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Mono-, multi-, inter-, and transdisciplinarity in sport performance support teams: Definitions and objectives.

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Abstract

Growth in sport science disciplines, specialist coaching, and performance support roles is increasingly emphasised in research and applied practice to enhance athlete preparation and development. However, *monodisciplinary*, *multidisciplinary*, *interdisciplinary*, and *transdisciplinary* are used ambiguously and interchangeably across literature and within sporting organisations, blurring differences in how collaboration and integration may be operationalised. We examine these approaches, distinguishing their purpose, process, and collaboration and integration. Drawing on research and examples from high-performance sport, we propose clear, practice-oriented definitions and identify characteristics associated with each approach. We position transdisciplinarity as a problem-focused approach that could frame communication, collaboration, and integration of ideas around a performance challenge. To illustrate how these distinctions can be operationalised, a case exemplar demonstrates how a Department of Methodology (DoM) and unified game model could organise diverse expertise. By clarifying terminology and illustrating relevance, this paper aims to support intentional and coherent collaborative practice within high-performance sport environments.

Keywords

Sports coaching; Sport science; High-performance sport; Performance support, Disciplinarity, Teamwork

Background to disciplinary approaches

In high-performance sports organisations, the implementation of athlete support for performance preparation and development is supported by specialists across multiple sport science disciplines, coaching, and performance support roles. These roles are increasingly emphasised in research, education, and applied practice (DeWeese et al., 2023). While support for athlete development and performance preparation has grown in sophistication over recent decades, there have been some calls for contemporising this effort, particularly in relation to interpersonal communication, collaboration, and integration among athletes, coaches, sport scientists, and performance practitioners within performance support environments (e.g., Hydes et al., 2026; Rothwell et al., 2020).

Critical to establishing more intentional and coherent collaborative practice within performance support teams in sports organisations is developing clarity on *monodisciplinary*, *multidisciplinary*, *interdisciplinary*, and *transdisciplinary* approaches. While these terms describe different levels of collaboration, integration, and interaction among team members and involve several disciplines (Choi & Pak, 2006), in the literature and in practice their definitions are often ambiguous and inconsistent (Whitfield & Reid, 2004), misused (Martin et al., 2022), and used interchangeably (Burns & Collins, 2023). This lack of clarity on the definitions and use of such terms has impacted on understanding in various contexts, including academia, sporting organisations, and national governing bodies. Importantly, these distinctions are not merely semantic. They imply different interpretations and expectations about role boundaries, levels of collaboration, communication processes, decision-making, leadership, and the degree to which disciplinary knowledge should be integrated. This issue is not just unique to sport science. In healthcare, for example, teamwork definitions are often ambiguous, and terminology is frequently conflated, with terms such as “multidisciplinary” and “interdisciplinary” used synonymously (see Howard & Potts, 2019). Martin et al. (2022) argue that this conceptual confusion can affect translation of research, stakeholder understanding, and decisions about how teams should be structured in practice. Similarly, Howard and Potts (2019) show how multidisciplinary, interdisciplinary, and transdisciplinary models differ in formal communication, treatment planning, hierarchical structures, and role overlap. Comparable issues have been identified within research and practice in sport science, where researchers, coaches, practitioners, scientists, key stakeholders, and performance support staff often lack awareness of the key definitions and distinctions between these approaches (e.g., King et al., 2024).

The confusion surrounding these terms is also evident in high-performance sport, where the same term can imply different expectations for practice. For example, Balagué et al. (2017, p. 52) define multidisciplinary

