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A Department of Methodology Can Coordinate Transdisciplinary Sport Science Support

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Abstract

In the current sporting landscape, it is not uncommon for professional sport teams and organizations to employ multidisciplinary sport science support teams. In these teams and organizations, a "head of performance" may manage a number of sub-discipline specialists with the aim of enhancing athlete performance. Despite the best intentions of multidisciplinary sport science support teams, difficulties associated with integrating sub-disciplines to enhance performance preparation have become apparent. It has been suggested that the problem of integration is embedded in the traditional reductionist method of applied sport science, leading to the eagerness of individual specialists to quantify progress in isolated components. This can lead to "silo" working and decontextualized learning environments that can hinder athlete preparation. To address this challenge, we suggest that ecological dynamics is one theoretical framework that can inform common principles and language to guide the integration of sport science sub-disciplines in a *Department of Methodology*. The aim of a Department of Methodology would be for group members to work within a unified conceptual framework to (1) coordinate activity through shared principles and language, (2) communicate coherent ideas, and (3) collaboratively design practice landscapes rich in information (i.e., visual, acoustic, proprioceptive and haptic) and guide emergence of multi-dimensional behaviors in athlete performance.

Keywords

Department of Methodology, ecological dynamics, transdisciplinary, sport science, athlete preparation

Introduction

In modern sport, multidisciplinary sport science teams are now common and play an integral part in the preparation of athlete performance. Olympic support teams, for example, will comprise specialists from a number of sub-disciplines including strength and conditioning, nutrition, performance analysis, psychology, technical and tactical, physiotherapy, and lifestyle support. The merits of multidisciplinary working has stimulated academic interest in rcent times, with advice on the facilitation of effective and collaborative performance teams (Sporer & Windt, 2018), recovery from underperformance (Gustafsson, Holmberg, & Hassmén, 2008), and a multidisciplinary approach to support the design of practice tasks to enhance performance (Mckay & O'Connor, 2018). Despite growing academic interest in multidisciplinary sport

science support, a crucial and often overlooked factor is the use of a theoretical framework to guide the coordinated and integrated approach to develop high levels of athlete performance. Without careful integration guided by a theoretical framework, multidisciplinary support teams can result in silo working (Springham, Walker, Strudwick, & Turner, 2018) and specialization and fragmentation of support services (Hristovski et al., 2017), leading to poor athlete development practices and performance outcomes. The importance of effective integrated working is highlighted by Portus (2019), one of Australia's most respected and experienced sport scientists, suggesting that the Australian Institute of Sport was at its most effective when an integrated hub of sport scientists and practitioners co-habited a "vibrant ecosystem" to "co-deliver ground-breaking innovations." In addition, Portus (2019) questioned the effects of the de-centralization of sport science at the Australia Institute of Sport on the potential for practitioners from different sub-disciplines to use a case approach in an integrated manner to focus on the needs of individual athletes (the case approach originates in the health care industry where a coordinated approach is used to meet the demands of patients).

To fully support an integrated case approach we suggest a move away from a traditional multidisciplinary approach (non-integrative disciplines) to a transdisciplinary view of sport science support. Transdisciplinarity calls for the integration of principles to provide a "space of knowledge beyond the disciplines" to promote collaborative problem solving (Nicolescu, 2002, p. 2). In this space of knowledge, the integration of principles can inform a shared context dependent vocabulary (Hristovski, Balague, & Vazquez, 2014) within sport science support teams to encourage innovation, collaboration, and highly effective integration. From a practical perspective, adopting a transdisciplinary approach requires some obvious behavioral characteristics (e.g., willingness to work together and share ideas). Here we argue that the introduction of a theoretical framework to guide the integrated efforts of sport scientists is essential to provide the substantial scientific rigor required for effective implementation and integration of concepts and tools from different sport science sub-disciplines in athlete support systems (Hristovski et al., 2017). We propose that the theory of ecological dynamics (the integration of ecological psychology and dynamical systems theory) is an appropriate theoretical framework to coordinate common principles and language of a team of sport scientists using a transdisciplinary approach to develop athletes and enhance performance.

