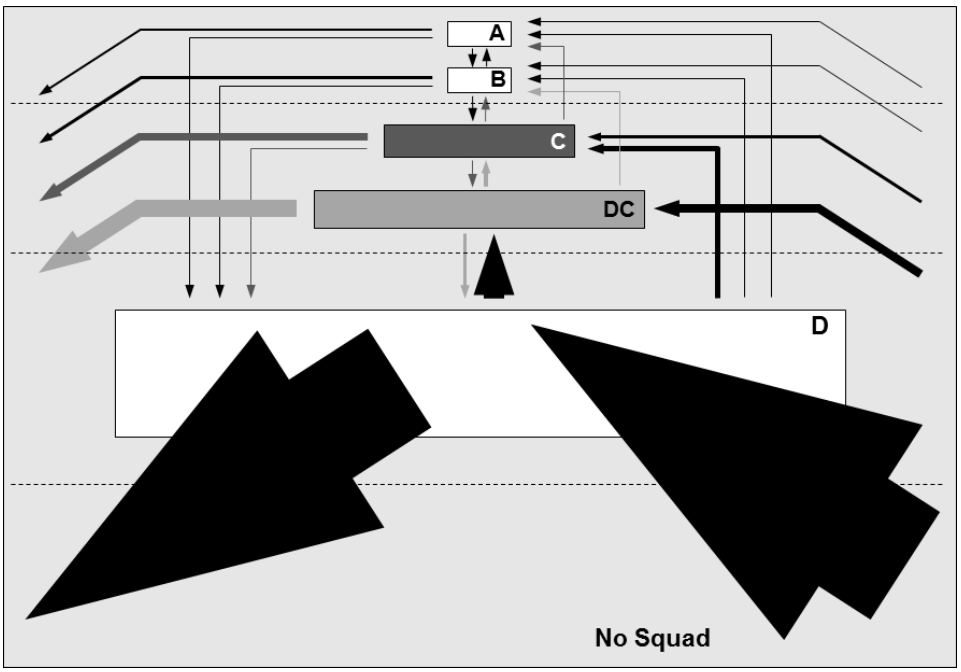

Figure 2: Empirical squad structure – mean annual transitions between squad levels (7-year longitudinal observation in athletics, cycling, field hockey, rowing, table tennis, weightlifting, and wrestling; adapted from Güllich & Emrich, 2012).

Table 4: Annual turnover of members in different talent development programmes (TDP). Annual turnover = [(Number of annual entries + Number of annual exits)/2]/Total number of members.

TDP Programme	Mean annual turnover	Probability of persistence within TDP		Reference
		After 3 y	*After 5 y*	
"Exemplary TDP" sport clubs	19%	*53%*	*35%*	Güllich et al., 2005
Elite Sport Schools	28%	*37%*	*19%*	Güllich & Emrich, 2005b
Soccer youth academies	25%	*43%*	*24%*	Güllich, 2014a
NSOs' squads (7 sports)	44%	*16%*	*5%*	Güllich & Emrich, 2012
NSO's squads (soccer)	41%	*21%*	*7%*	Güllich, 2014a

Table Notes: Elite Sport Schools and soccer youth academies are local elements of national programmes. They are club-based in that the athletes are members in a sport club that cooperates with a local school.

Generally, turnover rates within TDP programmes may vary depending on the ratio of selected talents per total talent population, number of stages, strength of competition in a sport, magnitude of the difference between selected and non-selected in conditions for talent development, and accuracy of TID.

Considering the different types of TDPs, they were all consistently characterised by sizeable annual athlete turnover in terms of yearly selections, de-selections, and side-entries across all age ranges (Table 4). The probability of still being in a TDP after five years is clearly below

40% in all locally-based TDP sub-divisions, and below 10% in the NSOs' squad systems (see also Hong, 2008; Ljach, 1997; Pion et al., 2015; Sands, 2012; Vaeyens et al., 2009).