teams in high-performance sport as “a non-integrative mixture of disciplines”, whereas Bartlett and Drust (2021, p. 1580) characterise a multidisciplinary team as “the integration of several specialised disciplines focused towards one common problem”. These contrasting definitions point to different assumptions and expectations about how practitioners may work together: while some approaches prioritise integration and coordination of efforts, others emphasise the distinct contributions of individual sub-discipline specialists (e.g., strength and conditioning specialists, coaches, sport psychologists, performance analysts, and skill acquisition specialists) working in parallel. Such ambiguity has practical implications, as definitions are not simply descriptive labels; they can shape the assumptions, expectations, and practices through which performance support teams, including coaches, understand their roles, organise their contributions, and integrate expertise. For example, a team that understands multidisciplinary as an additive, parallel, and/or sequential disciplinary contribution may operate differently from a team that understands it as integrated problem-solving. Conceptual clarity is not positioned as the sole barrier to integration, but as an important start point for examining how support teams are structured and how collaboration is organised. For coaches, these distinctions are important as they may shape how information, advice, and support from sport scientists and performance support staff are communicated, could be interpreted, and may be used to inform practice design and organisation, enhancing decision-making and planning for athlete performance preparation and development.

This ambiguity extends to job descriptions within high-performance sport, where contradictory expectations may also appear. For example, applicants may be required to collaborate effectively within a multidisciplinary team, while also be expected to integrate practice with a range of human performance and athlete health practitioners through an interdisciplinary approach. The interchangeable use of terminology in support staff teams could create inconsistencies and confusion between departments within organisations, impacting role clarity. For instance, a practitioner may struggle to understand the expected level of communication, collaboration, and integration with other support staff in an organisation. This role confusion could lead to a lack of coordination between sub-disciplines, siloed working, unclear lines of communication, competing goals, conflicting priorities, and fragmented delivery of athlete preparation and performance support (DeWeese et al., 2023; Salcinovic et al. 2022; Stewart et al., 2024).

Important strategy documents, such as the English Premier League’s Elite Player Performance Plan (EPPP) in football/soccer, also define and use the terms “multidisciplinary” and “interdisciplinary” interchangeably. For example, the EPPP defines a multidisciplinary approach as “the process by which the various support services are linked around the Coaching Programme so as to provide holistic support for each player at

an Academy” (Premier League, 2011, p. 8). However, later in the document, the concept of interdisciplinarity is introduced, implying that different scientific approaches need to be adopted to support performance and development at different competitive levels of a club. The EPPP states that “it is assumed that the underpinning principles of an inter-disciplinary approach within the Sports Science and Medicine Team will link effectively with the Multidisciplinary Approach advocated across the Academy” (Premier League, 2011, p. 65). Finally, it proposes that a “multidisciplinary approach is intended to create a fully integrated environment which will service all aspects of a player’s technical, athletic, education, and social development at the Academy” (Premier League, 2011, p. 72). This interchangeable use of terms, coupled with somewhat contradictory statements has serious implications for organisation and structure of athlete and team support, which may contribute to ambiguity surrounding the application of these support services. Addressing this lack of clear and consistent use of terminology is needed for fostering a shared understanding and creating collaborative and integrative performance environments.

Current ways of organising performance support may be understood through the notion of ‘situated normativity’ (Rietveld, 2008; Rietveld & Kiverstein, 2014), which helps explain how particular ways of working can become normalised within specific organisational contexts. Rietveld (2008) describes situated normativity as a form of normalised practice concerned with distinguishing more or less historically adequate ways of acting in a specific behavioural context. From this perspective, existing mono-, multi-, and interdisciplinary ways of working should not be viewed as inherently inadequate. Rather, they may be historically ingrained and considered adequate within particular sport organisations, roles, and routines when addressing specific performance challenges. However, these ways of working may become limited when competitive performance constraints change or when organisations are faced with unfamiliar performance problems, requiring deeper communication, collaboration, and integration across diverse forms of expertise.

Calls for more integrated approaches in sport science support and coaching are not new. Davids et al. (1994), for example, questioned current, dominant (at that time) mono-disciplinary approaches to sport science support. Davids et al. (1994) called for greater interdisciplinarity in sport science, particularly in relation to how research on movement coordination and skill acquisition can inform coaches’ understanding of performance challenges and contexts, integration of specialist knowledge, and the design of practice environments in competitive sport. The present paper builds on that original position by suggesting that, while interdisciplinary practice remains important, developments in theoretical understanding (e.g., applications of ideas in complexity science and ecological psychology), methods (nonlinear dynamics), and applied practice (nonlinear pedagogy)

