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Chapter 3

The talent development process as enhancing athlete functionality: Creating forms of life in an ecological niche

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Abstract

The theory of Ecological Dynamics proposes that talented performance in sport emerges when an individual continuously adapts to surrounding constraints to develop an increasingly functional relationship with a specific performance environment. Crucial to this relationship is the way in which a talent development environment (conceptualized as an ecological niche) impacts upon athlete development practices. The daily, weekly, and monthly development tasks athletes engage in must support a deeply intertwined relationship between values (affordances) and meaning (information), which can lead to performance excellence during competition. This perspective of talent development may be challenged by the associated values, beliefs, traditions, customs, behaviors, and attitudes that are embedded within the ecological niche. To protect development practices against social, cultural and historical norms, it is suggested that performance managers and coaches should design collaborative and integrated practice programs, based on a coherent theoretical framework of learners and the learning process, to enhance athlete functionality.

It has been argued that talent is not an entity possessed by an individual, but rather emerges as an increasingly functional relationship developed over time by an athlete with a specific performance environment (Araújo & Davids, 2011; Davids et al., 2013). From this perspective, 'talented' performance in sport, (i.e., enhanced athlete functionality) emerges when an individual continuously adapts to surrounding constraints, which change over micro- and macro-timescales (Button, Seifert, Chow, Araújo & Davids, 2020). These interacting constraints are specifically related to the individual (e.g., genetic composition and quality of learning experiences), task (e.g., relationship between key rule changes, equipment (re)design and performance demands) and the environment (e.g., social, cultural, economic, historical and political) during competitive performance and in practice. This perspective of expert performance is exemplified in Araújo and Davids' (2018) analysis of Bob Beamon's 1968 world-record long jump, illustrating how Beamon interacted with the task at hand, a distinctive set of physical environmental factors such as wind speed and air density, and unique personal circumstances (cognitions and emotions) leading to the exquisite self-regulation of performance during the Olympic final.

In this chapter we elaborate on the idea of talent as athlete functionality and discuss how it can be continuously enhanced in development programs by attention to the socio-cultural-historical constraints of a supportive form of life (Wittgenstein, 1953) in high performance sports organizations. Environmental constraints on the design of skill acquisition and talent development programs have received detailed attention recently, with the form of life concept describing how talent development programs in sport have been shaped in different societies (Rothwell, Davids & Stone, 2018; see also Uehara, Button, Falcous & Davids, in press). A form of life describes the everyday practices of specific groups or organizations and captures how

wider social, cultural, and historical constraints shape the expression of inherent values, beliefs, traditions, customs, behaviors, and attitudes. There have been many examples proposed of forms of life in high performance sport, such as Jamaican sprinting (Moore, 2015), East African distance running (Ankersen, 2012), Brazilian soccer (Uehara et al., 2018), Australian Rules Football (Browne, Robertson, Sweeting & Davids, 2019; Woods, McKeown, Shuttleworth, Davids, & Robertson, 2019) as well as Finnish winter sports (Forsman et al., 2016).

The complex and interactive nature of constraints on a form of life in performance sport is particularly compelling in the pathway to the New Zealand All Blacks' rugby union team. The form of life in New Zealand elite rugby union is predicated on self-regulation (players adapting and organising without external input) as a philosophy of a contemporary All Black being a "faster learner than someone else", with the ability to "adapt and adjust in the moment and then afterwards reflect and learn" (Hansen, 2018, p. 3). Interestingly, Coach Steve Hansen traced the All Blacks' philosophy of self-regulation back to the country's heritage, where, due to its geographical isolation, New Zealanders had to be "innovative, good decision-makers and do things for themselves" (Hansen, 2018, p. 5). His perspective provided rich insights on how these historically relevant cultural values and attitudes in an everyday form of life in a fledgling society proliferated into New Zealand sport and rugby union.

However, not all forms of life in different communities may have positive effects on developing talented individuals (Ross, Gupta & Sanders, 2018). For example, traditional approaches to talent development in sports organizations may promote a form of life where the early recruitment of potentially high-performing athletes is based on the assumption that 'talented' individuals already

possess the potential for a set of pre-required social, mental, and physical attributes and skills relevant for a particular sport (Araújo & Davids, 2011). This form of life in talent development programs is allied to systems and processes targeting early identification and specialization in very young athletes (Baker, Cobley, Schorer, & Wattie, 2017). This systemic approach putatively requires extended periods of time for engagement in deliberate practice (Ericsson, Krampe, & Tesch-Romer, 1993), favoring skill reproduction and copious repetitions and rehearsals in expertise acquisition.