Duration and age structure of TDP careers

Most careers within TDPs were relatively short. For example, in eight NSOs' squad systems (the sports mentioned in Figure 2 plus soccer) the persistence of ~70% of TDP careers lasted ≤2 years, and only ~30% persisted in the system for ≥3 years (Güllich, 2014a; Güllich & Emrich, 2012); findings consistent with others (e.g., Deprez et al., 2014; Hoare, 1998; Pion et al., 2015; Vaeyens et al., 2009). Consistent across all sports, the age of first entry and the age of exit correlated very closely, specifically "*the younger the entry – the younger the exit*" (Güllich & Emrich, 2012).

When comparing athletes who have reached lower or higher squad levels (within the sports defined in Figure 2), those who did not exceed the initial squad stage were first selected at 15 ± 3 years, those who reached the national junior squad, but not senior squad were selected at 17 ± 3 years, and senior world-class entered the squad system at 19 ± 4 years. In retrospective analyses of senior elite athletes, all 'top performers' were involved in athlete support programmes at some point of their career, but their entry age varied substantially (e.g., Güllich, 2014a,b; Hardy et al., 2013; Riewald, 2014; Vaeyens et al., 2009). Interestingly, late 'side-entrants' were over-represented among senior world-class athletes across all Olympic sports, compared to their national-class peers. Specifically, world class athletes consistently entered their respective NSO's squad system ~2 years later than national-class, Olympic Support Centres ~2 years, and Elite Sport Schools (where applicable) ~3 years later (Güllich, 2014b; Güllich & Emrich, 2005b, 2006, 2012, 2013).

When comparing squad members selected younger (–14) vs. older (15+ years; see Table 5), the former were characterised by starting specialised training and competition 2.5 years younger; reported stronger early intensification of sport-specific training (i.e., 130% more specialised training accumulated until 10 years; 95% more until 14 years); less involvement in other sports; and, 2.4 years earlier specialisation. Earlier selection was associated with greater success at early junior championships, but a reduced likelihood of later international senior success.

Table 5: Developmental participation histories, early junior success, and later senior success of athletes from all Olympic sports selected into their NSOs' squad systems at a younger or older age (adapted from Emrich & Güllich, 2016).

	Selection age			
	Up to 14 y (n=429)		At 15+ y (n=696)	
	M	*(SD)*	M	*(SD)*
Age at [years]				
First squad nomination	13.0	*(1.0)*	16.8	*(2.3)*
Start training in the main sport	8.5	*(2.5)*	10.9	*(3.9)*
Start competitions in the main sport	9.9	*(2.4)*	12.4	*(3.5)*
Specialisation in the main sport	10.7	*(3.9)*	13.1	*(5.2)*
Training volume until age 14 years				
Hours accumulated in the main sport	2,494	*(1,935)*	1,279	*(1,334)*
Sessions accumulated in other sports	228	*(496)*	350	*(653)*
Success level until age 14 years				
National / international	65%		33%	
Below	35%		67%	
Later senior success level				
World class (top ten worldwide)	56%		69%	
National class	44%		31%	

Once selected, and when compared to those not yet selected, the athletes involved in the TDP interventions (i.e., physiotherapy, medical care, performance analysis, nutritional consulting, performance lifestyle consulting, Elite Sport School) exhibited another 95% greater *increment* of their annual sport-specific training volume than the non-selected, through the subsequent three years (Emrich & Güllich, 2016). However, participation in athlete services, or their intensity, did not correlate with reduced occurrence or duration of discontinuities in the training and competition process, due to injury and/or educational time demands for example (Güllich & Emrich, 2012). Findings were consistent across cgs (centimetre, gram, second), game, martial

arts, and artistic composition sports.

Centralisation of TDP

In many sport systems and governing bodies a question often discussed is whether TDP would be more efficacious if organised with higher or lower degrees of centralisation (Güllich & Emrich, 2005a). The efficacy of centralised TDP is particularly interesting because it constitutes attempts to implement just the 'ideal type' of TID/TDP in its highest form. The 'best talent' together with extensive TDP resources are concentrated in a few centres. Facilities for youngsters' residence are typically provided, and schooling schedules are coordinated with training and competitions by way of Elite Sport Schools or alike (Güllich & Emrich, 2005a; Radtke & Coalter, 2007). The centres comprise the capability to organise an entire daily or weekly routine around the sport engagement, and facilitate greater training volumes along with intensified TDP nurture. Their disadvantages however include the inducement of extended individual opportunity costs. Many youngsters may have to leave home, their local school, friends, coach, and training comrades. Also, residence often implies financial costs on parents.

