

Handbook of References:
**Supplement to *Long-Term Development Development in Sport
and Physical Activity 3.0***

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Introduction

Sport for Life provides information and ongoing support for the integration of Long-Term Development in Sport and Physical Activity to national sport organizations, sport and non-sport sector leaders, and other contributors to the Canadian sport and physical activity ecosystem. Quality sport and advancing physical literacy are central to the work of Sport for Life.

This Handbook of References provides relevant literature to support *Long-Term Development in Sport and Physical Activity 3.0*. For each identified topic, highlights from the literature are summarized followed by select references. Additional references from leading researchers who have helped to shape our understanding of athlete development and high performance sport are packaged at the end of the document.

This resource may be used by anyone wishing to know more about the underpinnings of Long-Term Development in Sport and Physical Activity—the personal, organizational or system factors that bring Long-Term Development to life in all sporting and physical activity environments.

We encourage all readers to understand the landscape of athlete development, high performance sport, and quality involvement in physical activity is ever-changing—most data, findings, conclusions and interpretations are not universally accepted—there are many different ways to build a champion. Use this bank of information to inform your thinking, actions and discussions with others. Be open to new ideas and new ways of thinking about this exciting area of Long-Term Development.

Athlete Development Pathways or Models

Francis Galton (1869) first described the attributes of high achievement and expertise:

- innate capacity
- zeal
- power to work hard

The demands and requirements of different sports will guide the athlete development pathway for high performance athletes.

Sports have different demands and requirements:

Table II. Analytical categories of sports (from Emrich et al., 2001) and Olympic domain sports of athletes in this study.

Category	Definition
Cgs-sports	Performance is measured in centimetres, grams or seconds (cgs). The task is to minimise time or to maximise distance or weight. Olympic sports: Alpine skiing, athletics, biathlon, bobsledding, cycling, ice speed skating, kayak/canoe, luge, long-distance skiing, rowing, skeleton, swimming, triathlon, weightlifting.
Artistic composition sports	A sequence of skills is composed and the execution is rated by judges based on the skills' difficulty and the accuracy and aesthetic expression of their execution. Performance is defined as the result of the judges' rating. Olympic sports: artistic gymnastics, figure skating, platform diving, rhythmic gymnastics, synchronised swimming, trampoline.
Martial arts sports	The task is to strike the opponent's body with a hand, foot, leg or equipment and/or to disturb the opponent's balance while overcoming the opponent's direct opposition. Performance is defined as the frequency and/or effect of the strikes and/or of disturbing the opponent's balance as rated by judges. Olympic sports: Boxing, fencing, judo, wrestling, taekwondo.
Game sports	The task is to place a ball (or puck, shuttle etc.) either in a field in a manner it cannot be returned accurately by the opponent (net games) or in a goal, basket, zone etc. (invasion games) or to place players in a zone (run and field games) while overcoming the opponent's direct opposition. Performance is defined as the frequency of these events. Olympic sports: Badminton, baseball, basketball, beach volleyball, curling, field hockey, handball, hockey, soccer, softball, table tennis, tennis, volleyball, water polo.
Others	Sports that fulfil none or various of these criteria. Olympic sports: Archery, equestrian, modern pentathlon, Nordic combination, sailing, shooting, ski jumping, snowboard, windsurfing.

Observations of current athlete development pathways:

Current demand in sport makes for too much competition and not enough practice, training or recovery (Platonov 2006):

1. \$\$ drives increased # of competitions at expense of suitable recovery and training.
2. We ask/demand too much and too early of our young athletes.
3. We lack solid/evidence-based planning (training, recovery, competition) over years.
4. We lack valid/reliable assessment tools to evaluate athlete status and progression (eg core strength, strength of the ligaments, etc).
5. We don't do enough to prevent injury.
6. Must provide psychological development to enable athlete to deal with all the stresses of an elite athlete.
7. Quell the urgency to "be the best now".
8. Must do better job transforming our junior into senior athletes.

Common Athlete Development Pathways or Models

1. Deliberate practice theoretical framework (DPTF; Ericsson 1993 – 10 yrs/10,000 hours).

2. Developmental model of sport participation (DMSP; Côté 1999 – sampling, deliberate play/practice, specializing, investment).
3. Differentiated model of giftedness and talent (DMGT; Gagné 2004).

Most data derived from non-sport activities (music, chess)

1. Deliberate Practice Theoretical Framework (DPTF – Ericsson et al 1993) -- “the amount of time that an individual is engaged in deliberate practice activities is monotonically related to that individuals acquired performance” (this framework makes a strong argument in favour of starting deliberate practice at an early age, and suggests that this is also closely tied to the level of elite performance that is eventually achieved).
 ... “across many domains of expertise, a remarkably consistent pattern emerges: the best individuals start practice at earlier ages, and maintain a higher level of daily practice”.

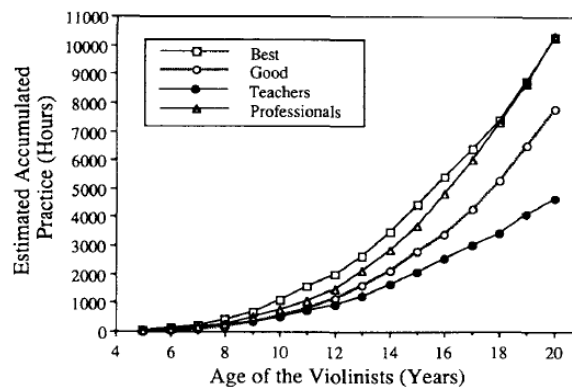
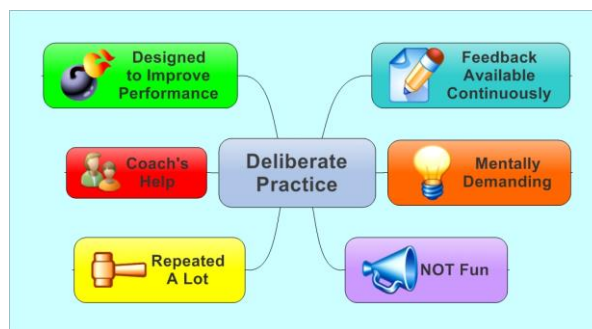


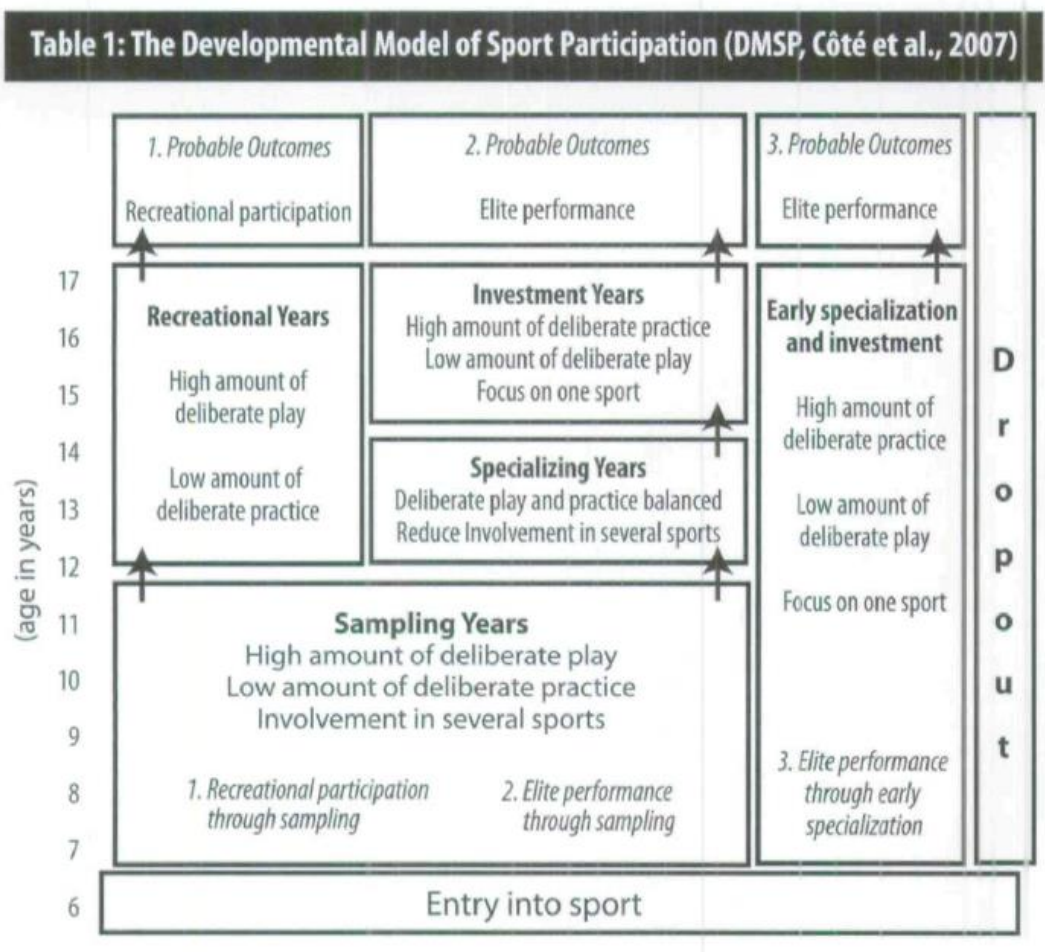
Figure 9. Accumulated amount of practice alone (on the basis of estimates of weekly practice) as a function of age for the middle-aged violinists (Δ), the best violinists (□), the good violinists (○), and the music teachers (●).

The origin of the 10,000-hour rule came from the world of music and chess



2. Developmental Model of Sport Participation (DMSP – Cote 1999) -- identifies two distinct pathways to elite performance, namely early specialization and early sampling
 - also ignores contribution of “natural abilities” (focus on developmental aspects of expertise)
 - the early specialization pathway is in fact quite consistent with the Deliberate Practice Theoretical Framework (Ericsson et al., 1993; Ericsson et al., 2009), in that it involves specialization in a single sport from as early as 6 years of age combined with a strong emphasis on deliberate practice from the outset of involvement.

- early sampling pathway, on the other hand, focuses on a diverse sporting involvement during childhood, and emphasizes the particular importance of ‘deliberate play’.