Traditional talent development models, typically, adopt deterministic methods predicated on an organismic asymmetry (Davids & Araújo, 2010). In these models, an overemphasis is placed on early identification and selection of a ‘talented’ child (i.e., displaying physical prowess and technical competencies that resemble those of an adult athlete). This highly selective process inducts children as young as 5 years of age into a ‘hothouse’ training environment (e.g., academies for early specialisation and intense practice) in the quest to provide purposeful and dedicated training and preparation for competitive performance in one sport (Baker, Cobley, & Fraser-Thomas, 2009). From an ecological dynamics perspective, and due to the inherent nonlinearity of human development, these models may be limited in their capacity to identify and develop athlete functionality (Phillips, Davids, Renshaw & Portus, 2010; Araújo, Fonseca, Davids & Garganta et al., 2010; Davids, et al., 2013). An established consequence of the prevalent form of life in talent development programs is the tendency for poor transition rates into elite levels of sport, such as in association football (Calvin, 2017). Other related issues that need to be examined, **to address challenges with supporting talented adolescents to fulfill their potential**, include: (i) system effects on an athlete’s mental health and wellbeing, (ii) an

individual's capacity for self-regulation, and (iii) his/her openness to the rich range of information available in the competitive performance environment.

Enhancing athlete functionality

The field of ecological dynamics suggests that high levels of athlete functionality emerge when an individual becomes skilled in interacting with multiple relevant affordances simultaneously, during practice or in competition (e.g., Araújo, Dicks, & Davids, 2019). Gibson (1979) defined affordances as *possibilities for action* that an environment offers to an animal. During sport performance, affordances as possibilities for action in a particular setting are what teammates, opposition players, equipment, surfaces, markings, and conditions offer to an athlete to realise specific actions. In practice, the actions of learners are solicited by opportunities for athletes to continually explore, directly perceive, and to select information to regulate behaviors immediately and prospectively (Fajen, Riley, & Turvey, 2009).

Insert Figure 1 about here

For example, research in basketball by Esteves, de Oliveira, and Araújo (2011) demonstrated how posture and foot position of defenders during one-on-one sub phases of play guided the decision-making behaviors that emerged from attackers with the ball. Their data showed that the defender's most advanced foot, at small distances between attackers and defenders, *afforded* attackers opportunities to drive past markers. Their results exemplified how the continuous coupling of perception and action in athletes located in a performance environment is at the heart of an ecological conceptualization of skilled performance behaviors in sport, suggesting how affordances could be designed into practice landscapes.

More recently, Withagen, Araújo and de Poel (2017) proposed that the theory of affordances is more complex than simply being defined as possibilities for action provided by the environment, suggesting that affordances can also invite or repel behaviors. Therefore, the environment should not be viewed as a "collection of causes, but as a manifold of action possibilities" that makes behavior possible (Withagen, de Poel, Araújo, & Pepping, 2012, p. 251). Within competitive performance environments, for example, an athlete is constantly presented with multiple affordances that present opportunities for action. The constant flow of specifying information sustains behavior in dynamic situations where highly skilled individuals are able to experience and discriminate between relevant affordances to deal with the demands of the current situation (Dreyfus, 2014). A challenge for coaches and high performance managers is to provide a range of high quality athletic experiences (during performance and learning) to support athletes to become selectively open to the perception and attunement of relevant affordances within specific sport settings (Fajen, et al., 2009). When athletes are consistently exposed to high quality athletic experiences, they are likely to develop the effectivities (skills, knowledge and capacities) to search an affordance landscape that confronts performers in sport. An athlete's skilled behavior and the functionality of their relationship with a performance environment, therefore, are emergent, based on the richness of the environmental information that is made available in athlete development and preparation for performance practices.