Our intention to promote an ecological dynamics framework to enhance the effectiveness of a transdisciplinary approach is based upon the following characteristics (for a detailed overview see (Davids, Handford, & Williams, 1994): (1) A complex systems theory perspective considers athlete performance preparation and support programs (including sport scientists, coaches, and athletes) as a whole system and not separate entities. The multiple dynamically interacting parts of such a system (e.g., sub-units of teams and individual athletes and practitioners) can cooperate to provide order in the overall system (Clarke & Crossland, 1985). Therefore, training individual component parts in isolation or devoid of environmental context is inappropriate; rather, carefully co-designed programs can develop multiple factors simultaneously in real world settings; (2) Complex systems are non-linear; therefore, the relationship between time spent in practice and an athlete's development is not deterministic. The emergent nature of a complex system means that small changes in the way an athlete interacts with the environment, due to carefully designed practice interventions, could have a large effect on the global system (i.e., an artistic gymnast dramatically increasing the overall score across all events due to increased confidence on the vault); (3) In an ecological dynamics framework the person-environment relationship is the important unit of analysis when considering how to strengthen perception action couplings to afford highly skilled performance. The direct perception of environmental information (i.e., playing surfaces, objects, and opposition players) can be used by athletes to

guide skilled action in practice and competition (Seifert, Araújo, Komar, & Davids, 2017). This is in contrast to deterministic models of human behavior where external features of the environment (e.g., game plans and detailed coach instructions) are deemed necessary to guide performance; (4) The extent to which an athlete perceives the rich information sources in practice and competition is related to constraints on action (Renshaw, Davids, Newcombe, & Roberts, 2019). Therefore, it is essential that sport scientists and practitioners identify how specific personal (e.g., physical and emotional attributes), environment (e.g., social, cultural, and historical factors), and task (e.g., rules, equipment, and performance demands) constraints influence behavior in practice and competition. To summarize thus far, we suggest whole system development, embracing non-linearity, the person-environment relationship, and identifying constraints on performance as principles that can coordinate context dependent language and integration among sub-disciplines.

This conceptualization of ecological dynamics positions practitioners and applied scientists as designers of learning environments (Stone, Rothwell, Shuttleworth, & Davids, in review) for beginners as well as advanced learners among experienced high-performance athletes. It has clear implications for the design of athlete development, support and advancement programs, predicated on each individual's continuous interactions with personal, task, and environmental constraints of practice (Coutinho, Mesquita, & Fonseca, 2016). This conceptualization signifies the need for designers of the micro (e.g., practice tasks) and macro structure (e.g., talent systems) of athlete development, support and advancement programs to recognize the non-linearity and complexity of interacting subsystems that influence human development (Bronfenbrenner & Morris, 2006; Davids, Gullich, Shuttleworth, & Araújo, 2017). Challenging, however, to adoption of an ecological dynamics framework to support athlete preparation and development programs are the wider social, cultural, and historical influences on system structures and organization in high performance sport (Rothwell, Davids, & Stone, 2018). These constraints co-create and reinforce a status quo bias that can stabilize athlete preparation and development programs on a trajectory which is often difficult to change (Ross, Gupta, & Sanders, 2018). This status quo bias is evident in the daily and weekly activities at particular sports organizations that are deeply entrenched in traditional practices, shaped by socio-cultural-historical constraints (Stone et al., in review). Such entrenched practices are exemplified by multidisciplinary support teams who adopt operational frameworks as the starting point to guide the preparation of athletes (e.g., coaching teams planning long-term development based on players acquiring certain technical abilities at set time points). The problem with using operational frameworks as the start point of athlete development is that they can foster approaches such as deliberate practice (Ericsson, Krampe, & Tesch-Römer, 1993), and associated early specialization systems (for criticisms see (Baker, Cobley, & Schorer, 2017), contributing to overuse of drill-based coaching methods (Ford, Yates, & Williams, 2010), despite evidence countering these approaches (e.g., Araújo & Davids, 2018; Baker, Schorer, & Wattie, 2018; Davids et al., 2017). Rothwell, Davids, and Stone (2018) discussed how these environmental constraints can promote a *form of life* in athlete development programs, fundamentally shaping an athlete's relationship with a performance context. Wittgenstein (1953) used the term form of life to describe the behaviors, skills, capacities, attitudes, values, beliefs, practices and customs that shape the culture, philosophy, and climate of societies, institutions and organizations. For good or bad, a form of life can influence the way sports organizations and national governing bodies implement athlete development and performance preparation programs, how athletes interact with the environment, and how the theory-practice relationship is considered in sport science support systems (Araújo et al., 2010).