Côté et al (2009)

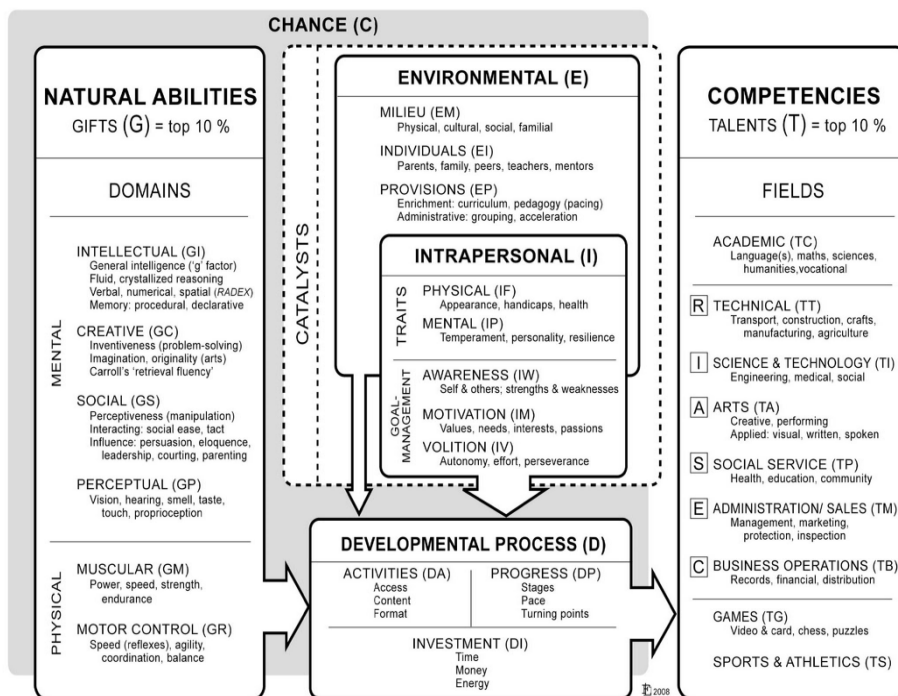
- deliberate play activities (e.g. backyard soccer or street basketball) are “intrinsically motivating, provide immediate gratification, and are specifically designed to maximize enjoyment”
- these authors also pointed out that deliberate play activities normally involve modified, age-adapted rules, and are typically set-up and monitored by a child or adult who is directly involved.
- potential for another stage, which would reflect the realities of continued development during adulthood
- “the existence of a fourth stage marked by maintenance and perfection of skills”. According to Côté, this additional stage would appear after the investment years, which is a conception that would broaden the utility of the DMSP as a framework to account for ongoing talent development from an athlete’s first formal involvement in their sport until the moment that serious competition is discontinued.

Early specialization	Early diversification
Ericsson	Cote
<ul style="list-style-type: none"> ➤ 10,000 hours of deliberate practice to achieve expertise ➤ Strong correlation between performance level & training hours ➤ Problems – elite performers don't always attain 10,000 hours ➤ Evidence of higher attrition & negative health outcomes 	<ul style="list-style-type: none"> ➤ More diverse range of skills developed through variety of sports ➤ Promotes development of intrinsic motivation, increased self-involvement ➤ Talent transfer across sports (cognitive and physical) ➤ Evidence from tennis (age 15), but still compile enough hours

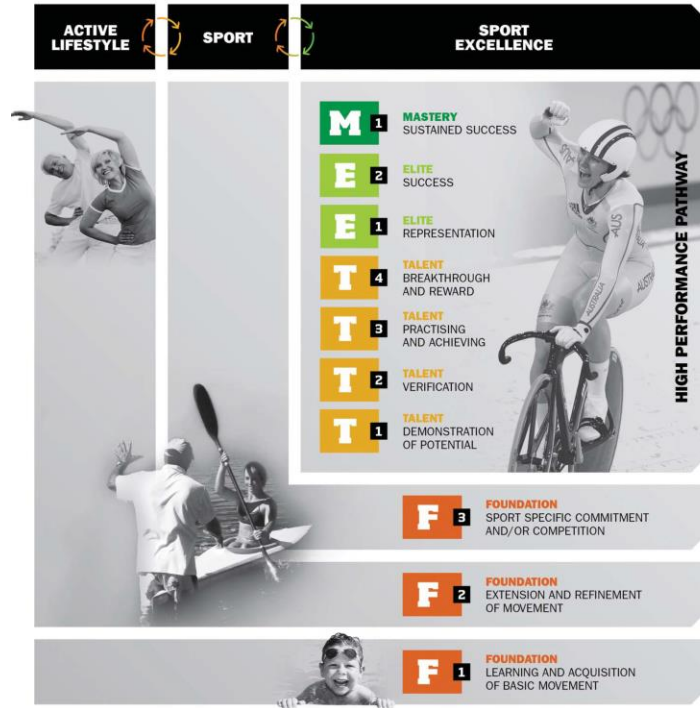
3. Differentiated Model of Giftedness and Talent (DMGT) – Gagne 2004

- i. Gifts (G) “the possession and use of untrained and spontaneously expressed outstanding natural abilities or aptitudes, in at least one ability domain, to a degree that places a person at least among the top 10% of age peers”
- ii. Talents (T) “outstanding mastery of systematically developed competencies (knowledge and skills), in at least one field of human activity, to a degree that places a person at least among the top 10% of ‘learning peers*’”

**the term learning peers is used in reference to others who have accumulated a similar amount of learning time from either current or past training.*



Gagné (2004)



Gulbin et al (2013)

4. “The proposed FTEM (Foundations, Talent, Elite, Mastery) framework offers broad utility to researchers and sporting stakeholders alike. FTEM is unique in comparison with alternative models and frameworks, because it: integrates general and specialised phases of development for participants within the active lifestyle, sport participation and sport excellence pathways; typically doubles the number of developmental phases (n = 10) in order to better understand athlete transition; avoids chronological and training prescriptions; more optimally establishes a continuum between participation and elite; and allows full inclusion of many developmental support drivers at the sport and system levels. The FTEM framework

offers a viable and more flexible alternative for those sporting stakeholders interested in managing, optimising, and researching sport and athlete development pathways.”

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Athletes with Disabilities

Block et al (2013)

“While a physically active lifestyle is important for everyone in promoting overall well-being and prevention or delay of chronic disease, physical activity is even more important for children and young adults with disabilities.”

Barriers to participation

These barriers include: (a) a lack of understanding about the benefits of physical activity; (b) a lack of awareness of the available physical activity options and community programs; (c) environmental constraints such as accessibility, transportation, and architectural design; (d) fear of liability of the program leader and lack of knowledge and training of instructors; (e) lack of appropriate programs; and (f) programs’ emphasis on competitive sports

Supporting participation

Quality instruction and training of instructors, teachers, coaches
Ongoing support for instructor, teacher, coach
Appropriate programming

Braun & Braun (2015)

For those participants with “hidden disabilities”:

Specific Learning Disabilities (SLD)

TABLE 1 Characteristics and Strategies for Young Athletes with SLD

Characteristics	Direct instruction	Strategy instruction
● Average intelligence	● Sequencing	● Development and use of cognitive strategies
● Difficulty with lengthy instructions	● Step-by-step prompts	● Metacognitive strategies
● Problems with working memory	● Segmentation	● Self-regulatory strategies
● Problems interpreting tactical plays	● Modeling and demonstration	● Mnemonics
● Difficulty understanding diagrams and playbooks	● Scaffolding	
● Problems with comprehension of sport language	● Monitoring	
● Ongoing feedback		

Attention Deficit Hyperactivity Disorder (ADHD)

TABLE 2 Characteristics and Strategies for Young Athletes with ADHD

Characteristics	Direct instruction	External supports	Self-regulatory instruction
<p>Predominantly Inattentive Type</p> <ul style="list-style-type: none"> • Easily distracted and forgetful • Does not seem to listen or follow directions • Unfocused; appears to make careless mistakes 	<ul style="list-style-type: none"> • Focusing attention • Providing step-by-step directions • Chunking • Promoting persistence 	<ul style="list-style-type: none"> • Visual and auditory prompts • Graphic organizers • Collaboration with peers • External reinforcers 	<ul style="list-style-type: none"> • Memory strategies (Mnemonics) • Goal-setting strategies • Self-monitoring • Sub-vocalization/Self-talk
<p>Hyperactive/Impulsive Type</p> <ul style="list-style-type: none"> • Talks excessively; interrupts others • Acts or speaks without thinking • Difficulty sitting still • Has trouble taking turns or waiting • Increased risk-taking behaviors 			

Autism Spectrum Disorders (ASD)

TABLE 3 Characteristics and Strategies for Young Athletes with ASD

Characteristics	Dealing with sensory overload	Facilitation of appropriate language and social skills	Capitalize on special interests or skills
<ul style="list-style-type: none"> • Atypical language development 	<ul style="list-style-type: none"> • Carefully structure environment 	<ul style="list-style-type: none"> • Interpreting comments of others (often taken too literally or misinterpreted) 	<ul style="list-style-type: none"> • Serve as an “expert” or resource for others
<ul style="list-style-type: none"> • Atypical social development 	<ul style="list-style-type: none"> • Offer a “plan for escape” (a safe haven) 	<ul style="list-style-type: none"> • Clearly state rules/expectations 	<ul style="list-style-type: none"> • Use of cooperative learning groups
<ul style="list-style-type: none"> • Repetitive behavior/perseveration 	<ul style="list-style-type: none"> • Be aware of proximity issues 	<ul style="list-style-type: none"> • Use a buddy system 	<ul style="list-style-type: none"> • Develop special interest clubs or groups
<ul style="list-style-type: none"> • Sensory sensitivities 	<ul style="list-style-type: none"> • Use of external supports such as graphic organizers, visual, auditory or tactile prompts 	<ul style="list-style-type: none"> • Utilization of peer-assisted learning skills (careful attention to selection of peer) 	
<ul style="list-style-type: none"> • Lacks empathy 		<ul style="list-style-type: none"> • Use same language and terms to establish routines 	
<ul style="list-style-type: none"> • Concrete/literal approach • Difficulty accepting compliments and corrections 		<ul style="list-style-type: none"> • Prevent misunderstanding 	

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Benefits of Outdoors

Improved physical, psychological, emotional, cognitive outcomes associated with physical activity, play and time in the outdoors. In addition to benefits to the individual, marked improvements to social cohesion and group dynamics across all age groups. Supports advancement of Human Capital Model (Bailey et al 2013).



Primary contributions to children and adolescents is in the form of risky play:

- thrilling and challenging forms of play
- involves a risk of physical injury
- *most often takes place outdoors and in children's free play* (Sandseter (2009))
- Play in natural environments is associated with young children's improved motor abilities and increased creativity.
- Access to nature nurtures self-discipline and self-confidence among children, including children with disabilities.
- Green exercise may offer added benefits when compared to equal exertion in indoor gyms (more space, less structure, more activity).
- Play and physical activity levels are greater in the outdoor spaces compared to indoor spaces
- Exposure to natural environments can mitigate symptoms of ADHD
- Reduced BMI, improved blood pressure, lower stress, increased healing from greater access to outdoor/green space

From being smarter to more cooperative to healthier overall. A well-documented article by two physicians builds a strong case for the importance of unstructured free play in the out-of-doors for all age groups, and especially young children. While concerned about the "obesity epidemic" in young children, the authors say that the *health benefits* from outdoor play are only one aspect of the overall benefits. They suggest that the concept of "play" is more compelling and inviting to most adult caregivers, parents and guardians than "exercise." The authors cite *cognitive benefits* from play in nature, including creativity, problem-solving, focus and self-discipline. *Social benefits* include cooperation, flexibility, and self-awareness. *Emotional benefits* include stress reduction, reduced aggression and increased happiness. Children will be smarter, better able to get along with others, healthier and happier when they have regular opportunities for free and unstructured play in the out-of-doors (Burdette HL et al 2005).