over the past three decades may require a further shift towards transdisciplinarity. However, despite longstanding calls for greater collaboration and integration, the organisation of practitioner support in high-performance sport may remain in a state of ‘situated adequacy’ (Rietveld & Kiverstein, 2014), in which traditional practices continue unquestioned, although constrained by conceptual ambiguity and inconsistent use of disciplinary terminology. Hence, in this position piece, we consider the definitions and applied practice approaches in sport implicated by mono-, multi-, inter-, and transdisciplinarity. We explore how inconsistent use of these terms may contribute to misunderstandings about how performance support teams coordinate disciplinary expertise and work collectively to support coaches, athletes, and teams in performance preparation and athlete development. We first discuss each term and consider how its definition and use may differ across research and applied practice. We then offer definitions and key characteristics of each disciplinary approach, proposing working definitions informed by the literature, seeking to support clearer application in sport performance contexts.

Building from this conceptual clarification, we consider transdisciplinarity as one possible way of organising performance support around complex, shared performance problems. Finally, we present an exemplar case in team sports illustrating how the combination of a Department of Methodology (DoM), a unifying game model, and associated principles of play in invasion sports, may provide an integrative framework for the support activity of specialist coaches and sub-discipline specialists. This exemplar is used not to imply that transdisciplinarity is superior to other approaches, but to illustrate how a transdisciplinary approach may support stronger collaboration and integration across diverse forms of expertise, knowledge, and experience when corresponding with complex performance problems in high-performance sport environments.

Disciplinary Approaches

Monodisciplinarity

“Mono”, derived from the Greek word *monos* meaning “alone” or “one” (Harper, 2026), relates to monodisciplinary approaches involving a single discipline or sub-discipline working in isolation, focusing solely on its own area of expertise (McGregor, 2007). To use a food metaphor, monodisciplinarity is likened to a bowl of apples, illustrating work or thought confined to a singular discipline, where one type of fruit represents one disciplinary or sub-disciplinary perspective (McGregor, 2023). This approach involves a specialist working independently, with little to no interaction with experts from other disciplines. Practitioners typically view and address performance problems solely from their own disciplinary perspective to the exclusion of other perspectives (Woods et al., 2021). These disciplines or one sub-disciplines share common methodologies (i.e.,

paradigms and philosophies), techniques, theories, and a common language, including terminology and jargon, aligned to their discipline-specific interests (McGregor, 2007). Disciplines tend to become self-contained, highly specialised, and siloed, which minimises interaction with other experts from other disciplines (Ertas, 2000). Practitioners within these disciplines or sub-disciplines may develop an effective level of *intradisciplinary* teamwork and communication due to their common language (Ertas et al, 2003; McGregor, 2023). However, the isolated nature of monodisciplinarity may decrease communication across disciplines and limit the emergence of new ideas and innovation between specialists from different disciplines (Sanchez-Segura et al., 2018).

An isolated monodisciplinary approach has been criticised within sport science for its narrow, confined, and insular thinking (Balagué et al., 2017; Hristovski et al., 2017; Otte et al., 2022; Rothwell et al., 2020; Vaughan et al., 2019; Woods et al., 2021). The dominant practice for researching and solving performance problems has been characterised as being somewhat reductionist, focusing on separate dimensions of behaviour. This traditional approach typically involves practitioners working in isolation, operating in silos within a single discipline, such as biomechanics, physiology, skill acquisition, or psychology (Balagué et al., 2017; Rothwell et al., 2020; Vaughan et al., 2019; Woods et al., 2021). However, adopting a sequential, monodisciplinary approach to scientific inquiry and problem solving may risk limiting understanding of complex phenomena, as performance challenges and issues are often complex, multifaceted, and interconnected, requiring insights from diverse perspectives (Vaughan et al., 2019). While a monodisciplinary lens may offer a valuable but partial perspective, important connections may be ignored, this fractionated or blinkered view could be conflated to represent the functioning of the whole (Hyun, 2019; Montuori, 2025; Woods et al., 2021).