German reunification in 1989/90 brought about a unique opportunity to compare two dissimilar sport systems within one country, now both embedded in an open society (Popper, 1945). The former GDR's TDPs were concentrated in 31 sport clubs with 25 Elite Sport Schools. These were largely conserved after 1990 and integrated into eight Olympic Support Centres with 13 satellite branches and 21 Elite Sport Schools (Güllich & Emrich, 2013). Area-wide development of sport clubs was only re-initiated after 1990. Contrastingly, West-German sport is traditionally more de-centralised, organised in ~70,000 sport clubs of which ~35% integrate both mass and competitive sport. Yet, 18 relatively small Elite Sport Schools were established after 1990. In addition, athlete services are provided by twelve Olympic Support Centres with 28

satellite branches.

Ten years after reunification, youth prevalence of sport club membership was still ~1.7x higher in West-Germany, while young athletes' probability of involvement in an Elite Sport School was 57x higher in East-Germany (Table 6). Eastern Sport Schools also recruited at a significantly younger age and provided much more extensive athlete services (Güllich & Emrich, 2005b). Furthermore, among all youth squad members, the prevalence of involvement in the athlete services of an Olympic Support Centre was 1.6x higher in East-Germany. Eastern athletes participated in the services ~3 years younger (Güllich & Emrich, 2013) and moreover, received 64% more annual service time per athlete.

Table 6: Elite Sport Schools (ESS) in West (n=16) and East Germany (n=21): Size (number of elite sport students), recruitment age, and prevalence of international junior and senior success (based on data from Güllich & Emrich, 2005b).

	West	East	Total
Elite sport students total sum [n]	1,470	9,816	11,286
Members per ESS [Mean ± SD]	92 ± 68	467 ± 297	305 ± 294
Prevalence of ESS involvement among youth sport club members	0.03%	1.48%	0.18%
Recruitment age -12 years	44.51%	77.33%	70.03%
13-15 years	31.25%	18.99%	21.72%
16+ years	24.24%	3.68%	8.25%
Prevalence of international junior finalists among ESS students	7.07%	2.80%	3.32%
Prevalence of international senior medallists among ESS graduates	4.04%	1.20%	1.55%

The organisational differences are also reflected in athletes' dissimilar developmental participation patterns (Güllich & Emrich, 2013). Fewer East-German athletes participated in different sports. They specialised in their main sport 2.7 years younger and accumulated 58% more sport-specific training up to 18 years of age. They were more successful only at junior championships, but not in the long-term at international senior levels.

With specific reference to Elite Sport Schools, their overall 'success rate' corresponds to other

TDPs, where the prevalence of graduates attaining international senior medals correlates negatively with the proportion of early (≤12 years) selected athletes (r=–0.41), and positively with the proportion of late (16+ years) selected athletes (r=0.68). In addition though, members of these schools have reported impaired subjective health and well-being, and achieved comparatively lower educational attainments (Güllich & Emrich, 2005b; Hong, 2008; Van Rens et al., 2015; Verkooijen et al., 2012).

When considered together, the findings suggest that centralised approaches to early TID/TDP are actually more associated with economic *inefficiency* when embedded in an open society. They induce larger material and immaterial costs at an individual (i.e., time, education, psychophysical health), as well as a system level that are not necessarily matched by an increased likelihood of senior athletic attainment.

Later-age talent search and transfer

Recent studies have suggested (Güllich & Emrich, 2014; Oldenziel et al., 2004) that some athletes can successfully switch between sports during late adolescence (or beyond), with sometimes relatively rapid development in their new sport context. Targeted secondary analysis within Güllich & Emrich's (2014) data reveals that 44% of all Olympic and senior world championship medallists reported changing to compete in another sport. For 52% of these, the transition occurred at 15 years plus; to which 89% made their international championship debut in their new sport within three years or less.