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Benefits of Quality Physical Activity

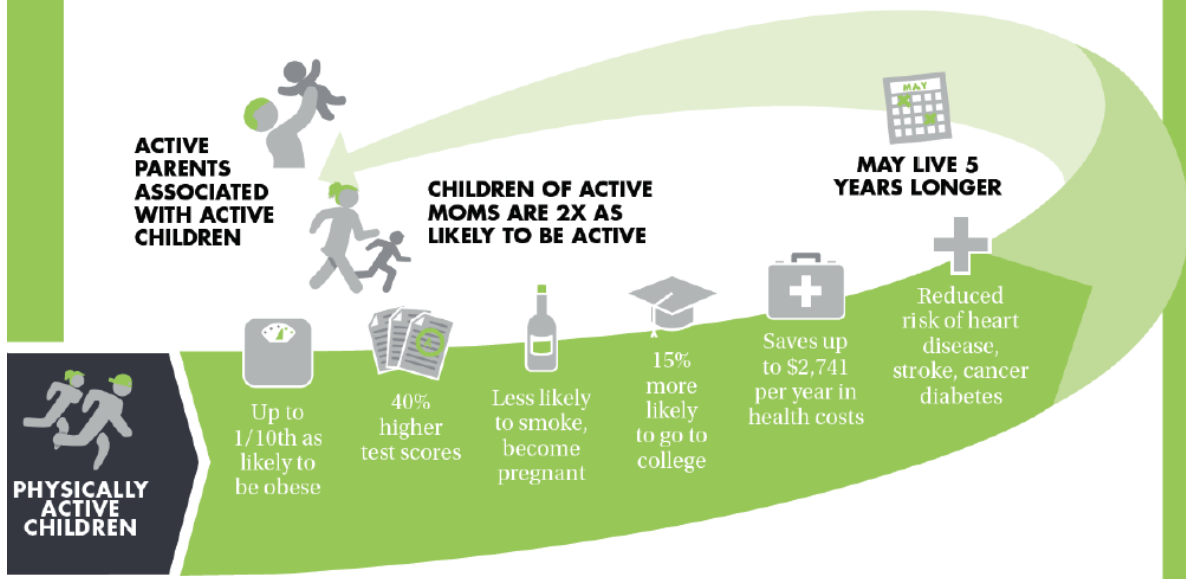
Children need movement

‘...movement is considered to be the bedrock of all intellectual development... often it is merely limited opportunities for movement that create many so-called behavioural and learning difficulties.’ Olds, 2001

“Despite the fact that physical activity is universally acknowledged to be an important part of healthy functioning and well-being, the full scope of its value is rarely appreciated. This article introduces a novel framework for understanding the relationships between physical activity (and specifically sport-related forms of physical activity) and different aspects of human development. It proposes that the outcomes of physical activity can be framed as differential ‘capitals’ that represent investments in domain-specific assets: Emotional, Financial, Individual, Intellectual, Physical, and Social. These investments, especially when made early in the life course, can yield significant rewards, both at that time and for years to come. The paper presents a new model—the **Human Capital Model**—that makes sense of these effects, outlines the different capitals, and briefly articulates the conditions necessary for the realization of Human Capital growth through physical activity.” (Bailey et al 2013)



LIFETIME BENEFITS OF PHYSICAL ACTIVITY



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Benefits of Quality Sport

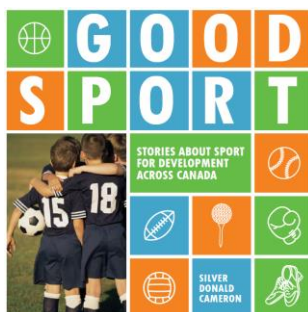
Improved physical, psychological, emotional, cognitive outcomes associated with quality sport. In addition to benefits to the individual, marked improvements to social cohesion and group dynamics across all age groups. Supports advancement of Human Capital Model (Bailey et al 2013).



“Sport for development is not a new idea, but its resurgence in Canada over the past decade is having profound impacts in rural and urban communities across the country. MoreSports in Vancouver; the Active Circle in Indigenous communities; Right to Play; and hundreds of small-scale initiatives launched with support from the True Sport Foundation, are among the new programs engaging young people, their parents, volunteers and community leaders in underserved and remote communities.

Why is this work important? Improved health and fitness, along with coaching and leadership training, contribute to youth’s social productivity – their ability to lead lives that make a net contribution to community. Counter to current trends that exacerbate the divide between rich and poor, sport for development is about creating a society where differences in income, race, and religion do not prevent social cohesion and mobility. It makes our communities more inclusive and resilient.”

JW McConnell Family Foundation (2013)



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Brain Development

'Early experiences determine whether a child's developing brain architecture provides a strong or weak foundation for all future learning, behavior and (both physical and mental) health.'

Center on the Developing Child, Harvard University

'When they have the opportunities to explore, risk, and try and try again in an environment that is both safe and challenging, babies can engage in motor practice play that leads to advanced physical abilities, mobility, agility, dexterity, and as a result, confidence, independence and learning.' Kernan, 2007

The worrisome decline in physical activity and basic movements of daily living is leading to startling revelations about development of the brain and its numerous cognitive functions.

"In light of the interrelation between motor and cognitive development and the predictive value of the former for the latter, the secular decline observed in motor coordination ability as early as preschool urges identification of interventions that may jointly impact motor and cognitive efficiency." Pesce et al (2016)

"Results suggest that specifically tailored physical activity (PA) games provide a unique form of enrichment that impacts children's cognitive development through motor coordination improvement, particularly object control skills, which are linked to children's PA habits later in life. Outdoor play appears to offer the natural ground for the stimulation by designed PA games to take root in children's mind." Pesce et al (2016)

"Cognitive Outcomes of Enriched Physical Activity as a 'Side Effect' of Motor Competence"

Adele Diamond (2013, 2015) has done much work to advance our understanding of executive function and the role of physical activity. Clearly more research is required in this area as we know little about the different kinds of activities or sports that promote executive functions, the duration of the effects and the age-related impacts.

"...I predict that the later (movement activities that improve physical fitness and also train diverse motor and EF skills) will be the most effective in improving the EFs of young children. Until the many holes in the research literature begin to be filled it will be difficult to draw firm conclusions but I put my money on activities that improve physical fitness but also (a) train and challenge diverse motor and EF skills, (b) bring joy, pride, and self-confidence, and (c) provide a sense of social belonging (e.g., group or team membership)."

"The main finding from this study was that being consistently moderately physically active throughout adolescence was significantly associated with cognitive performance at age 18 years" "adolescents who are physically inactive might be losing an important stimulus to improve learning and cognitive performance." Esteban-Cornejo et al (2015)

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Deliberate Practice

Ericsson (1993) first describe the role of “deliberate practice” in the development of expertise. Debate has emerged regarding the overall contributions of deliberate toward expertise (Macnamara et al 2016).

Ericsson (2016)

“In their original article, Ericsson, Krampe, and Tesch-Romer (1993) reviewed the evidence concerning the conditions of optimal learning and found that individualized practice with training tasks (selected by a supervising teacher) with a clear performance goal and immediate informative feedback was associated with marked improvement. We found that this type of deliberate practice was prevalent when advanced musicians practice alone and found its accumulated duration related to attained music performance. In contrast, Macnamara, Moreau, and Hambrick’s (2016, this issue) main meta-analysis examines the use of the term deliberate practice to refer to a much broader and less defined concept including virtually any type of sport-specific activity, such as group activities, watching games on television, and even play and competitions. Summing up every hour of any type of practice during an individual’s career implies that the impact of all types of practice activity on performance is equal—an assumption that I show is inconsistent with the evidence. Future research should collect objective measures of representative performance with a longitudinal description of all the changes in different aspects of the performance so that any proximal conditions of deliberate practice related to effective improvements can be identified and analyzed experimentally.”

Macnamara et al (2016)

“Why are some people more skilled in complex domains than other people? According to one prominent view, individual differences in performance largely reflect individual differences in accumulated amount of *deliberate practice*. Here, we investigated the relationship between deliberate practice and performance in sports. Overall, deliberate practice accounted for 18% of the variance in sports performance. However, the contribution differed depending on skill level. Most important, deliberate practice accounted for only 1% of the variance in performance among elite-level performers. This finding is inconsistent with the claim that deliberate practice accounts for performance differences even among elite performers. Another major finding was that athletes who reached a high level of skill did not begin their sport earlier in childhood than lower skill athletes. This finding challenges the notion that higher skill performers tend to start in a sport at a younger age than lower skill performers. We conclude that to understand the underpinnings of expertise, researchers must investigate contributions of a broad range of factors, taking into account findings from diverse subdisciplines of psychology (e.g., cognitive psychology, personality psychology) and interdisciplinary areas of research (e.g., sports science).”

The Relationship Between Deliberate Practice and Performance in Sports: A Meta-Analysis

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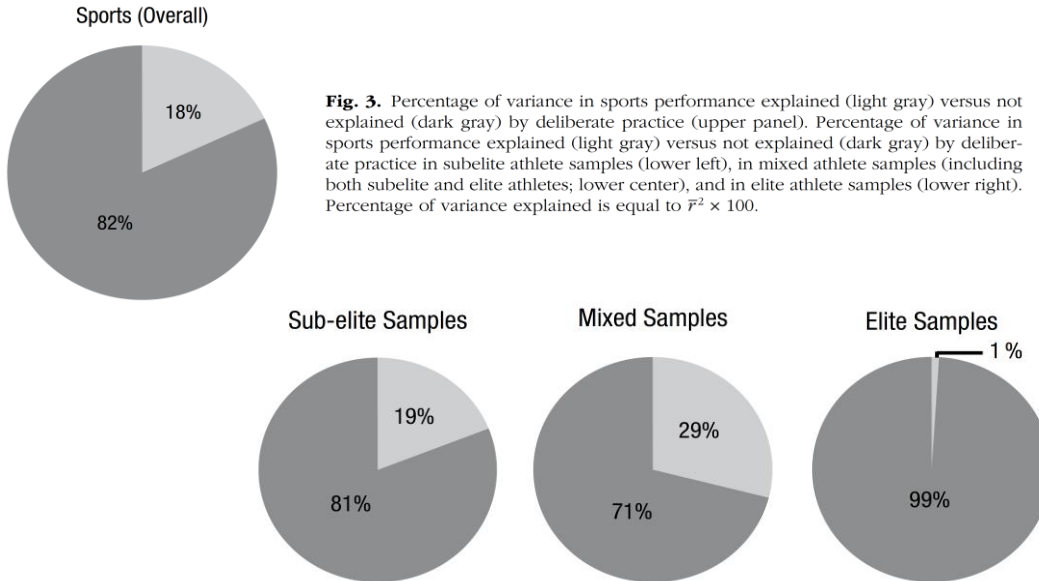
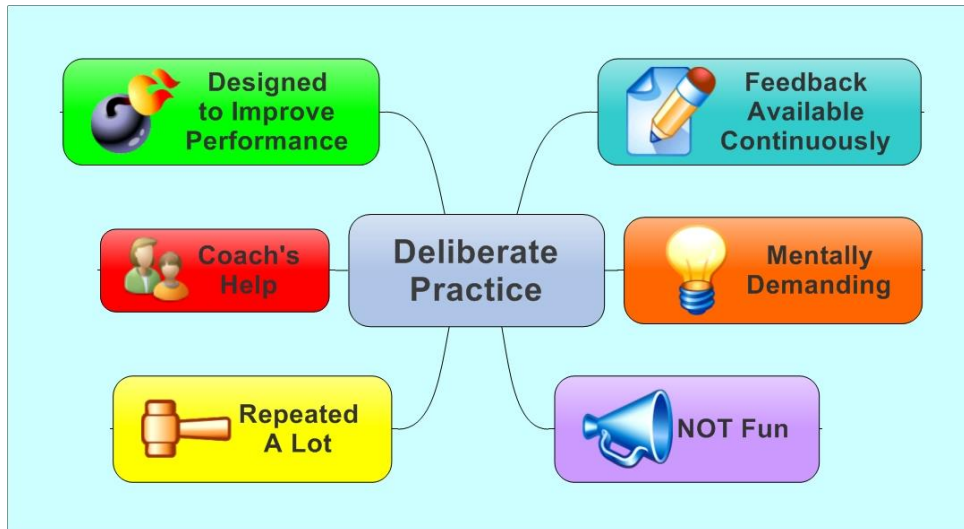