Figure 1 illustrates that, crucial to enhancing athlete functionality, is the careful design of the micro-structure of practice to present athletes with a rich *landscape of affordances* (i.e., practice environment rich in information), that represents the opportunities for perceiving and acting on information, and the cognitions of competition (Renshaw, Davids, Newcombe, & Roberts, 2019).

In this way athletes can learn to navigate the interrelated nature of available opportunities for action, which are not isolated, uniform possibilities for action, but rather a rich and varied "nested structure of interrelated affordances" (Bruineberg & Rietveld, 2014, p. 3) to regulate performance behaviors. The value of athletes experiencing a rich landscape of affordances is exemplified by observations of Rothwell, Stone, Davids and Wright (2017) in a comparison of elite (international players) and sub-elite (domestic players) British rugby league players and their practice experiences. A key difference observed was the international players' reported experiences of scenario-based practice tasks (i.e., 13 v 13 full game situations). This type of learning design presented athletes with a micro-structure of practice tasks that invited the exploration of different coordination tendencies and the effective engagement with a performance environment through exposure to specific and relevant information to couple perception and action (Araújo & Davids, 2011). Practice experiences that aim to sample the ecological constraints of the performance environment, and related affordances, can lead to greater skill transfer in sports which are dynamic, unpredictable and fast paced, but also in more stable practice environments which still vary (albeit to a lesser extent) (Seifert et al., 2019). This idea demonstrates the importance of the performer-environment relationship in supporting athletes to utilise affordances to regulate behaviour. However, it is important to note the significance of specific design elements by coaches and practitioners, since the "environment is not a neutral manifold of action possibilities the agent simply chooses from; rather, the environment can invite a certain action or even urge a person to do something" (Withagen, de Poel, Araújo, & Pepping, 2012, p. 253).

Withagen, Araújo and de Poel (2017) have suggested it is important to draw on phenomenology to understand the mutuality of the environment-individual perspective on affordances as invitations for behaviors, and the role that athlete agency plays in modulating the coupling strength with affordances during learning. Bruineberg and Rietveld (2014) have characterised the phenomenology of being invited by affordances as a tendency towards an *optimal grip*, indicating the behavior that an individual displays to improve their grip on a performance context or situation. In ecological dynamics an optimal grip on the relations with a performance environment is predicated on self-regulation tendencies and the functionality of human behavior. As skill level increases, an individual becomes increasingly open to a field of affordances that is, the affordances that solicit and stand out as relevant in a specific performance context because of an individual's intentions and concerns at that time (Kiverstein & Rietveld, 2015). This mutualist perspective is exemplified by observations of Rodney Mullen (2015, 8.36) the 'God Father' of modern street skating, when describing bank tricks. He elaborates:

"you see this wall, it's fairly mellow and it's beckoning to do bank tricks.....and you hit this wall, and the first thing you do is fall forward, as you adjust you punch it up and then when I would do that it would throw your shoulder this way (left rotation) and that's begging for a 360 foot because that's how you load up for a 360 foot."

The emergence of Mullen's behaviors is the result of the interaction between a wall's many solicitations and his capacity to modulate the coupling with them. Clearly, solicitations are not only dependent on the current intentions and concerns of the individual, but also depend on the individual's action capabilities, which affordances are more important than others at a specific point in time, personal history, and the socio-cultural-historical factors that harness a form of life (see Withagen, de Poel, Araújo, & Pepping, 2012).

A Form of Life

To fully appreciate the complexity of a form of life it is useful to draw on Bronfenbrenner's bio-ecological model of human development to enrich our understanding (Bronfenbrenner, 2005). A form of life is embedded in a complex dynamical system that is multi-layered (Figure 2), consisting of the microsystem (e.g., practice settings and contexts), mesosystem (e.g., significant others who influence practice settings such as parents and caregivers), exosystem (e.g., organisational influences), and macrosystem (e.g., socio-cultural-historical influences) (Bronfenbrenner, 1979).