While transition often occurs informally, some agencies have launched initiatives to systematically promote the occurrence, supplementing 'mainstream' early TID by establishing later-age talent transfer programmes (see Gulbin, 2008; Vaeyens et al., 2009; see Chapter 35). Vaeyens

and colleagues (2009) analysed the first year 'success rate' of the UK's "Sporting Giants" initiative. Out of 3,010 applicants participating in assessment events (age 19.6 ± 2.9 years), 101 were invited to an 8-week apprenticeship and confirmation phase in canoeing, handball, rowing or volleyball. Of these, 48 were then selected into NSO squads, to which 23 reached national finals or even international representation within one year. While the transferred talents provided an 'injection' of 'only' 4% new talent into the total squad system, the 'success rate' *within* later-age talent transfer (23 out of 101 selected) is appealing, in view of the low efficacy of early TID/TDP.

Summary

The findings evidenced from TID/TDP to date show little empirical correspondence to the fundamental premises that act as central pillars to early TID and TDP. Future outstanding athletes cannot be predicted reliably by way of TID at a young age (cf. Q1). Particularly early TDP involvement correlates negatively with long-term senior success (cf. Q2). Early TID and TDP preferentially selects (i.e., a selection effect) and further reinforces (i.e., intervention and/or socialisation effects) developmental participation patterns that are partly inconsistent with those developmental patterns likely to benefit long-term international senior success (cf. Q3). Correspondingly, evidence indicates that most TDP careers are short; an earlier age entry correlates with earlier age exit; and TDPs generally exhibit high athlete turnover rates. This does not imply that early selection and long-term TDP involvement is not possible, nor that it does not occur, but it is comparatively infrequent. Early TID/TDP primarily proceeds by recruiting great numbers of youngsters and 'trying them out', while expanding the frequency of youngsters 'tried out' through increased athlete turnover. Some are retained while most are de-selected again within short time-periods and new side-entrants are recruited. On the other hand, most world-class athletes were actually only selected at later developmental ages, and late 'side-entrants' were over-represented among world-class. Put another way, most of the many early selected

youngsters do not become successful seniors, while most of the successful seniors were not amongst those selected early (see Figure 3).