Fig. 3. Percentage of variance in sports performance explained (light gray) versus not explained (dark gray) by deliberate practice (upper panel). Percentage of variance in sports performance explained (light gray) versus not explained (dark gray) by deliberate practice in subelite athlete samples (lower left), in mixed athlete samples (including both subelite and elite athletes; lower center), and in elite athlete samples (lower right). Percentage of variance explained is equal to $r^2 \times 100$.

Components of Deliberate Practice (Ericsson et al 1993)



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Developmentally Appropriate

Declining rates of participation in sport accompanied by large increases in youth injury are key indicators of excessive demands placed on our developing athletes. These excessive demands are characterized by poor training programs, insufficient recovery, and too much competition. Treating our children as adults is no longer acceptable.

Robert Malina (2015) is prolific in this area and describes numerous recommendations to improve the way we ask our developing athletes to train, recover and compete. “The search for talent is pervasive in youth sports. Selection/exclusion in many sports follows a maturity- related gradient largely during the interval of puberty and growth spurt.”

Myer et al (2011, 2015, 2016) provide guidelines for appropriate timing of training.

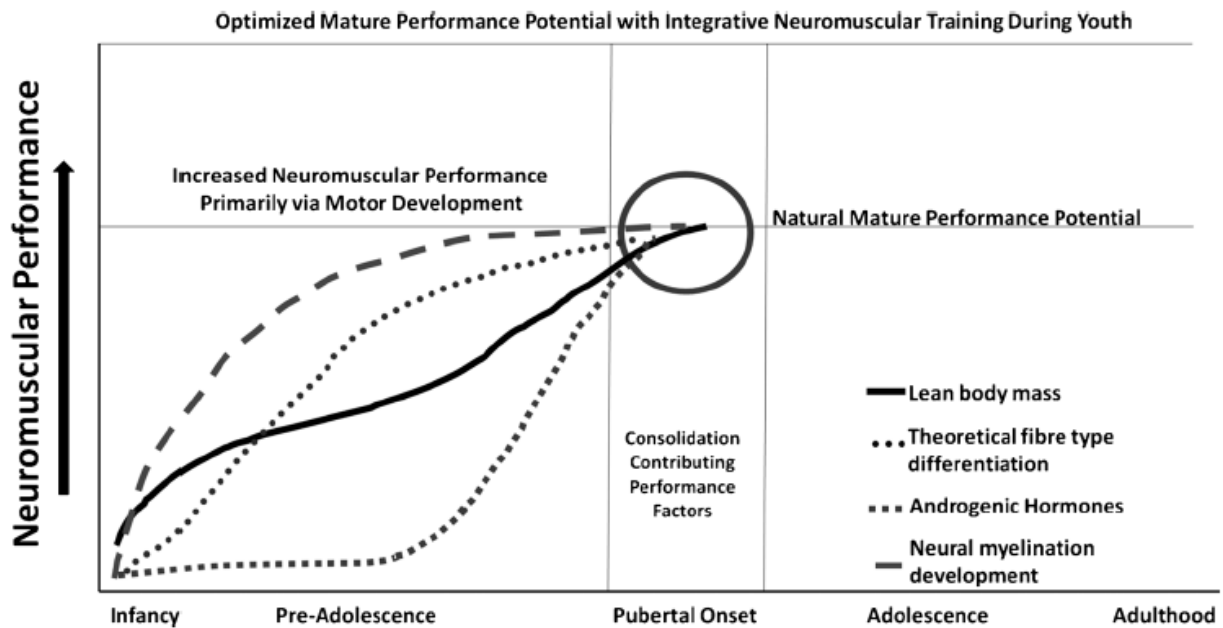


Figure 1: In youth, several factors contribute to motor control and strength expression. In children, motor control and strength may be less related to hypertrophy and more likely associated with neural development. It is proposed that integrative neuromuscular training focused on skill-related fitness (e.g., agility, reaction time, coordination, power, speed, and balance) can maximize neural development during pre-adolescence and optimally prepare youth to capitalize on the consolidated factors that contribute to motor performance following the onset of puberty. [Adapted from Kraemer WJ, Fry AC, Frykman PN, Conroy B, Hoffman J. Resistance training and youth. *Ped. Exer. Sci.* 1989; 1:336–50. Copyright © 1989 *Ped. Exer. Sci.* Used with permission.]

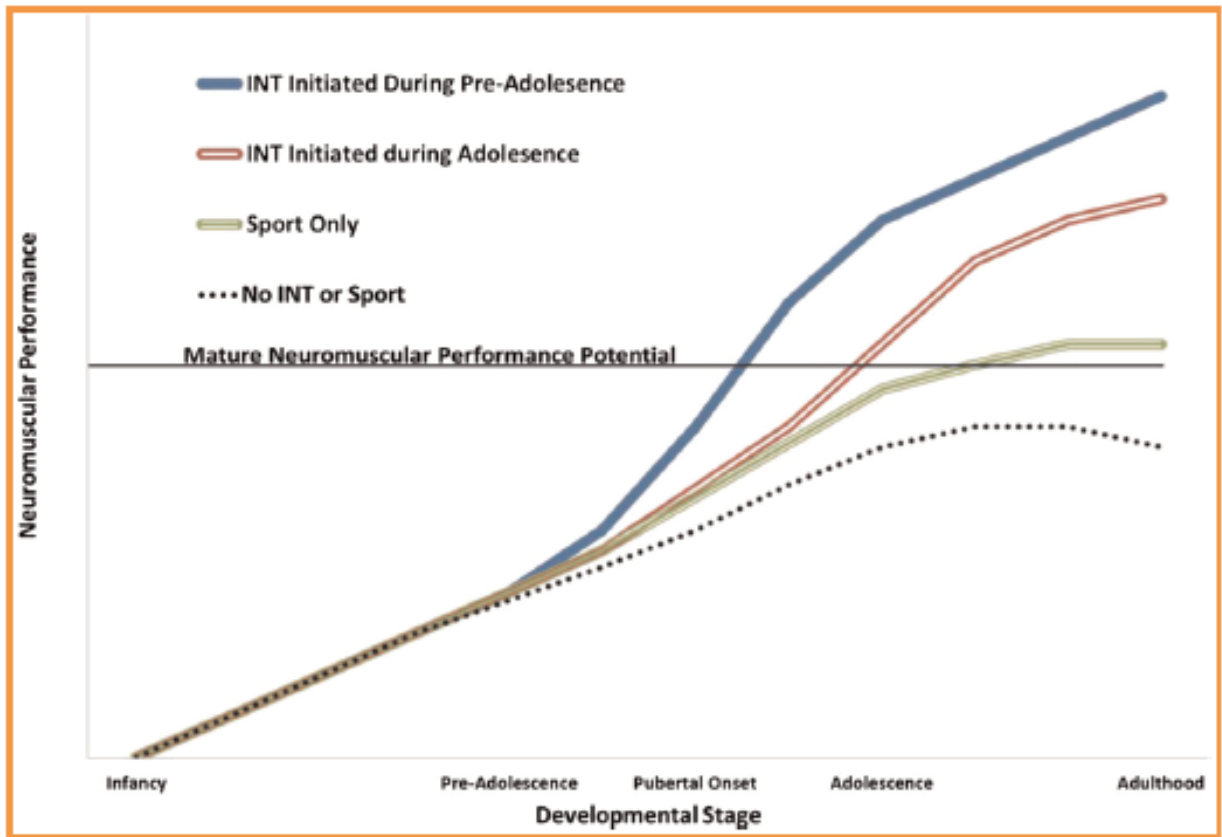


Figure 2. Conceptual model that compares the effects of integrative neuromuscular training initiated at different times in youth. The different patterned lines represent the initiation of these integrative training techniques during preadolescence (dark solid line) and adolescence (double line), which likely will improve motor capacity and performance beyond natural adult potential (without such training). It is suggested that integrative neuromuscular training initiated in preadolescence and maintained into adolescence will maximize training age and the potential to achieve optimal adulthood motor capacity. Broken lines indicate potential detrimental effects of physically inactive youth who are not exposed to the integrative training model. INT = integrative neuromuscular training.