A challenge for sports practitioners is to identify how socio-cultural and historical constraints influence athlete preparation and

performance environments (Ross, Gupta, & Sanders, 2018), and to understand how evidence-based methodologies can underpin a model of transdisciplinary that works to support athlete learning and development. The aim of this paper, therefore, is to promote the idea that a conceptualized framework can integrate the collaborative work of scientists and practitioners who are charged with development of skill, expertise, talent, and preparation for performance in athletes. We propose that a conceptualization of skill performance and self-regulation (e.g., the extent to which athletes take the responsibility to address immediate, daily, weekly, and yearly performance problems) in competitive performance is needed to provide foundational principles to coordinate the work of all practitioners (e.g., strength and conditioning specialists, trainers, coaches, sport psychologists, performance analysts, and skill acquisition specialists) in a *Department of Methodology*.

Integrating Experiential and Empirical Knowledge in a Department of Methodology

A challenge in sports organizations is to understand how evidence-based methodologies can support practitioners in developing innovative models for athlete learning, development, and performance preparation. Current models of athlete development and support in preparation for performance tend to be dominated by isolated specialists working "in silos" (e.g., Springham et al., [2018]; see also earlier comments of Marc Portus). They tend to be guided by a reproductive philosophy in program structure for athlete development and performance preparation, which may be superficially coordinated but lacking the deep integration offered by a Department of Methodology. The aim of a Department of Methodology would be for group members to work within a unified conceptual framework to (1) coordinate activity through shared principles and language, (2) communicate coherent ideas, and (3) collaboratively design practice landscapes rich in information (i.e., visual, acoustic, proprioceptive, and haptic) and guide emergence of multi-dimensional behaviors in athlete performance (Chow, Davids, Hristovski, Araújo, & Passos, 2011). This type of collaborative working was demonstrated by Mckay and O'Connor (2018) to illustrate how a team of technical and tactical coaches and sport scientists integrated knowledge, experience, and ideas to identify possession sources for the Queensland Red's rugby union team. This collaborative effort revealed that traditional practice designs did not account for the most common sources of turnover possession, where unstructured possessions (i.e., transitions from kick receipt, unexpected turnovers from errors, and quickly taken tap penalties) were the most common form of possession sources. Informed by dynamical systems theory and constraints-led pedagogy, the team of defense and attack coaches, physical performance staff, and performance analysts collaborated to identify principles of unstructured practice (self-organization, adaptation, communication, and competitiveness) to support the re-design of practice tasks that simulate rugby union match play conditions. 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). For details see Mckay and O'Connor (2018).

Mckay and O'Connor (2018) demonstrate how integrated work in a Department of Methodology can lead to a shared, theoretically-informed understanding of when, how, why, and by whom particular fields of a practice landscape can be searched during practice. Rietveld and Kiverstein's (2014) concept of embedding affordances (opportunities for action) in a form of life also has important implications for a Department of Methodology. Although a form of life at the macro level (i.e., wider socio-cultural contexts and historical influences on sports) may be more challenging for individual sport scientists, pedagogists, and practitioners to work with, they may be better positioned to shape a form of life at the micro level (i.e., at the level of practice task designs in daily, weekly, and monthly machinations of sport science support) (Davids et al., 2017). In this

micro-structure of practice, the behaviors, skills, capacities, attitudes, values, beliefs, practices and customs of a Department of Methodology can lead to learning designs that offer rich affordance landscapes that selectively invite performance behaviors conducive to successful outcomes for athletes in a sports organization.