In applied sport settings, this approach can be observed when a performance problem is interpreted primarily through one specialist, applied scientific lens. For instance, a sport scientist focused on biomechanics may deconstruct diving performance to better understand the technique of the take-off of a dive; however, this perspective could provide a partial view *about* the phenomenon under study. Biomechanics alone may uncover key biomechanical principles of the take-off phase of a dive, but when viewed in isolation and removed from its context, only offers a partial understanding of skill performance and adaptation (Davids et al., 2023; Hydes & Rothwell, 2022). For example, biomechanical analysis may provide important insight into movement technique but may not fully account for how perception-action coupling and task, environmental, and individual constraints interact to shape a performer's actions (Davids et al., 1994).

Based on existing literature, we propose that monodisciplinary practice can be defined as an approach in which a specialist works independently, viewing and addressing performance problems solely from their own disciplinary or sub-disciplinary perspective to the exclusion of other perspectives.

Multidisciplinarity

“Multi,” derived from the Latin word “multus,” meaning ‘much’ or ‘many’, simply means more than one (Harper, 2026). To continue with a food metaphor, a multidisciplinary approach is likened to a fruit salad, where each piece of fruit remains intact and identifiable, with each discipline maintaining its distinctiveness and retaining its independence (Choi & Pak, 2006; McGregor, 2007). In broader literature on disciplinary collaboration and team science, a multidisciplinary approach involves experts from different disciplines or sub-disciplines working alongside one another on a common goal or problem (Pain, 2003), which, in sport, may include improving athlete preparation and performance. Each discipline works on its own component of a problem, making separate contributions in an additive way (National Research Council, 2015), with few attempts to create new, unified understanding (Collins & Fillery-Travis, 2015). These contributions are often made in parallel or sequentially, but not in an integrated or coordinated manner (International Rice Research Institute, n.d.; Rosenfield, 1992). Each discipline stays within its disciplinary boundary while contributing in an additive manner to understanding a common goal without the intent to integrate (McGregor, 2023).

In high performance sport, multidisciplinary practice may involve specialists sharing information that others can use, without necessarily developing a collectively integrated understanding of a specific performance problem. For instance, people from the originating discipline may integrate other disciplinary contributions into useful information for themselves, but the multidisciplinary team does not, nor is it expected to, engage in integration (McGregor, 2023). When using multidisciplinary thinking, a practitioner draws appropriate information from multiple disciplines, so relevant ideas and information can be used (or discarded) for themselves. Seeking insights from several disciplines or staff members within a multidisciplinary team can provide understanding from a wider perspective that is outside normal disciplinary boundaries (Dua, 2020). To illustrate, a sport scientist labelled as an ‘Academy Sport Scientist’ or ‘Physical Performance Coach’ working with a sports team might collect and report Global Positioning System (GPS) data on the dynamics of player movement. The sport scientist collects a range of external load and intensity metrics during training and performance, including statistical data on total distance, high-speed running and sprint distance, relative high-speed running, acceleration and deceleration counts across multiple intensity thresholds, and measures of maximum and relative running

velocity. A subset of these metrics (e.g., total load, total distance, and high-speed running exposure) is then shared with the coaching staff. From the sport scientist's perspective, the broader dataset is used to monitor weekly and chronic training load, assess exposure to high-intensity actions, and manage player workloads in relation to competitive demands. This report informs decisions about whether training load and/or intensity should be individualised (increased, maintained, or reduced), and which physical qualities may need to be targeted within upcoming sessions.

From the coaches' perspective, the shared metrics may be used to frame their own perspective and make informed decisions about practice design (e.g., session duration, type of drill, and/or repetition structure). By recording these data, the sport scientist can support understanding from outside the coach's usual role perspective. Although data and metrics are shared across disciplines, they may be interpreted independently rather than collectively integrated. Each individual sub-discipline specialist, such as the coach, may use this approach to frame something new; however, only the individual or sub-discipline is engaged in integrative thinking and design processes from their own disciplinary perspective. Specialists may come together to share their expertise or relevant information while appreciating that knowledge integration is not the end goal; rather, it is used to provide others with information that could help frame their own perspective, ideas, and thoughts (Jantsch, 1972). Despite a multidisciplinary team having multiple expert or sub-discipline specialists, cohesion is low, and a common language is missing (Sanchez-Segura et al., 2018). In essence, "people mingle disciplines" (McGregor 2007, p. 489).