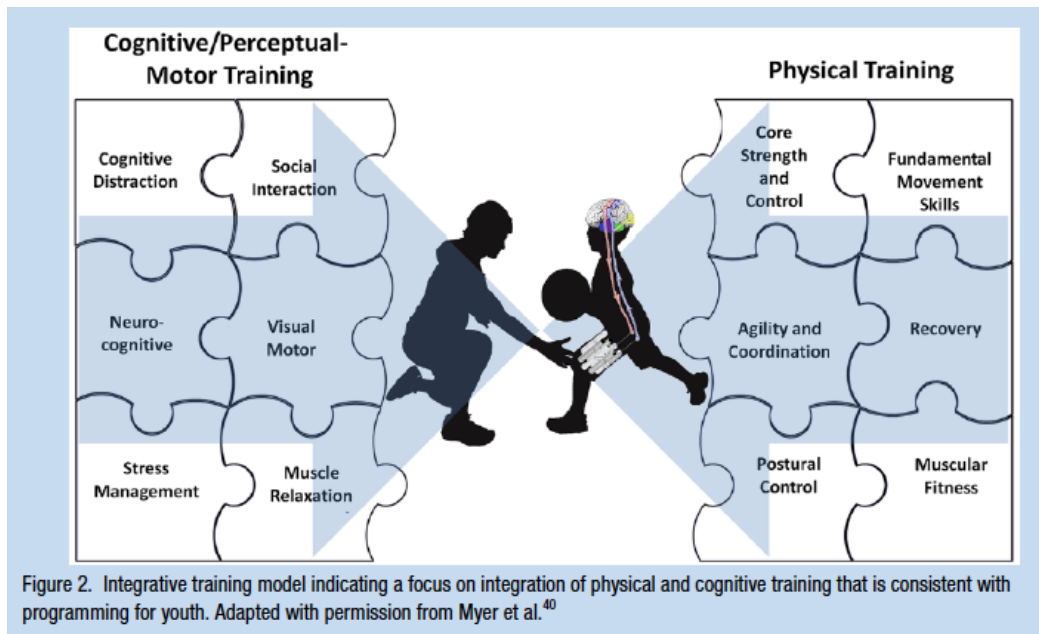


Figure 2. Integrative training model indicating a focus on integration of physical and cognitive training that is consistent with programming for youth. Adapted with permission from Myer et al.⁴⁰



Clinical Recommendations

SORT: Strength of Recommendation Taxonomy

A: consistent, good-quality patient-oriented evidence

B: inconsistent or limited-quality patient-oriented evidence

C: consensus, disease-oriented evidence, usual practice, expert opinion, or case series

Clinical Recommendation	SORT Evidence Rating
Youth should be given opportunities for free, unstructured play to improve motor skill development and parents and educators should encourage child self-regulation to help limit the risk of overuse injuries.	C
Parents and educators should help provide opportunities for free, unstructured play to improve motor skill development during the growing years, which can reduce injury risk during adolescence.	C
Youth should be encouraged to participate in a variety of sports during their growing years to influence the development of diverse motor skills and identify a sport, or sports, that the child enjoys.	C

Growth, maturation and performance on the field (Bergeron et al 2015)

“Sport performance during youth is underpinned by a range of physical and physiological variables that are governed by the timing and tempo of growth and maturation. Youth sport, however, is highly selective, with a maturity-associated selection/exclusion process commonly occurring during the interval of puberty and the adolescent growth spurt, which covers the period between 9 and 15 years of age. Sport performance progressively improves with growth and maturation, and appropriate aerobic, anaerobic and resistance training further enhance performance; but there is asynchronous development through childhood and adolescence into young adulthood. Thus, initial selection, long-term athletic/sport performance prediction and optimal athlete development remain a challenge. Research has developed a sound scientific foundation to inform decision-making; but those involved in youth athlete development must nurture talented individuals, and appreciate that both positive and negative changes in performance might be more related to biological clocks than to coaching and training.”

Considerations for developmentally appropriate training, competition and recovery of young athletes:

- Avoid early single sport specialization (except for the few sports that warrant early focus such as gymnastics, diving, figure skating).
- Research suggests that youth should avoid early sport specialization, as diverse athletic exposure and sport sampling enhance motor development and athletic capacity, reduce injury risk and increase the opportunity for a child to discover the sport(s) that he/she will enjoy and possibly excel at.
- Be mindful of training volume, intensity and variety to avoid overuse injuries -- multifaceted neuromuscular training and programs focused on intrinsic factors such as strength, endurance and proprioception/balance, have been shown to reduce injury incidence in many sports.
- Youth athletes are increasingly being exposed to inappropriate and unrealistic demands or expectations leading to psychological overload induced by themselves or by their coach or parent(s).

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Early Childhood Resilience and Adverse Events

With increasing pressure for children and adolescents to demonstrate adult-level expertise, we are learning more about appropriate challenges to develop the social-emotional and cognitive capacity for our young athletes. From a child's first days, opportunities to move and explore their world while interacting with a caring adult is essential.

The Center on the Developing Child at Harvard University describes 8 things to remember about early child development (developingchild.harvard.edu/resources/8-things-remember-child-development/):

1. Even infants and young children are affected adversely when significant stresses threaten their family and caregiving environments.
2. Development is a highly interactive process, and life outcomes are not determined solely by genes.
3. While attachments to their parents are primary, young children can also benefit significantly from relationships with other responsive caregivers both within and outside the family.
4. A great deal of brain architecture is shaped during the first three years after birth, but the window of opportunity for its development does not close on a child's third birthday.
5. Severe neglect appears to be at least as great a threat to health and development as physical abuse—possibly even greater.
6. Young children who have been exposed to adversity or violence do not invariably develop stress-related disorders or grow up to be violent adults.
7. Simply removing a child from a dangerous environment will not automatically reverse the negative impacts of that experience.
8. Resilience requires relationships, not rugged individualism.

“Other than talent and opportunity, what makes some people more successful than others? One important determinant of success is self-control—the capacity to regulate attention, emotion, and behavior in the presence of temptation. A second important determinant of success is grit—the tenacious pursuit of a dominant superordinate goal despite setbacks. Self-control and grit are strongly correlated, but not perfectly so.”

Duckworth and Gross (2014)

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Early Single Sport Specialization

Malina (2010) describes the roots of early sport specialization:

- Eastern European sport system
- Parent(s) desire to give their child(ren) an “edge”
- Labelling as “gifted” or “talented”
- Pursuit of scholarships
- Pursuit of professional contracts
- Sporting goods industry
- Expertise research

Early specialization for most sports does not predict later success

Vaeyens et al (2009) various sports

Moesch et al (2011) CGS sports

Soberlak and Cote (2003) NHL

Gulich (2014, 2016)

Vaeyens et al. (2009) have demonstrated that talent identification programs based on early success have not proven to be effective in terms of predicting adult expertise. More specifically, they pointed to some fascinating research on German Olympians from 2000 and 2008, which compared those athletes who eventually achieved top-10 international finishes with their less successful senior national team peers. The results of this research showed that, although there were no differences in the onset of initial training or competition, the more successful athletes started training for and competing in international championships significantly later than their less successful teammates. Furthermore, and very much in keeping with the concept of early diversification, the results also showed that world-class athletes were more likely to have trained and competed in other sports during their formative years.

Additional support for later specialization comes from Moesch et al. (2011), who compared the developmental patterns of Danish elite and near-elite athletes in a particular category of sports referred to as ‘CGS’ sports (i.e. centimeter, gram, second). In these sports winning is based on superior performance with respect to distance, weight, or time, and their basic demands tend to be largely physical in nature. The results of this study showed that the elite athletes passed important milestones later (e.g. starting sport, first competition, etc.), spent fewer years on junior national teams, and ultimately spent more years on senior national teams than did the non-elite athletes. Furthermore, it was found that even though the near elite group had accumulated more practice hours by age 15, this advantage disappeared by the age 18, and the elite group ended up with a significant and lasting advantage by age 21 (6,335 hours vs. 5,204 hours).

Finally, although no differences were found between the two groups in terms of diversity of sporting involvement, both were found to have participated in approximately 1.5 other activities beyond their main sport. Soberlak and Cote (2003) examined many of these same concepts in the very different and more complex sport of ice hockey. More specifically, this study took an in-depth look at the developmental histories of a small group of Canadian major junior hockey players who had recently signed National Hockey League contracts. In terms of deliberate practice, relatively low amounts were reported in the sampling years, followed by a gradual increase during the specializing years, and a considerable increase throughout the investment years up to age 20 (i.e. the participants age at the time

of data collection). In terms of deliberate play, the opposite trend was apparent, with high amounts reported during the sampling years, a significant decrease during the specializing years, and a virtual disappearance during the investment years. As far as organized games are concerned, involvement in these activities was shown to gradually increase during the sampling years, to do so again during the specializing years, and then, coinciding with their graduation to major junior hockey, increase significantly during the investment years.

“Junior success is a poor indicator of long-term senior success. Their success at the age of 10 had a zero correlation with their success as a senior. Same was true with their success at 11-14, 15-18. We have a zero correlation.”

“That means, those who were better at a young age were not those who were better at an older age. This also applies to different types of sports – CGS sports (where performances are measured in centimeters, grams, seconds), games sports, combat sports, artistic composition sports. The results are all the same across all different types of sports.” German Olympic medalists played 2 or 3 other sports at a high level before focusing on their main sport at 20 years of age.

“Those who were recruited into the system earlier, started specializing significantly earlier -- as a result, looking at where they got to in the long term, those recruited earlier were more successful at a youth age, but they were under-represented in terms of senior world class (top ten worldwide),” (Güllich 2014, 2016).

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Mental Health

“The physical impacts of elite sport participation have been well documented; however, there is comparatively less research on the mental health and psychological wellbeing of elite athletes.” (Rice et al 2016)

Key Points

The evidence base regarding the mental health and wellbeing of elite athletes is limited by a paucity of high-quality, systematic studies, including intervention trials.

On the basis of current evidence, elite athletes appear to experience a broadly comparable risk of high-prevalence mental disorders relative to the general population. A greater risk of disorder may be experienced by elite athletes who are injured, approaching/in retirement or experiencing performance difficulty.

While the importance of elite athlete mental health is gaining increasing attention, targeted, disorder-specific models of care are yet to be established for this group. There is scope for such models to capitalise on early-intervention principles and establish cross-discipline collaboration.

“The findings suggested that elite athletes experience a broadly comparable risk of high prevalence mental disorders (i.e. anxiety, depression) relative to the general population. Evidence regarding other mental health domains (i.e. eating disorders, substance use, stress and coping) is less consistent.”

“The research demonstrates that this population is vulnerable to a range of mental health problems (including substance misuse), which may be related to both sporting factors (e.g. injury, overtraining and burnout) and non-sporting factors. More high-quality epidemiological and intervention studies are needed to inform optimal strategies to identify and respond to player mental health needs.”

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Nonlinear Pedagogy

Sports expertise: a dynamical systems theory (Phillips et al 2010)

- “Expert skill acquisition emerges through interactions between specific *individual* (mental and physical – physiological and anthropometric), *task* (specific to a sports discipline) and *environment* (socio-cultural factors – family support, access to facilities, cultural trends in sport participation) constraints”

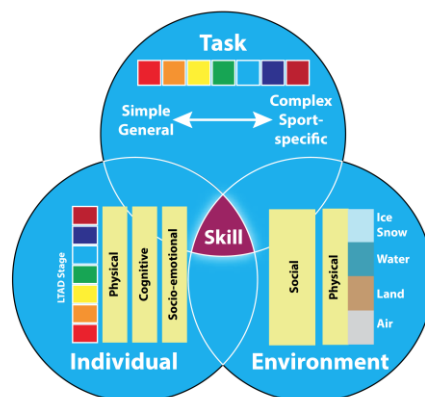
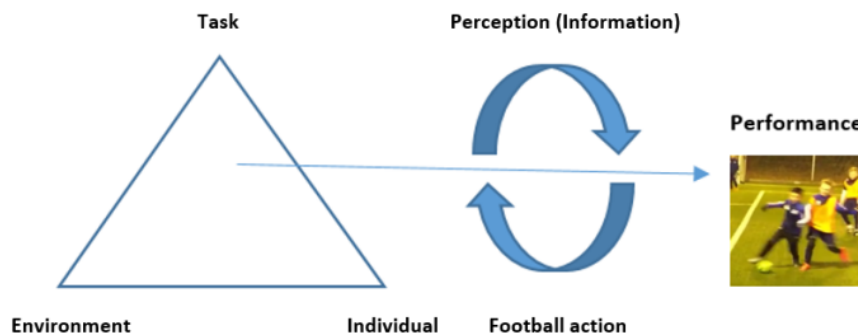
Applications for talent development

Design learning environments that push individual athletes to the edge of criticality can lead to the emergence of unique performance solutions:

- this process involves designing learning tasks with multiple performance solutions and performers are required to explore the practice environment to enhance their decision-making and action capabilities

Create learning scenarios where opportunities for action are rich and varied – these can enhance exploratory activities, and lead to the emergence of more adaptive behaviours and functional performance solutions for individuals and teams

- this approach leads to the creation of different ways to achieve the same outcome goals
- Deliberately create instability in practice environments leads to the development of performers with high levels of adaptability who can choose from a range of stable functional movement patterns



Talent development as a nonlinear process: an adaptive transitional development model

How to expose athletes to “higher grade opponents” (forced into discomfort into more demanding competitive environments)

- step-wise sequential model is the traditional approach to talent development and advancing players BUT creates several CHALLENGES:

Limitations of step-wise sequential model

Athlete selection (meeting a certain standard) often based on guesswork as assessment of performance potential (often based on the whim of coaches).