Insert Figure 2

Crucially these sub-systems have a reciprocal and bidirectional nature in regards to their influence on human development through the proximal processes of regular complex interactions between people, processes, context and time (Bronfenbrenner, 2005). Under these complex interactions, attractors (stable states of system organization) emerge and exert their attraction on the gatekeepers of performance programmes and teams, and on the developing individual. These ideas were exemplified in Rothwell, Stone, and Davids' (2019) exploration of a form of life in British Rugby League football player development contexts, where results revealed the overpowering influence of hyper-masculinity and technique replication as the dominant social, cultural, and historical constraints on athlete learning in player development systems. To understand why these dominant constraints are embedded in the sport, it is important to consider that Rugby League football's roots are firmly grounded in the working class industrial north of England. Industrialization in the north of England during the 1800s was successful in part due to Fredrick Winslow Taylor's 'task system of management', that aimed to increase manufacturing

productivity by preventing the workforce from using their initiative and encouraging management to embed a *body as machine* philosophy across the workforce. This mantra was clearly evident during a 1907 lecture Taylor (2008, p. 216) made about his task system of management, in reference to the labour force he commented;

“We do not want your help, we do not want your initiative. All we ask you is to do what you are told to do and do it quick, and we will see you do it quick, because you cannot stay with us unless you do.”

Under these conditions, masculine attitudes and compliance in following orders and instructions without question were common behaviors deemed to satisfy the constraints of hierarchal control systems to increase manufacturing productivity. There was a clear threat of impending dismissal hanging over workers who could or would not comply with system instructions. Indeed, these prevalent organisational characteristics are likely to have influenced the values of surrounding rugby league clubs, with sport historian Tony Collins (2006, p. 149) suggesting that “the attitudes of rugby league players were, therefore, shaped and defined by the world of industrial labour, which was intensely physical, often aggressively oppositional to management and, above all, almost absolutely masculine”. That these attitudes and behaviors are synonymous with traditional coaching practices, which are still evident today in many sports domains, illustrates the deeply-ingrained socio-cultural legacy of a historically-dominant form of life for over 120 years. In this way, analysing and understanding a form of life offers nuanced and complex insights into, and understanding of, a sport culture, which should not be viewed as the behaviors, or practices that occur in the immediacy of the microstructure of the daily practices of a sports team or organisation. Rather, these ideas suggest how a sports culture may be shaped by the

influences and complexity of the multi-layered, macro-scale system categorised as the form of life. This point has enormous relevance for the development of human potential in a variety of performance contexts, and should be at the forefront of system design and analysis of performance managers, sport scientists and practitioners, and coaches when addressing the challenge of enhancing athlete functionality.

Talent development environments as an ecological niche

Viewing expert performance as enhanced athlete functionality is at odds with the traditional perspective of talent development practices. To support athlete functionality an ecological dynamics rationale suggests sport practitioners, coaches and talent development managers should focus on developing an environment that supports a deeply intertwined relationship between values (affordances) and meaning (information), in creating high quality learning experiences. To adopt a position of value and meaning it is important to specify the term environment in regards to talent development. Lewontin (2001) describes the environment in ecological terms as:

"something that surrounds or encircles, but for there to be a surrounding there must be something at the center to be surrounded. The environment of an organism is the penumbra of external conditions that are relevant to it because it has effective interactions with those aspects of the outer world." (pp. 48–49)

An ecological account of sport performance requires an athlete to develop knowledge of an environment based upon the continuous perception of rich environmental information to support action opportunities (Gibson, 1979), aligned with Reed's (1996) argument that individuals do not

seek to construct internalised knowledge structures, but seek values and meanings in a performance environment. Value and meaning can be embedded through high quality athletic experiences which help athletes to learn how to self-regulate and develop their functionality. Next, to further conceptualize value and meaning in a talent development environment we draw parallels with an ecological niche and consider some refinements to a form of life in sports organizations.

Rietveld and Kiverstein (2014) have emphasized the concept of an ecological niche (such as a talent development environment) and the relationship with a form of life as the cornerstone of Gibson's theory of affordances. In other words, an athlete's ability to respond to relevant affordances within a talent development environment (conceptualized as an ecological niche) is directly related to the values, beliefs, traditions, customs, behaviors, and attitudes harnessed by the wider form of life. To exemplify, an ecological niche was suggested to refer to how a cohort of athletes, practitioners and sport scientists within a talent development program go about their daily activities in the microstructure of practice (Davids, Güllich, Shuttleworth, & Araújo, 2017), designed to support the self-regulation of an athlete. An ecological niche has an interactive evolutionary feature where the environment shapes individuals and individuals shape the environment through socio-cultural processes (Withagen & van Wermeskerken, 2010).