This distinction is important, as definitions of multidisciplinary practice often imply different levels of integration. Inconsistency in the use of a multidisciplinary approach in sport science, coaching, and performance support has created confusion and hindered the development of a shared understanding. This ambiguity is problematic in defining a multidisciplinary team as different definitions often conflate distinct levels of interaction, integration, coordination, or shared understanding, ranging from parallel and sequential work to highly integrated collaboration. For instance, within published research literature, Alexander et al. (2019, p. 1) define a multidisciplinary team as "professionals from various disciplines who work collaboratively to provide best care to an athlete", while Bartlett and Drust (2021, p. 1580) describe it as "the integration of several specialised disciplines focused towards one common problem". However, some definitions emphasise a more segmented, independent, and parallel approach, with Rimer et al. (2024) defining multidisciplinary practice as an aggregation of practitioners from various sub-disciplines who work independently alongside each other in a cooperative manner, highlighting that they should "stay in their own lane" (e.g., p. 60). Similarly, Burns and Collins (2023, p.

1878) state that each practitioner is “predominately fixated and tasked with their piece of the puzzle” and has only a broad and superficial understanding of the whole problem. Salcinovic et al. (2022) add that a multidisciplinary team consists of individuals working toward their own goals with limited interaction. In contrast, Schneider and Schmitz (2024, p. 165) present more of an interconnected view of multidisciplinary teamwork, stating that “the MDT consists of numerous dyadic relationships, with each team member interconnected with every other”. These definitions exemplify the spectrum of interpretations and expectations associated with multidisciplinary teamwork within current academic literature in sport performance support research.

While multidisciplinary approaches to sport performance research and support are often proposed to provide ‘optimised’ performance solutions for teams and athletes (Fullagar et al., 2017), a critical distinction must be made between the notion of multidisciplinary practice and its effectiveness in achieving a truly collaborative and integrated environment. Gabbett and Whiteley (2017) have criticised those responsible for performance, preparation, and medical care in professional sporting organisations for largely working in silos and merely “paying lip service” to terms like “*multidisciplinary*” (e.g., p. 52). The core issue, however, is that sports science and performance support frequently romanticise and conflate multidisciplinary teamwork with a level of integration it does not inherently possess. In reality, working in silos and disciplinary isolation is a characteristic of, rather than contrary to, multidisciplinary practice. According to Klein (2015), multidisciplinary is an approach that juxtaposes disciplines. While juxtaposition fosters wider knowledge, information, and methods by representing different disciplinary perspectives, disciplines remain separate, retaining their original identity, and the existing knowledge structure is unchallenged or questioned. The purpose is to bring together unique perspectives, methods, and approaches of each discipline without attempting to integrate them into a unified framework (Nicolescu, 2013). The emphasis in multidisciplinary is on preserving the distinction and autonomy of each discipline, rather than seeking to merge or blend disciplinary perspectives (McGregor, 2023). This tendency is evident in high-performance multidisciplinary teams where performance support staff have different views on the same topic or problem, often with isolated goals that can lead to conflicting training aims (King et al., 2024).

Simply put, a multidisciplinary team is like an expanded monodisciplinary team that includes multiple specialists who contribute towards a common goal, the athlete and/or team. Each discipline or sub-discipline specialist does what they think is best for the athlete and/or team, hoping their combined efforts will improve performance. Within performance support, it is often assumed that “more is better” and that simply assembling a group of specialists will naturally lead to collaboration and integration of ideas and methodologies (Buchheit &

Carolan, 2019; Sporer & Windt 2018). However, in professional practice this can lead to an “illusion of integration” (Otte et al., 2020, p. 2). A multidisciplinary team or “work group” exists when people are brought together simply because they work in the same organisation or with an athlete and/or team, but they do not share work tasks and/or responsibilities (Payne, 1982, p. 5). While multidisciplinary approaches can and have produced results (Otte et al., 2022), support staff tend to work with athletes and/or teams independently and to share information with each other. They form a collection of specialists working on different aspects of performance-related issues without constructing an integrative perspective of performance. Consequently, the athlete and/or team may be merely a recipient of prescribed training, instruction, and interventions (Rothwell et al., 2023; Woods et al., 2021), leading to a ‘copy and paste’ approach (O’Sullivan et al., 2023) and possible issues such as fragmented, disjointed, and poor athlete preparation and performance outcomes (King et al., 2024; Rothwell et al., 2020).