- Coach may rely on statistical data or 2nd hand evaluations (e.g. media) which may or may not be useful since it does not include psychological attributes.
- For example, a promoted athlete may face psychological barriers (e.g. momentarily overawed or intimidated by playing against more experienced performers, or experiencing low self-confidence and high levels of anxiety).
- Second lower initial performance levels might be reasonable to expect or predict as the new player takes time to adapt to the increase in skill demands (perceptually, technically, decision-making).
- Third selectors are more likely to make selection mistakes due to a lack of detailed knowledge about individual performers leading to a preference for players who do not have the requisite qualities to succeed.
- Fourth (finally) b/c of limited opportunity to compare players at different levels, players with potential to be successful at higher levels may have to play for a long time before they get their chance at the higher level – this effect may imply their performance might become too stable, reaching a plateau – subsequently when they do get their chance they might struggle to adapt to the new demands.

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Overuse Injuries in Young Athletes

In 2000, the Committee on Sports Medicine and Fitness from the American Academy of Pediatrics published a set of recommendations in a paper called “Intensive Training and Sports Specialization in Young Athletes”.

The abstract states: “Children involved in sports should be encouraged to participate in a variety of different activities and develop a wide range of skills. Young athletes who specialize in just one sport may be denied the benefits of varied activity while facing additional physical, physiologic, and psychologic demands from intense training and competition. This statement reviews the potential risks of high-intensity training and sports specialization in young athletes. Pediatricians who recognize these risks can have a key role in monitoring the health of these young athletes and helping reduce risks associated with high-level sports participation.”

This policy statement was recently reaffirmed (October 2014).

The type and rate of injury in developing athletes has increased dramatically in the last 10-15 years. “Overall estimates of overuse injuries versus acute injuries range from 45.9% to 54%. The prevalence of overuse injury varies by the specific sport, ranging from 37% (skiing and handball) to 68% (running).” In addition to physical injuries, there are psychological injuries of concern both of which are largely due to early single sport specialization and emphasis on competitive success. Risk factors for overuse injury are shown in the table below (DiFiori et al 2014).

TABLE 2. Categorization of Risk Factors for Overuse Injury

Intrinsic Risk Factors
Growth-Related Factors
Susceptibility of growth cartilage to repetitive stress
Adolescent growth spurt
Previous injury
Previous level of conditioning
Anatomic factors
Menstrual dysfunction
Psychological and developmental factors—athlete specific
Extrinsic Risk Factors
Training workload (rate, intensity, and progression)
Training and competition schedules
Equipment/footwear
Environment
Sport technique
Psychological factors—adult and peer influences

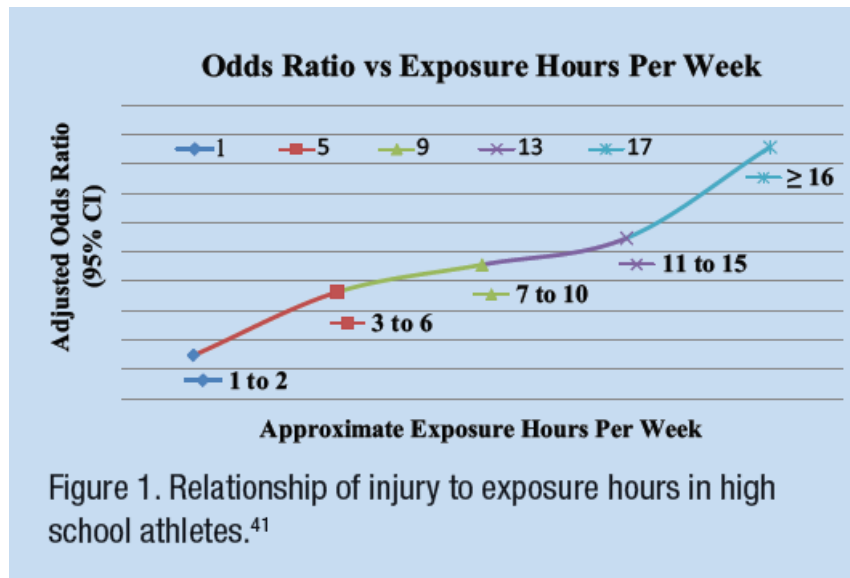
(Adapted from DiFiori JP. Evaluation of overuse injuries in children and adolescents. *Curr Sports Rep.* 2010;9:372–378.)

Burnout is of particular concern in the young athlete as it is linked with anxiety, depression, and a host of other conditions. The factors related to burnout in young athletes is shown in the table below (DiFiori et al 2014).

TABLE 5. Factors Related to Burnout in Young Athletes^{184,187,188}

Environmental Factors	
	Extremely high training volumes
	Extremely high time demands
	Demanding performance expectations (imposed by self or significant other)
	Frequent intense competition
	Inconsistent coaching practices
	Little personal control in sport decision making
	Negative performance evaluations (critical instead of supportive)
Personal Characteristics	
	Perfectionism
	Need to please others
	Nonassertiveness
	Unidimensional self-conceptualization (focusing only on one's athletic involvement)
	Low self-esteem
	High perception of stress (high anxiety)

Jayanthi et al (2013) illustrate a linear relationship between exposure and risk of injury (odds ratio, 8.28), showing significantly elevated risk once training volume exceeded 16 hours per week (see figure below).



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Parents

Camilla Knight and her colleagues (2014, 2015) have made valuable contributions to understanding the role of parents in providing a quality environment to shape the child-athlete through appropriate adult role models and supportive relationships. This relationship is perceived as vital to the growth of psychosocial attributes relevant to positive youth development and athletic excellence.

“Expertise in sport parenting requires parents to develop knowledge and utilize a range of intrapersonal, interpersonal, and organizational skills in order to support their child, manage themselves, and operate effectively in the wider youth sport environment.”

“We propose that sport parenting expertise is dependent on the degree to which parents demonstrate a range of competencies; namely that parents, (a) select appropriate sporting opportunities and provide necessary types of support, (b) understand and apply appropriate parenting styles, (c) manage the emotional demands of competitions, (d) foster healthy relationships with significant others, (e) manage organizational and developmental demands associated with sport participation, and, (f) adapt their involvement to different stages of their child’s athletic career.”

Table 2
Roles of parents in sport.

Role	Examples of role fulfillment ^a	
Providers	Providing tangible support	Signing children up for training Transporting children to competitions Paying for coaching and equipment
	Providing informational Support	Talking to children about training and competitions Providing information regarding nutrition Seeking information regarding competition preparation
	Providing emotional Support	Helping children after losses and during slumps Comforting children after disappointing or negative sporting experiences (e.g., opponents cheating) Supporting children while they are injured
Interpreters	Effort is more important than outcome	Positively reacting to wins and losses contingent on effort Providing feedback on child's performance Maintaining positive feedback throughout competitions Highlighting the importance of attitude and effort
	Valuing the range of benefits associated with sport	Discussing different outcomes associated with sport participation (e.g., improvement; fitness; friendships) Providing opportunities for social interactions Reinforcing life skills developed in sport
	Encouraging sportspersonship	Providing positive feedback for a good attitude Celebrating sporting behaviors Discussing the importance of sporting behaviors
Role Models	Encouraging sport participation	Engaging in sport themselves Watching and reading about sport Having an active life style
	Sporting behaviors	Maintaining composure at competitions Congratulating opponents for their performances
	Valuing effort over outcomes	Putting 100% effort into own sporting endeavors Reacting positively to their own losses

^a Examples are based on Fredricks and Eccles (2004), Gould et al. (2006, 2008), Knight and Holt (2014), Knight et al. (2010), 2011, Lauer et al. (2010a, 2010b), Omli and Wiese-Bjornstal (2011), and Wolfenden and Holt (2005).

Harwood and Knight (2015)

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Physical Literacy

- Physical literacy is MORE THAN fundamental movement skills
- Physical literacy is the inseparable interaction between human movement, cognitive and social-emotional aspects

The International Physical Literacy Association defines physical literacy as:

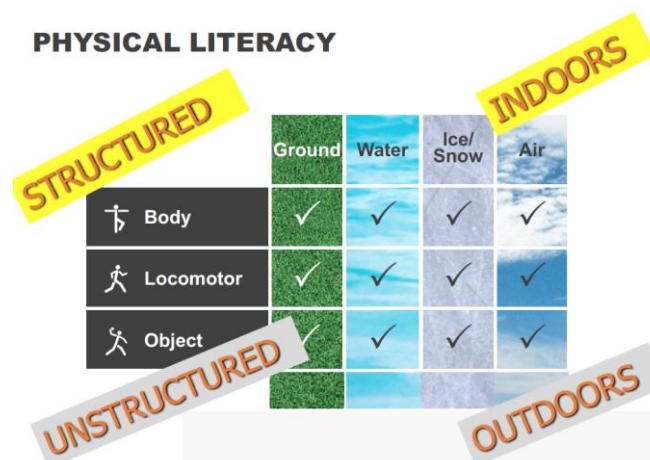
Definition of Physical Literacy

Physical literacy is the motivation, confidence, physical competence, knowledge and understanding to value and take responsibility for engagement in physical activities for life.

International Physical Literacy Association, May, 2014

While other definitions exist, “common to all definitions is the core understanding that physical literacy is about having the requisite motor skills required to successfully accomplish a range of everyday occupational and recreation activities from household chores to participation in sport. Each definition also acknowledges that motor skill, though, is not enough; a physically literate person also has the competence and confidence to engage in wide array of activities, in different environments (snow, ice, water, air) and derives both pleasure and an enhanced sense of self through their movement experiences.” (Cairney et al 2016)

“While physical activity and exercise have been shown to be positively linked to cognitive development, selecting the right kinds of activities for children, particularly in the first six years of life, is critical to ensuring children stay engaged and benefit from participation. The concept of “thinking movement” has been described before, where emphasis is placed not only on the importance of physical activity, but the combination of cognitive (e.g., problem solving) and movement based skills together as necessary for stimulating positive change in cognitive ability.”