A Department of Methodology should be composed of a group of practitioners and applied scientists who share integrative tendencies based on a rich mix of empirical and experiential knowledge. Traditionally, applied science support for athletes and coaches has been dominated by empirical knowledge derived from separate sub-disciplines of science, often imposing a hierarchical relationship between theory and practice in athlete support. It is important that a Department of Methodology attends to the fundamental relationship between theory and practice, emphasizing that it is not a trivial issue for philosophical reflection only. Indeed, James Gibson (one of the founders of ecological psychology), drawing inspiration from the words of the Gestaltist Kurt Lewin highlighted this: "There is nothing so practical as a good theory" (Gibson, 1979, p. 135). Moreover, recent models for application of sport science support for athlete learning and preparation for performance have indicated the importance of evidence from the *experiential knowledge* of experienced practitioners and athletes involved with elite and developmental athlete performance programs (Burnie et al., 2018; Greenwood, Davids, & Renshaw, 2014; Mccosker, Renshaw, Greenwood, Davids, & Gosden, 2019; Phillips, Davids, Renshaw, & Portus, 2010). Experiential knowledge is gained from the experiences of professional coaches and practitioners in the micro-structure of practice over minutes, hours, days, weeks and months of developing and preparing athletes for competitive performance (Araújo & Davids, 2016; Renshaw, Davids, Newcombe, & Roberts, 2019). A deep integration of experiential and empirical knowledge can lead to new models of coaching and sports science support predicated on theory, science and knowledge from high-quality, applied practice in sport (see Figure 1, next page). The outcome could be a deeply symbiotic process where academics, researchers, and practitioners can co-create new knowledge and innovative designs of practice and training programs. However, as previously discussed, the value and role of experiential knowledge of practitioners has often been neglected largely because of the inability to collect data through classical experimental designs due to the inherent complexity of studying athlete expertise and knowledge. In this way, the rationale for evidence-based approaches in applied sports science and coaching has been skewed towards a limited categorization of knowledge used in shaping practice.

Future research designs aimed at understanding athlete development in elite sports organizations would need to consider different types of knowledge and data to integrate in innovative practices. Relevant tasks include the need to track athlete development and preparation, not only over days, weeks or months, but also to include research questions that capture competitive cycles over seasons and years (Renshaw & Gorman, 2015). More use should be made of individual or multiple baseline methodologies, rather than using traditional group-based experimental designs with control groups, as they may not be most appropriate when implementing theoretical concepts or considering the ethics of impacting athletes' performance needs and careers. This is especially the case when it comes to assessing impact of interventions on elite and developing high level athletes. It is simply not feasible to undertake experimental manipulations with such groups. Appropriately representative interventions should be developed that utilize the knowledge of practitioners and scientists to gain critical insights on implementation of methodologies to evaluate athlete learning and development. Research designs, such as field-based studies and observations that disentangle the need for laboratory-based research, can evaluate the effectiveness of interventions on athlete learning and development in the messy, noisy world of competitive high-performance sports organizations. Future quantitative reviews also need to consider a range of different data

sources, rather than simply sample experimental studies in the scientific literature. These databases could emerge from performance analysts working closely with coaches, practitioners, and sport scientists in practice programs as well as from scrutiny of competitive performance (e.g., Robertson, Back, & Bartlett, 2016).

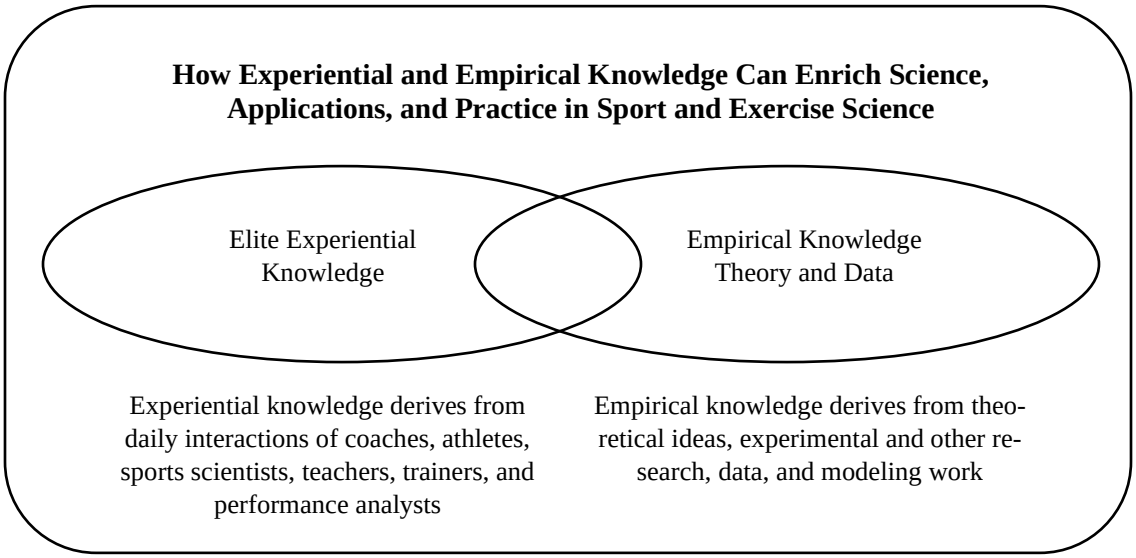

Figure 1. Different types of knowledge needed to support athlete development and preparation for performance in sport. Integration of experiential knowledge of elite practitioners in sport can enrich (and in turn be enhanced by) empirical knowledge of science and theory. The space where the two bodies of knowledge intersect can be inhabited by elite sports practitioners, applied scientists, and coaches working in a Department of Methodology in a high-performance sports organization or club.