Affordances and abilities available to individuals are highly dependent on the skills and practices available within an ecological niche, which should be conceived of as a set of affordances with relational properties of a performer-environment system (Gibson, 1979). Performance managers and coaches who want to enhance athlete functionality should design the ecological niche as the

start point when tasked with harnessing specific athlete behaviors that may lead to performance excellence during competition. This type of rationale for a high performance sports organization is well exemplified by Great Britain Hockey's Talent Development Framework (2018). The GB Talent Development Framework (2018) aims to create an ecological niche to support players in developing "highly adaptable skills", "players who implicitly understand the principles of the game", and players who are "self-organizing" so that they can "adapt in order to perform". These aims are aligned with an ecological dynamics rationale of sport expertise, where athlete functionality is viewed as a high level of autonomous self-regulation to satisfy constraints (i.e., expressing highly adaptable skills), through continuous interactions with a performance environment (to explore the principles of the game), and responding to relevant affordances to effectively perform (Araújo et al., 2019). Although GB Hockey's (2018) aim for talent development is a welcoming one, the implementation of this strategy is at the mercy of the form of life and key agents who influence the environments that players inhabit on a regular basis.

Why opportunities for athlete self-regulation may be more extensive at the less structured end of the practice design continuum

Of course, athlete self-regulation (and an optimal grip on a performance environment) is likely to be inhibited if a coach continually insists on overseeing the design of task constraints which provide a narrow and uniform range of affordances in practice. A more functional level of athlete self-regulation is likely to emerge if a coach works closely with an athlete, team and a group of sport practitioners (in a Department of Methodology as we argue later) to *co-design* affordances for self-regulation in practice designs. Co-designed practice tasks are likely to invite individual learners to use actions, perception, cognitions, while engaging emotionally with a practice

environment. Moreover, the less structured practice environments at one end of the affordance landscape continuum (Figure 1) provide many opportunities for individuals to learn to self-regulate through exploratory practice away from the watchful eye of the instructor.

To clarify, more functional opportunities for athlete self-regulation are more likely to emerge from extended experiences at the less structured end of the practice design continuum outlined in Figure 1. At this end of the continuum, athletes can be encouraged to drive their learning processes and exploit self-regulation tendencies amongst a wider range of task constraints in the affordance landscape. Traditionally, self-regulation has been defined from a narrow cognitive orientation referring to all the ‘self-generated thoughts, feelings and actions that are planned and cyclically adapted to the attainment of personal goals’ (Zimmerman, 2000, p.14). The bias towards conceiving internalised regulation of behaviour through pre-planned goal achievement is apparent from the traditional perspective, which fits well with carefully choreographed practice designs for repetitive action reproduction and reactive behaviours. From an ecological dynamics rationale, self-regulation is rather conceptualized more broadly, emphasising co-designed practice tasks to support an individual’s emergent and extensive behavioural interactions with his/her performance environment, rather than referring to behaviours guided by internalised plans and goals. In ecological dynamics, individuals are fully engaged in learning to self-regulate by developing and exploiting a deeply intertwined relationship between their own actions, perceptions, thoughts and intentions and emotions, to continuously support these emergent interactions. By harnessing this functional relationship with a performance environment, athletes need to be exposed to a rich and varied landscape of affordances in which they learn to self-regulate by harnessing and adapting stable action-perception couplings.

The significant influence of the wider form of life on how athletes, performance managers and coaches influence and shape an ecological niche is exemplified by Henriksen, Stambulova and Roessler's (2010) athletic talent development environment model, which demonstrates how an ecological niche can be "shaped and sculpted by the rich variety of social practices humans engage in" (Rietveld & Kiverstein, 2014, p. 326). This richness of social practices is what Wittgenstein (1953) considered to be at the heart of a form of life, which can exert a powerful influence on how individuals develop a functional relationship with an ecological niche to utilize relevant affordances (Reed, 1996). In this way, the development of talent is predicated on the relational nature of a form of life and an athlete's capacity to engage with the affordances of a performance environment. This important relationship signifies that talented individuals have not acquired a new set of skills, but rather, inhabit a richer landscape of affordances within an ecological niche.