Key components of a quality physical literacy experience

PL environments

- Ground
- Water
- Ice/snow
- Air
- Outdoors

Risk play behaviours

- Great heights
- High speed
- Dangerous tools
- Dangerous elements
- Rough and tumble play
- Disappear/get lost

Basic motor movements

- Locomotor
- Non-locomotor
- Object manipulation

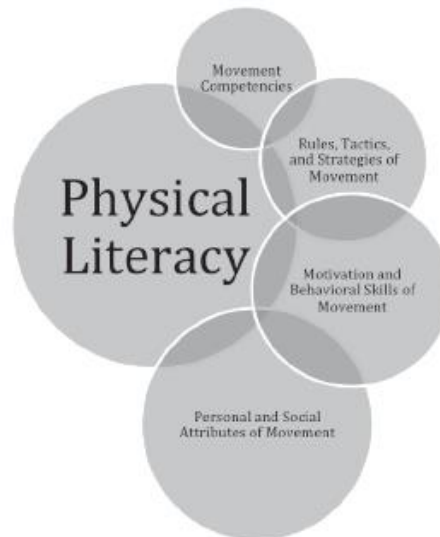
Learning formats

- Individual
- Cooperative
- Competitive

TGFU categories

- Net/wall
- Striking/fielding
- Target
- Invasion
- Individual pursuits (combative/acrobatic)

Core components of physical literacy (Dudley 2015)



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APPROACHES TO MANAGING RISK

Tom Mullarkey, chief executive of the UK's Royal Society for the Prevention of Accidents (in Guldberg, 2007) very simply summed up the balancing of risk, challenge and safety, by stating that things should be 'as safe as necessary, not as safe as possible'.

Risky play...is an important kind of play where children acquire better motor control and learn what is dangerous and what isn't.

...being able to make mistakes at a young age is vitally important in terms of learning and development.

WHY IS THIS LEARNING SO IMPORTANT?

Tim Gill (2007: 15) identifies four arguments in support of risk in childhood:

- 1** Helping children to learn how to manage risk (understanding safety)
- 2** Feeding children's innate need for risk with reasonable risks in order to prevent them finding greater unmanaged risks for themselves
- 3** Health and developmental benefits
- 4** The building of character and personality traits such as resilience and self-reliance

WHAT DO WE MEAN BY RISK?

It is important to distinguish between a 'risk' and a 'hazard':

The easiest way to think of it is that a risk is something you can judge, how high can you go and still safely jump off the swing and fly through the air. This is good. Children learn 'physical literacy' this way by starting small and then becoming more adventurous.

A hazard is something you cannot judge, is the swing pivot almost worn right through and about to give way unexpectedly? This cannot be judged by a child, so this is bad and must be avoided by good management practices.

London Play Briefing, November 2007
(updated October 2010) Risk in Play

'Early experiences determine whether a child's developing brain architecture provides a strong or weak foundation for all future learning, behavior and (both physical and mental) health.'

Center on the Developing Child, Harvard University

'When they have the opportunities to explore, risk, and try and try again in an environment that is both safe and challenging, babies can engage in motor practice play that leads to advanced physical abilities, mobility, agility, dexterity, and as a result, confidence, independence and learning.' Kernan, 2007

With quality planning and appropriate delivery of risky experiences, attributes of athlete development can be obtained – the categories of risk include (Sandseter 2007):

- Great heights
- High speed
- Dangerous tools
- Dangerous elements
- Rough and tumble
- Disappear and get lost

When planning play opportunities we need to consider what it is that we want individual children to gain from the experience? We know from the research that early childhood is an important time for developing children's ability to:

- Persevere
- Take risks
- Solve problems
- Develop confidence and independence
- Nurture their curiosity
- Develop an identity as a learner

Aistear: Key Messages from the Research Papers

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Positive Youth Development

“Positive Youth Development (PYD) is a strength-based approach to child and adolescent development based on the assumption that all youth have the potential for positive developmental change. Hence, PYD is way to view development rather than a specific construct, and it is used as an ‘umbrella term’ referring to ways in which children and adolescents may accrue optimal developmental experiences through their involvement in organized activities. Optimal development can be defined as ways of “enabling individuals to lead a healthy, satisfying, and productive life, as youth and later as adults, because they gain the competence to earn a living, to engage in civic activities, to nurture others and to participate in social relations and cultural activities.” (Holt & Neely 2011)

The literature shows that sport can lead to both positive and negative outcomes.

As Coakley (2011) argued, “By itself, the act of sport participation among young people leads to no regularly identifiable development outcomes. The point is that merely participating in sport does not necessarily produce positive outcomes; rather, the developmental benefits of sport participation are contingent on social contextual factors. These contingent social contextual factors are largely based on how coaches, parents, and peers contribute to the ways in which youth sport is delivered and experienced.” (Holt & Neely 2011)

The 5Cs of PYD was introduced by developmental psychologist Richard Lerner (e.g., Lerner et al., 2005). The 5Cs are competence, confidence, character, caring/compassion, and connection. Competence represents a positive view of one’s actions in domain specific areas. Confidence reflects an internal sense of overall positive self-worth and self-efficacy, and one’s global self-regard. Character refers to an individual’s respect for societal and cultural rules. Caring/compassion is a person’s sense of sympathy and empathy for others. The last C is connection and describes positive bonds with people and institutions. The 5Cs are therefore essentially measurable constructs that represent the desired outcomes of youth development. When all five Cs are present, a sixth C (contribution) may occur, which enables youth to give back to their community and society.” (Holt & Neely 2011)

PYD can be promoted through quality sport experiences and “is contingent upon the way sport is delivered and experienced through participants’ interactions with coaches, parents, and peers.” (Holt & Neely 2011)



Positive youth development (PYD)

is an approach to working with and researching youth. Instead of focusing on solving problems, PYD seek to build strengths in four broad areas:



Competence

Youth should be learning and improving skills including sport specific skills (e.g., batting), general movement skills (e.g., jumping), and life skills (e.g., goal setting).

Confidence

Youth should experience sport in a way which helps them build their self-esteem and their belief in their ability to be successful



Connections

Youth form important supportive relationships with coaches and other adults in sport and valuable friendships with teammates.

Character

Youth should learn values such as respect, sportpersonship, and helping others through appropriate sport environments.



Côté et al., 2010; Vierimaa et al., 2012

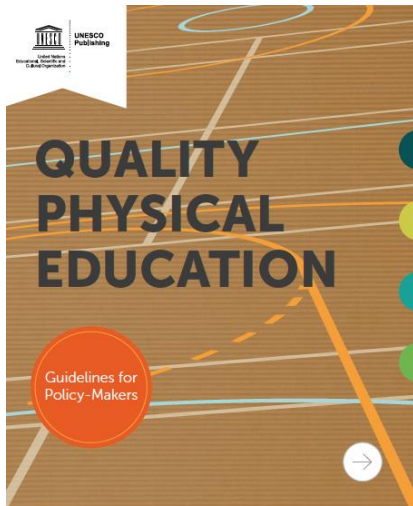


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Quality Physical Education



In 2015, UNESCO published a set of guidelines for policy-makers regarding the urgent need for quality physical education. A Call to Action was released:

“The provision of physical education is in decline across all world regions. Rising levels of physical inactivity, along with the substantial associated disease risk, have been described as a pandemic by WHO. Cut-backs in physical education provision will only increase these concerns exponentially. Besides the health concerns, it is essential that governments take policy action to ensure the subject secures its rightful place in school curricula and that, consequently, students benefit from exposure to alternative learning domains.”

The Declaration of Berlin 2013 – UNESCO’s World Sports Ministers Conference (MINEPS V)

“Physical education is the most effective means of providing all children and youth with the skills, attitudes, values, knowledge and understanding for lifelong participation in society.”

The UNESCO Charter of Physical Education and Sport (1978)

“Every human being has a fundamental right of access to physical education and sport, which are essential for the full development of his personality. The freedom to develop physical, intellectual and moral powers through physical education and sport must be guaranteed both within the educational system and in other aspects of social life.”

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Relative Age Effect

“Annual age-grouping is a common organizational strategy in sport. However, such a strategy appears to promote relative age effects (RAEs). RAEs refer both to the immediate participation and long-term attainment constraints in sport, occurring as a result of chronological age and associated physical (e.g. height) differences as well as selection practices in annual age-grouped cohorts.” (Cobley et al 2009)

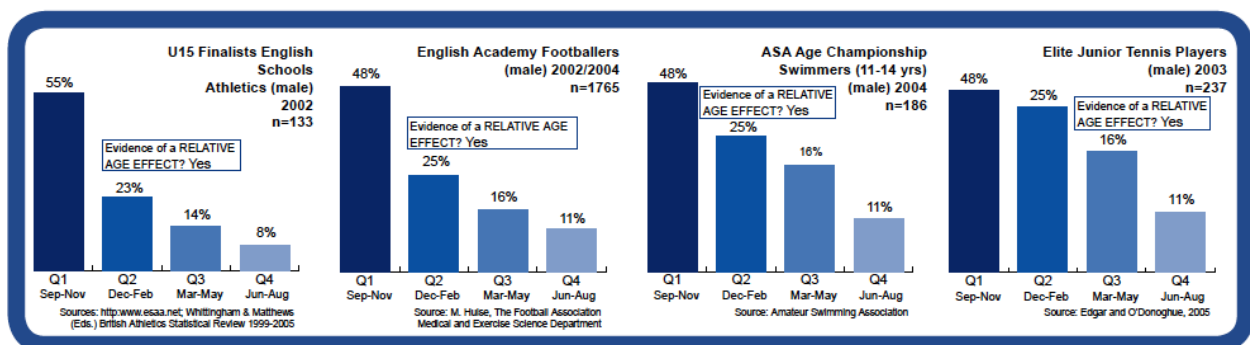
“Sports context involving adolescent (aged 15–18 years) males, at the representative (i.e. regional and national) level in highly popular sports appear most at risk to RAE inequalities.” (Cobley et al 2009)

The Relative Age Effect: Closing the door on younger talent

“The relative age effect describes how people born later in the selection year, the youngest children in their class or peer group, are much less likely to go on to achieve high-level sporting performance.” (SportNation 2006)

“There can be almost 12 months’ difference between the youngest and oldest children in the school year. Put very simply, teachers and coaches are favouring the oldest children and ignoring the youngest. The evidence is overwhelming.” (SportNation 2006)

“In many different sports the relative age effect is clear to see. The tables below show birth dates in male squads for athletics, football, swimming and tennis. The bias towards autumn birthdays is remarkable.” (SportNation 2006)



“To reduce and eliminate this social inequality from influencing athletes’ experiences, especially within developmental periods, direct policy, organizational and practitioner intervention is required.” (Cobley et al 2009)

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Sector and System Alignment

Managing Elite Sport Systems: Research and Practice (2015) (see Chapter 1) is a recently published book that discusses the need to learn from and work with ALL sport system contributors and stakeholders (e.g. autonomous regional and local public and private organizations, educational institutions, sport academies and institutes) to build a robust and responsive sport system. To date, we see tremendous investment targeting “talent” (identification, detection, development, etc) with a minimum of investment being done on the ‘system’ and how the elements of the system interface with the athlete.