A key challenge for practitioners is understanding how to put complex theoretical ideas into practice. For example, we have argued that, within a practice design context, practitioners should see themselves as *learning designers* (Davids, 2015; Stone et al., in review). However, integrating complex theoretical ideas into learning designs can be highly challenging. It is this gap between the theoretical underpinning and the practical application that is often cited as the most significant barrier practitioners face as they negotiate the pragmatics of practice design (Greenwood et al., 2014). This challenge is a significant factor that precludes migration from the historical status quo bias and associated path dependency. We propose that one role of the Department of Methodology is to support the practitioner's journey, providing a clear route between what typically are two disconnected and distant locations (i.e., theory and practice). We contend that by employing a Department of Methodology high performance sports organizations or clubs can support practitioners in continually seeking to develop more innovative and robust practice environments that are likely to facilitate a greater level of transferable and targeted learning and development.

Need for A New Model of Athlete Development and Sports Science Support

Problems and challenges with traditional models of athlete development and performance preparation were outlined by Ross, Gupta, and Sanders (2018) who discussed the barriers to changing practice in sports organization, drawing attention to the inertia for meaningful change that is inherent in such systems. The ideas of Ross, Gupta, and Sanders (2018) dovetail with views expressed on the pitfalls of adhering to traditional forms of life in elite sports organizations discussed elsewhere (Chow, Davids, Shuttleworth, & Araújo, 2016; Rothwell et al., 2018). It is important to note that some forms of life can result in *system capture*, termed acculturation:

the tendency to coach and support athletes "in the way that it has always been done." While traditional ways of coaching and supporting athletes in elite sports organizations may yield some success, adhering to traditional methods because of system capture may risk misconceiving athletes, sports teams—and even sports themselves—as stable, linear systems, rather than as complex, adaptive, nonlinear systems (Davids, 2015). The latter provides a paradigm of elite and developmental sports as constantly changing and subject to the continuous influence of changing environmental constraints dominated by technological, scientific, social, cultural, economic, and political perturbations (Rothwell et al., 2018). Sports organizations need to adapt to these important environmental constraints in a dynamic landscape by embracing innovations, whether they emanate from technological, empirical, or practical routes. To achieve this fundamental aim and avoid system capture, it is important to adopt an evidence-based, theoretical rationale to provide a sound principled framework for applied sport science support and pedagogical practice (Renshaw et al., 2019). For example, the recent upsurge of technologies that promote "brain training" and "perceptual-cognitive training" have been criticized for dualist methods of athlete preparation due to the lack of a theoretical framework to guide the development and implementation of such technologies (Renshaw et al., 2019, p. 2).

Analyzing athlete performance in simulated (representative practice designs) and competitive performance environments from an ecological dynamics perspective supports an evidence-based rationalization of significant constraints which shape successful performance behaviors, providing the basis for designing representative training, preparation, and learning contexts. This approach has been illustrated in relation to athlete preparation and practice design in several sports (Greenwood et al., 2014). For example, (Mccosker et al., 2019) investigated competitive performance of elite level long jumpers (n = 244; male and female) seeking to ascertain the main individual, environmental, and task constraints that shaped performance outcomes. Data (Mccosker et al., 2019) suggested that the key performance-shaping constraints in long jumping included the following: individual constraints (especially specific intentions and performance goals of athletes and their impact on immediate jump performance), environmental constraints (strength and direction of wind), and task constraints (requirement that front foot must be behind foul line at take-off board to avoid making a foul jump).

On the basis of these findings, the interconnectedness of jump performance highlighted that each jump should not be viewed as a performance trial occurring in isolation, but rather as part of a complex system of interconnected events which contribute to competitive outcomes. These findings emphasized the nature of the contribution of performance analysis in competitive performance contexts. Evidence from performance analytics can support athlete preparation for competition by enabling practitioners to design more innovative training tasks based on dynamic ecological constraints in competition. The targeting of specific constraints on physical, psychological, cognitive, and perceptual demands of competitive performance environments on individual athletes can be met by a group of practitioners working within a Department of Methodology in a sports organization. The framework of ecological dynamics can be integrated with experiential knowledge of skilled and experienced practitioners to provide a comprehensive theoretical rationale to coordinate their work in supporting the self-regulation of each performer. This new model of athlete development and preparation for performance can support coaches, sport practitioners, and athletes to collaboratively explore and exploit functional intentions, specific performance goals and movement solutions aligned with context-specific demands of competition.