Implications for Practitioners

The theoretical concepts discussed so far can guide practitioners in harnessing a useful form of life to enrich individual and team functionality in sport, exemplified by former Queensland Reds and Australian national team rugby union coach Jim McKay. In an excellent applied science paper (see McKay & O'Connor, 2018), McKay described how he was able to harness a form of life that was influenced by experiential knowledge and the empirical knowledge available in a higher education institution. Blending experiential (continuous reflection on lived coaching experiences) and empirical (dynamical systems theory and data) knowledge can mitigate effects of social, cultural, and historical constraints that are not conducive to the development of coaches and athletes. McKay's work demonstrated how performance analysis data, combined with a

theoretical framework of the learner and the learning process, and experiential knowledge based on many years of high performance practice, contributed to highly adaptable and effective team play (during this period the Queensland Reds were Super Rugby finalists on three occasions, Australian conference winners twice, and won the 2011 Super Rugby competition [formed of teams from New Zealand, Australia and South Africa]).

This highly effective and integrated approach provided evidence to the coaching team about the most common 'attacking possession sources', with data revealing that 56% of possessions were received from unstructured play (possession received from unexpected incidents in open play), leading the coaching team to ask themselves "how closely does our current pedagogy and training reflect the reality of possessions sourced?" (Mckay & O'Connor, 2018, p. 276). These data, along with critical theoretical ideas and experiential knowledge of coaches, resulted in a move away from traditional methodologies of over-emphasizing repetitive rehearsal of structured plays in practice to more representative practice designs based on "unstructured game-based practice" providing "opportunities for players to develop their decision-making and tactical awareness in simulated match conditions" (Mckay & O'Connor, 2018, p. 274/275). Practice task designs that are less structured closely sample the ecological constraints of the performance environment. This is an invaluable approach for performance preparation and skill transfer because athlete behaviors are regulated by information-movement couplings that emerge as they are solicited to continuously explore a rich practice landscape (unstructured game-based practice) to detect and become attuned to relevant affordances (Seifert et al., 2019). Key to the success of Mckay's continued interventions was the carefully integrated and multi-disciplinary approach of the attack and defence coaches (traditionally trained in isolation), performance

analysts, and physical performance staff to collaborative design integrated physical and cognitive learning environments. From an ecological dynamics perspective, we indicated earlier that such contemporary approaches to practice task designs should be predicated on the establishment of a Department of Methodology in a high performance sports organization.

What is a Department of Methodology and why is it important for modern sports organizations?

In some sports organizations, a Department of Methodology refers to a group of data scientists and computer analysts seeking to interpret patterns of performance behaviors from the statistical analysis of results from previous competitions across extended periods of time. From an ecological dynamics viewpoint, a Department of Methodology is not conceived in the same narrow way. Instead, a more broad and contemporary approach is advocated involving athletes, coaches and sports practitioners from the full range of scientific sub-disciplines working together on practice task designs of relevance to elite and developmental sport performance. Currently, multi-disciplinary sport science teams working to design high quality athletic experiences to support athlete functionality can present a number of challenges. This is especially the case in results-driven and highly-pressured performance environments, where the fear of change at the expense of performance regression may lead to a status quo bias and psychological factors that result in default athlete development practices, resulting in ‘path-dependence’ (Kiely, 2018; Ross, et al., 2018). A major threat associated with maintaining status quo biases could mean sport scientists and practitioners, working towards a common goal, may adopt and utilize different theoretical approaches in interpreting human performance behaviors in isolation. The result may be ‘silo working’ and adoption of conflicting, disjointed athlete development

practices (Springham, Walker, Strudwick, & Turner, 2018). Therefore introducing collaborative practice programs, based on a coherent theoretical framework of learners and the learning process, expertise and talent development within high performance sports organizations may be a compelling feature of practice designs and environments to enhance athlete functionality.