De Bosscher et al (Chapter 9 Systems and Athletes) describes that “athletes’ successes are not possible without: the network of sports clubs where they develop as athletes; the training and competition opportunities they are offered; the guidance from coaches, physiotherapists, doctors, dieticians and sports scientists they frequently require; and the support services they receive from national governing bodies, governments, Olympic Committees and/or private partners that make a sporting career an attainable option for athletes. Talent, whether it is in sport, arts, economy or science, is an individual quality that can be fully expressed only in a specific social environment and with the support of others.”

Pankhurst et al (2013) state “the purpose of talent identification and development (TID) is to develop successful adult athletes. It is the antithesis of waiting for talent to ‘arrive’ by random chance! Whether one is more effective than the other awaits explicit examination. However, as research indicates, high success rates with junior athletes often correspond with low success rates when these same athletes become adults, as indicated by the junior and adult ranking lists in many sports. On this simple outcome basis at least, the evidence is that current methods of TI and TD do not develop world class performers. In apparent contrast, the key constructs referred to in this paper point first to an extensive, developing and wide ranging research base in TID.”

Pankhurst et al (2013) have identified five key constructs that underpin TID:

- i. sport specialization and selection
- ii. practice
- iii. athlete development
- iv. junior and adult success
- v. the role of stakeholders in the sport system

For the latter construct, all stakeholders involved with TID (athletes, parents, coaches, administrators, sport organizations and others) across all levels of governance need to build a collaborative and coherent system. TID is a biopsychosocial construct that requires relationships or partnerships grounded in trust and expertise.

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Skill Acquisition

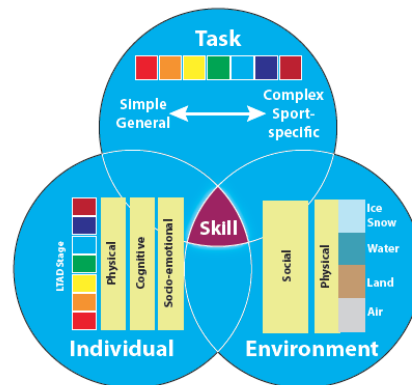
Skill acquisition is a critical discussion for grounding our understanding in the following areas:

- Teaching the right skills at the right time
- Providing the best possible progressions for learning
- Planning and delivery of purposeful instruction or learning opportunities in all areas of athlete development
- Balancing deliberate practice with deliberate play
- How specific is learning and are the skills transferable to another sport or domain?
- Are there sensitive periods for motor skill learning and sport skills?

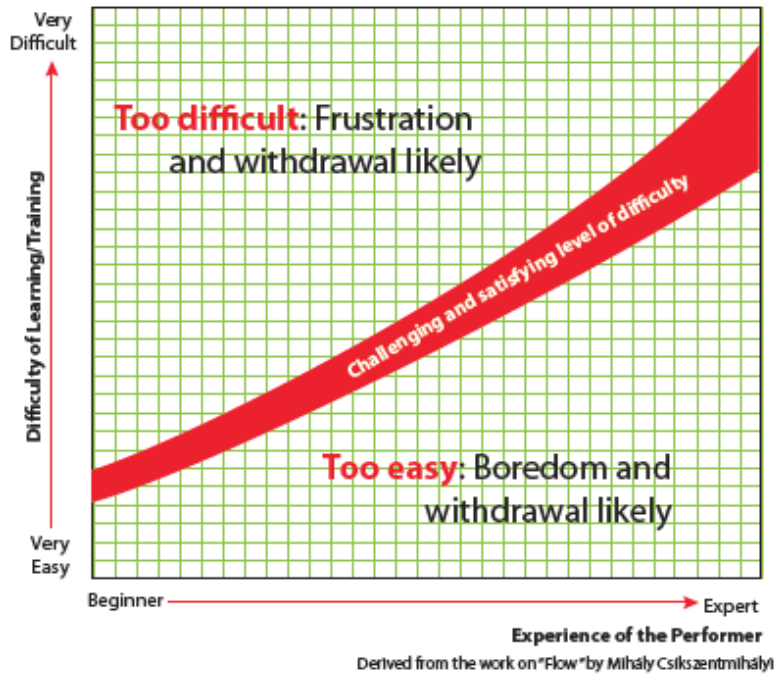
While the literature is helping us to answer some of these questions, there remains much to learn.

“Children (and adults) learn skills best when the skills they are trying to learn are a challenge – but not too difficult a challenge. If the challenge is too easy, boredom becomes a problem; or if it is too difficult, frustration sets in quickly. As they succeed (and occasionally fail) they build their confidence thus ideally become more motivated to take on progressively more difficult challenges thus developing their ability and overall physical literacy. The level of challenge faced by a learner depends on three major factors: *Individual, Environment, and Task.*” (Higgs et al 2016 Sport for Life: Athlete Development Matrix Version 1.1)

“The figure below shows the broad relationship between the three factors (Task, Individual, Environment) and their most important components. The skill an individual is able to learn is dependent on the individual’s stage of development (physically, mentally and emotionally), on the physical and social environment in which they practice, and the task they are trying to achieve.” (Higgs et al 2016 Sport for Life: Athlete Development Matrix Version 1.1)



“Because it is important to consistently challenge learners, parents and coaches should strive to systematically modify both the task and the environment in which the task is performed, based on the changing capacity of the individual. For each individual, at each stage of development, the task difficulty needs to be continually adjusted to ensure the challenge remains stimulating – rather than boring or frustrating (see figure below).”



(Higgs et al 2016 Sport for Life: Athlete Development Matrix Version 1.1)

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Talent Identification and Development

Talent can be defined as:

- a special natural (innate) ability or aptitude
- a capacity for achievement or success

Other synonyms include:

Gift – Aptitude – Ability – Faculty – Genius – Capability

Talent has numerous applications:

Identification

- the search for promising performers already in a given sport

Development

- advancing and improving the performance of an athlete in a given sport

Detection

- the discovery of potential performers not currently in the sport of interest

Retention

- maintaining contribution to high performance in a given sport

Transfer

- later introduction of proven performers from other sports into a new sport

De Bosscher et al (2006) describes 9 pillars of sports policy factors influencing international success. Note that “talent identification and development system” is Pillar 4.

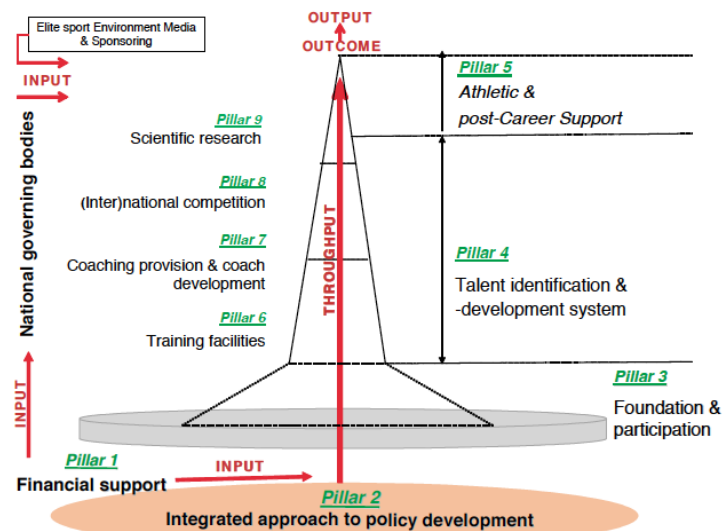
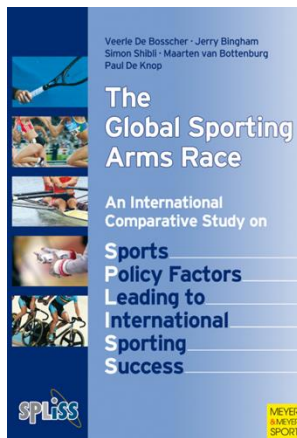


Figure 2. The nine pillars of sports policy factors influencing international success

Factors determining the development of expertise (in addition to deliberate practice):

Genetics (eg. oxygen consumption, skeletal muscle hypertrophy and morphology, white matter integrity and gray matter density of cerebellar and cortical regions involved in motor control)

Other activities (eg. play, unstructured training, competition structure/format, movement/sport diversity)

Psychological traits (eg. confidence, propensity to experience performance anxiety, aversion to negative outcomes, sensitivity to reward, and cognitive ability factors such as general intelligence, working memory capacity, ability to control attention, perceptual speed, psychomotor speed)

Collins et al (2016b)

Discriminating factors:

- ✓ Commitment
- ✓ Reaction to challenge
- ✓ Reflection and reward
- ✓ Role of coaches and significant others

Non-discriminating factors:

- ✓ Incidence and type of trauma

“There seems to be general agreement on the importance of challenge for effective development on the athlete pathway. What seems less coherent, however, are ideas on how much, when and how this challenge should be used.”

“The literature suggests that differences between levels of adult achievement relate more to what performers bring to the challenges than what they experience. Therefore, it is essential that young athletes have the opportunity to develop psycho-behavioral and coping skills, and have adequate social support, to ensure that adversity is interpreted as a positive growth experience. A periodized and progressive set of challenges, preceded with specific skill development, would seem to offer the best pathway to success. The importance of preparing athletes for challenges, supporting them through the experience, and then encouraging positive evaluation and reflection is key to successful outcome.”

“Building and Deploying the Speed-Bumps: How the Impact of Challenge Can Be Optimized” (Collins et al 2016a)

- Encouraging/holding back athletes to compete at levels above or below their current age grading, either through training or exposure in competitions (“drip-feeding”)
- Juniors warming up at major senior events
- Alter space/time/skill constraints for athletes within practice and competition settings
- MANY OTHER OPTIONS!

“When designing challenging periods, examples can be as simple as encouraging/holding back athletes to compete at levels above or below their current age grading, either through training or exposure in competitions. This can be achieved by drip feeding players into senior level competitions or training for short periods of time and/or with specific targets set. Even simply warming up at major senior events with senior athletes or participating in an element of their technical skillset at intervals independent of the competition event itself (penalty kicking at half time for example) can have a significant impact. It is also important to periodically test for progress by placing athletes in surroundings familiar to them (back into their own age grading, for example), having spent periods of time away under increased ‘challenge.’

This return can provide competition or training opportunities at a level whereby an athlete is freely able to express newfound experiences and confidence, whilst allowing a period of adaptation is essential to maximize opportunity for growth. Periodizing challenge in this manner can be positive both for the individual and the other squad members, potentially accelerating development. A well- structured plan can apply any number of periodized blocks throughout an athlete’s development journey.”

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Additional references from leading researchers

The final section of this handbook contains additional references from several leading researchers around the world who have made substantial contributions to the understanding of athlete development, talent identification, sport-specific and system factors underlying high performance sport. These are a selection of references from each author and are not a complete listing of their work.

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Supporting Material

This supporting material includes government and organizational reports, website resources, and policy documents. They provide background about the sport and physical activity ecosystem in Canada, while offering context for some of the philosophy that's woven throughout this resource.

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