As another example, Burnie et al., (2018) reported how strength and conditioning training could vary in its transfer to elite sport performance from training designs. Many typical strength and conditioning training programs had problems with over-use of non-specific exercises and training, with limited effects on enhancement of adaptive intramuscular coordination tendencies

needed for elite sports performance in sports such as cycling, running, kayaking and rowing. Newell's (1986) model of interacting constraints has been used to propose how changes in physical capacities (such as strength or flexibility) need to be accompanied by adaptations in other effectivities such as coordination (Burnie et al., 2018) and cognition (Araújo et al., 2019). An effective Department of Methodology could be headed by an experienced individual with a broad understanding of athlete performance and learning and would support organizational function with many deeply integrated components (e.g., strength and conditioning specialists, trainers, coaches, performance analysts, skill acquisition specialists) that are continuously interacting and evolving under the demands of the current and future performance constraints of the athletes, team, and sport. Such a re-organization of high-performance sport systems might alleviate some problems and weaknesses of traditional models of athlete support and coaching which include the following:

- Coaches overemphasizing action reproduction and rehearsal of tactical and strategical patterns of behaviour which leads to imitation of styles of play from other performers and teams or adoption of the latest trends in performance development. A Department of Methodology would provide the much-needed conceptualization and system structure to allow sports organizations to develop uniquely relevant performance styles underpinned by a set of principles, consolidated in environmental constraints (currently captured in cliché descriptors such as “our organization's DNA”).
- The role of a performance analyst being limited to data analyst or computer scientist, with little involvement in practice task designs informed by performance data. A Department of Methodology would provide the system structure for an integration of expertise in data analytics and the design of practice and conditioning tasks to enhance athlete self-regulation in performance (see next point).
- An over-specialized role for strength and conditioning staff and sport psychologists who are called upon *reactively* when problems are perceived to arise, or as a treatment for a performance issue, with a single athlete. A Department of Methodology would provide the system structure for continuous and prospective interactions between skilled specialist practitioners in elite athlete development and preparation for performance.
- Enhancement in isolation of specific athlete attributes such as strength, coordination, resilience, performance anxiety reduction. Rather than the innovation of collaborative practice designs during training, which require athletes to satisfy a range of personal, task, and environmental constraints without the constant direction of a coach, can lead athletes to *self-regulate* more effectively in practice tasks which integrate key elements of physical conditioning, psychological and emotional regulation and movement (re)organization under pressure. A Department of Methodology would provide a framework for new models of learning design and athlete preparation for coaches and other sport practitioners.

Conclusion

We have argued that effective preparation and development of athletes for performance in elite sports require a unique integration of theoretical principles and experiential knowledge of expert practitioners to guide the designs of learning and practice environments. The application of research findings and concepts could be best facilitated with new models of coaching and sport science support for athlete learning and development, perhaps best undertaken by a group of sport practitioners working together in a Department of Methodology to facilitate collaborative integration of theory and practice. The essential point is that research in ecological dynamics, on experiential knowledge of elite athletes and coaches, is beginning to reveal how some elite performers in sport have not developed in traditional ways, but rather in highly adaptive ways (for examples see Burnie et al., 2018; Greenwood et al., 2014; Mccosker et al., 2019). These

athletes have posed unique challenges to coaches and sport science practitioners, who have perceived the need to adapt the learning and development of these players by facilitating their emergent behaviors (Ross, Gupta, & Sanders, 2018). This body of evidence implies the need for new models of coaching and of sport science support for athlete development and preparation for performance. These new models of coaching and support will require research on the generation of new variables and measure and better analyses of performance to understand how these athletes satisfy interacting constraints and how practice task constraints may be (re)designed to elicit learning and development during practice and training.

Author's Declarations

The authors declare that there are no personal or financial conflicts of interest regarding the research in this article.

The authors declare that they conducted the research reported in this article in accordance with the Ethical Principles of the Journal of Expertise.

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