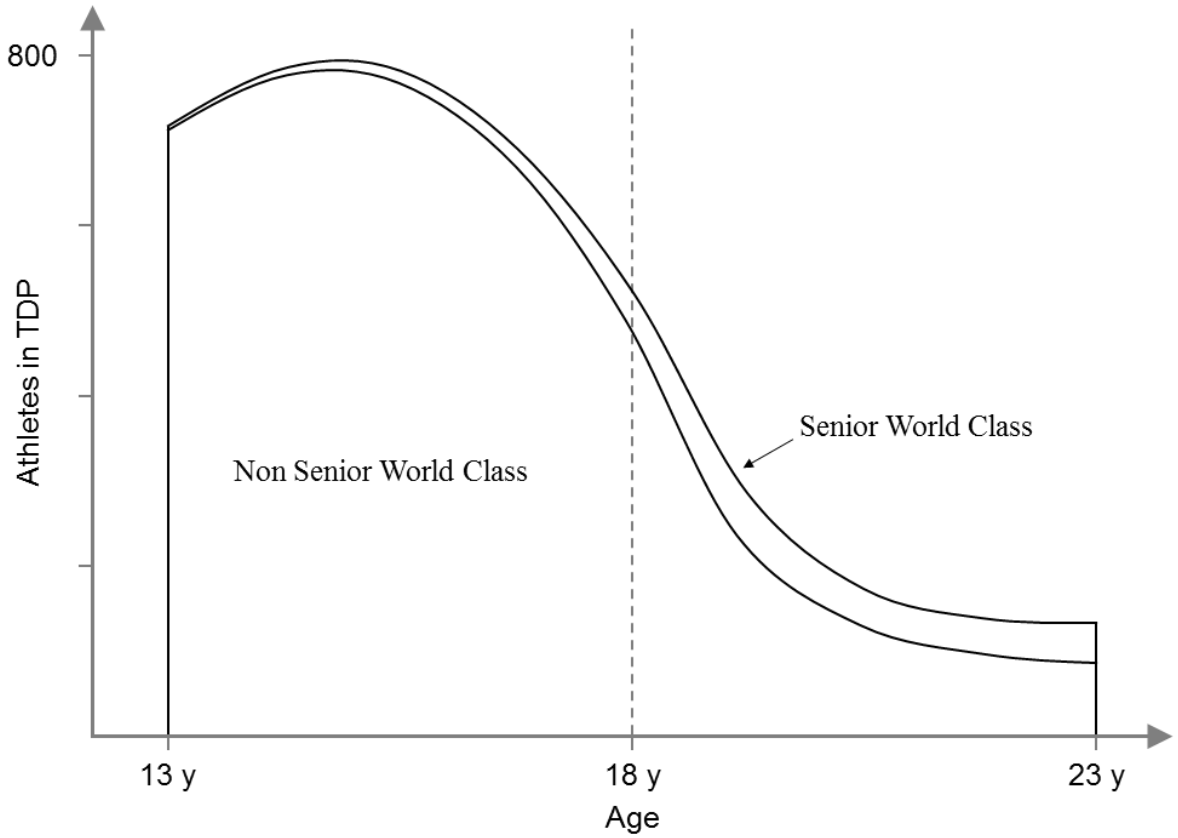

Figure 3: Frequency distribution of athletes within talent development programmes (TDP), differentiated within each age category into those who become senior world class and those who do not. Schematic illustration based on data of seven NSOs (Güllich & Emrich, 2012).

Considered together, these observations suggest that the population of senior top athletes – in the sport contexts examined – predominantly *emerges* in the course of multiple procedures of selection, de-selection, and replacements across the consecutive age and stage categories, rather than originating from early selected youngsters along with the effects of their continuous TDP nurturing (cf. Q4). Potential individualistic TDP effects are obviously 'overwritten' by collectivistic effects. More precisely, the mass and plurality of non-selected athletes practicing competitive sport, together with the diversity of their developmental participation patterns is superior in the probability of bringing out 'high-potentials' in the long-term compared to the comparatively few selected and nurtured at a young age.

Early TID/TDP preferentially selects those young athletes exhibiting – besides higher relative calendric age (RAE) and accelerated biological maturation (see Table 2) – earlier specialisation and intensified early sport-specific training (i.e., selection), and in addition reinforces further intensification of specialised training among the selected (i.e., intervention/socialisation). In other words, the 'gift' of subsidised TDP resources leads to greater expenditure of the youngster's individual resources (i.e., youth athlete time, effort, body), and likewise expands their opportunity costs along with increased risks (i.e., compromised enjoyment, health, premature dropout; Butcher et al., 2002; Côté et al., 2007; Fraser-Thomas et al., 2008; Myer et al., 2015; Wiersma, 2000). The alternative approach of moderately intense specific childhood/adolescence training, variable involvement in different sport contexts, and longer development outside TID/TDP which is over-represented among senior world-class, implicates a rather cost-reducing, risk-buffering early sport participation and investment pattern, with greater long-term return (Güllich & Emrich, 2013, 2014).

It should be considered that the ideology and content of TID and TDP across the globe has been widely adopted from the former Eastern bloc's systems; often seen as exemplary (Green & Oakley, 2001). However, they were incommensurable with Western sport systems on multiple aspects; and two key points are particularly relevant here. Firstly, individual decision autonomy was largely delegated to the state, while societal characteristics were extremely 'favourable' for the athlete's motivation and disposition to accept very high individual costs (Güllich & Emrich, 2013). Specifically, the societal scarcity of educational, professional, leisure, and travel opportunities was contrasted by substantial privileges for athletes. For example, they were granted better educational and occupational prospects, and nutrition. Athletes were 'public servants in sport', had material safeguarding, and travelled to Western countries. These extrinsic incentives

are less present and potent in Western societies and sport (and gradually cease in Eastern systems), while the larger scope for self-determined decisions about one's allocation of time leads to more careful individual consideration of the balance of one's costs, risks and benefits. Secondly, achievement sport in the Eastern bloc was stringently restricted to TDP within few centralised institutions. Practicing achievement sport was widely impossible outside TDP, and it was very improbable that non-selected athletes superseded selected athletes or were able to 'side-enter' at later stages. In contrast, Western sport systems cultivate competitive sport in more or less massive area-wide participation (e.g., sport clubs, high-school sport). Among the many initially 'missed' talents, most may still continue competitive sport, with the potential to supersede those selected earlier and to enter TDP in later years.