To start to address challenges associated with working in large multi-disciplinary teams, sport organizations could adopt a Department of Methodology underpinned by a coherent theoretical framework, such as ecological dynamics. A Department of Methodology conceived in ecological dynamics is broader than skill acquisition, which is incorporated in the work of the full range of applied scientific sub-disciplines integrated together with athlete input too. Therefore, this integrated approach could coordinate the activities of practitioners and sport scientists, together with athletes, to engage collaboratively as ‘designers’ of an ecological niche to provide high quality athletic experiences to harness functionality and promote self-regulation tendencies. This conceptualization signifies the need for all designers (e.g., tactical & technical coaches, strength & conditioning trainers, rehabilitation therapists, sport psychologists, performance analysts) within a Department of Methodology to consistently work together with athletes to provide opportunities to: 1) search and explore the sub-systems of the human body to motivate exploratory behaviors, 2) discover and strengthen perceptual attunement to information to learn which sources can be used to regulate actions, and 3) exploit system degeneracy to increase athlete functionality during performance (for further details see Renshaw et al., 2015). The intention of practitioners to provide athletes with opportunities to explore and perceive information during practice may appear an ambitious task in disciplines that traditionally view human behavior as a matter of cause and effect. In strength and conditioning, for example, a

coach may consider their role as simply improving physical capacities and not improving an athlete's "perceptual, cognitive, technical, tactical, and psychological abilities" (Zweifel, 2018, para. 8). A growing number of research publications, across many scientific sub disciplines, support the key idea for performance preparation practices to be underpinned by an ecological dynamics rationale. For example, applied practice in performance analysis (Couceiro, Dias, Araújo, & Davids, 2016), strength and conditioning (Verhoeff, Millar & Oldham, 2018), injury reduction (Leventer, Dicks, Duarte, Davids et al., 2015), and improving elite springboard diving performance (Barris, Farrow, & Davids, 2014) have all addressed performance-related challenges in practice designs by implementing an ecological dynamics framework of human behaviors. Designing affordance rich practice environments based on an ecological dynamics framework can challenge *traditional* modes of practice that are inherent in nature, are more likely to be based on historical methods regardless of their effectiveness, and are strongly influenced by socio-cultural-historical constraints.

Future research directions

Re-conceptualizing talent development environments as an ecological niche aims to enhance athlete functionality through the coordinated activities of practitioners and sport scientists to carefully design high quality athletic experiences to present athletes with a rich landscape of affordances. Building talent programs that are based on value and meaning can enrich socio-cultural practices that foster environments rich in information. Designing talent enhancement programs this way can support the dynamic potential of individuals to self-regulate, based on the continuous influences of task, individual, and environmental constraints (Davids, Renshaw, Pinder, Greenwood et al., 2016). An important scientific endeavour, therefore, is to understand

how all stakeholders can facilitate talent development environments of this nature in regards to the influence of socio-cultural-historical constraints.

To advance these theoretical conceptualizations future research efforts could consider: 1) identifying and categorizing key socio-cultural-historical constraints on athlete development to assess the feasibility of applying these ideas through tracking athlete development and preparation over days, weeks, months, and competitive cycles over seasons and years (Renshaw & Gorman, 2015), 2) utilizing the experiential knowledge of practitioners and sport scientists to gain realistic insights on relevant research designs and the impact of interventions on coaches and athletes, and 3) bridging the gap between theoretical underpinning and practical application, which is often cited as the most significant barrier practitioners face as they negotiate the pragmatics of practice design (Greenwood, Davids, & Renshaw, 2014; McCosker et al., 2019).

In addressing these important research endeavours practitioners and sport scientists can develop a better understanding of the athlete development phenomena and socio-cultural-historical contexts in which athlete development practices take place. Carrying out research that positions the person-environment relationship as the important unit of analysis can start to readdress the organismic asymmetry in talent development research and practice, and provide new insights into the processes of enhancing athlete functionality within specific performance environments (Uehara, Button, Falcous, & Davids, 2016).

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Figure Captions:

Figure 3.1: A Continuum of Practice Designs with different affordances on offer for learners. At one end, learners are typically directed to fewer affordances in specified areas of the learning landscape by instructors (symbolized by the uniform shapes, few in number). In contrast, a more diverse and extensive range of affordances on offer at the less structured end of the landscape for practice designs (symbolized by the rich and varied shapes and sizes available).

Figure 3.2: A form of life is a complex multi-layered system that has a relational nature in regards to how individuals develop a functional relationship with an ecological niche to utilize relevant affordances.