Practical implications

This chapter suggests some fairly clear implications for policy-makers and practitioners with a view to facilitating national collective senior success. The fact that early TID/TDP is generally not necessary and actually negatively correlates with long-term success is economically relevant. It suggests that particularly early TID/TDP is dispensable and a reallocation of resources may lead to greater utility. Those resources may (1) be shifted to TDP at higher ages, together with (2) proactive later-age talent search and talent transfer, and/or (3) be used to build up and maintain a large talent pool that may 'feed' TDP systems through all age ranges. The latter occurs primarily outside formal TDP, and may comprise: (a) the promotion of general youth participation in competitive sport and strengthening of local training environments; (b) providing opportunities for and encouraging training and competition experience in various sports; and (c) fortifying coaches' education. With a view to the specific design of TDP programming, collective senior success also presumably benefits from lessening individual costs and risks associated with early specialisation and intensified training. The expansion and intensification

of specialised training appears only beneficial in late adolescence or later in most sports. Finally, the substantial variation of developmental patterns leading to international senior success highlights the profound individuality of exceptional careers and suggests pronounced *individualisation* in shaping conditions and TDP interventions applied to the individual athlete.

Future directions

The present findings suggest that the low efficacy of early TID/TDP, and the slowed respective growth of knowledge, correlate with the (partial) inaccuracy of the underlain premises. For example, only limited added utility (in terms of improved 'success rates') may presumably be expected from further extended scientific scrutiny of early TID assessment. Besides being near-impossible, early TID is undertaken for the purpose of early selection into TDP, but early TDP has not been evidenced to benefit later senior success. Instead, the subtleties of effective TDP interventions, and the outcomes associated therewith, constitute the need for some clear research priorities. Based on the focus of this chapter: What kinds of conditions and TDP interventions, applied to which athlete at what ages, and in what way, may most optimally benefit long-term performance development; and why?

Finally, the endeavour to investigate and improve TID/TDP systems requires their substantiated *evaluation*. Many evaluation approaches at present typically draw on the *subjective* (i.e., how do participants or stakeholders *subjectively perceive* present TID and TDP) or *normative* quality dimension (i.e., to what extend TID and TDP corresponds to a *normative* 'ideal type' defined by a legitimised 'higher authority'; e.g., umbrella organisation). Such thinking and approach rests on the 'gap' notion (Parasuranam et al., 1985), where 'quality' is defined as the 'discrepancy gap' between the subjective perception of TID and TDP vs. subjective expectations, or normative definitions. Such 'gaps' can be reduced by manipulating expectations, perceptions,

or changing the definition of the ‘ideal type’ of TID and TDP.

By contrast, *instrumental* quality dimension determines to what extent a programme actually contributes to *attaining the objective* to which it was designed. Clearly, the outcome goal is collective senior success (i.e., number of medals). Still, an issue remains: How do you define ‘success’ of a country’s TID and TDP? Two questions require resolution: (1) How many medals are ‘good’ or ‘bad’ for a country, in view of different countries’ varying success potential relative to socio-economic factors (population size, economic prosperity, state of civil liberties). (2) To what extent does the outcome attainment (medals) rest on TDP effects and/or conditions outside the TDP in a country? A suitable technique may for example be to calculate the linear regression function for how “population size” and “GDP per capita” (e.g., Penn Tables) predict the number of medals across the different countries (Bernard & Busse, 2004; Emrich et al., 2012; evidently only reasonably applicable within either democratic or authoritarian systems [cf. Freedom House, 2015]). The prediction may then (1) help indicate whether and how far a country is located above or below expected international success. This is combined with (2) the analysis to what extent athletes’ international success rests on their (earlier) participation in TDP, and on which TDP characteristics.

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