Based on the literature, we propose that multidisciplinary practice can be understood as an approach involving two or more disciplines working alongside one another toward a common goal, with each discipline making separate, additive contributions and with little intention to integrate. Practitioners may work in parallel or sequentially, rather than as a coordinated and integrated whole.

Interdisciplinarity

Interdisciplinarity or interdisciplinary teamwork, has become an increasingly prominent term used within sport science research and performance support, driven partly by the complex nature of high-performance sport (Doherty et al., 2013; Lane & Kreider, 2025; Secomb, 2024). However, despite its growing popularity, interdisciplinarity remains widely misunderstood, poorly defined, and hindered by a proliferation of, often, unclear terminology (Graff, 2016), leading to confusion about what interdisciplinary is, how it differs from multidisciplinary, and what interdisciplinary practice looks like when working with others to offer performance support (Beukers et al., 2017). As a result, there is no distinctly clear division between what interdisciplinarity is and what it is not (Holbrook, 2013). Furthermore, there is no universally accepted definition of “interdisciplinary”; instead, as Klein (2010) notes that there is a plethora of definitions, with varying uses of the term, which can lead to confusion. Critically, many supposedly “interdisciplinary” activities are actually “multidisciplinary” (Klein, 2015), meaning that disciplines work in parallel, in an additive or sequential way (Choi & Pak, 2006), rather than working jointly to address a common problem (Morales, 2017).

The Latin word “inter” means “between” or “among”. In the broader literature on disciplinary collaboration and team science, interdisciplinary practice involves specialists from different disciplines sharing ideas and methods between each other in a collaborative, coordinated, and reciprocal way (McGregor, 2023). While each specialist approaches a shared problem from their unique disciplinary perspective, interdisciplinarity aims to analyse, synthesise, and harmonise links between those perspectives into a coherent whole (NSERC, 2012). Although interdisciplinary team members work jointly to address a common problem (Morales, 2017; Rosenfield, 1992) and “surrender” some aspects of their role, they will still maintain their core discipline-specific base (Choi & Pak 2006, p. 356). This approach means that disciplines interact and work collaboratively, rather than working independently (NCSU, 2020). Therefore, interdisciplinarity can be considered as a continuum with different levels of collaboration, coordination, and integration, rather than a simple binary category of “interdisciplinary” or “not interdisciplinary” (Graff, 2016; Holbrook 2013; Klein 2015).

The distinction between multidisciplinary and interdisciplinary practice can be illustrated through the metaphor of a stew (Choi & Pak, 2006). Each vegetable in the pot represents a distinct discipline, retaining its identity as disciplines engage and interact (McGregor 2023). The thick stock represents the integration of some part of each vegetable, forming a new cohesive medium. This new medium represents the blended understanding that emerges, which is more than just the sum of its individual parts. This stew represents an interdisciplinary team, composed of related but not identical disciplines. The “cooking process” highlights the team’s operational methodology, through reciprocal (mutually beneficial) collaboration, where expertise is shared, pooled, and decisions are made collectively in a coordinated manner. The combined result of interdisciplinary teamwork (thick stock) is facilitated by coordinated collaboration and reciprocal relationship between disciplines (Strauss, 1999). In applied sport performance settings, however, the value of integration lies not simply in producing a more cohesive understanding among specialists, but in whether that shared understanding might lead to clearer, more accessible support for coaches and athletes. Understanding these nuances in definition is therefore important for fostering effective interdisciplinary collaboration in high-performance sport environments.

The varied, vague, and overly simplified definitions of interdisciplinary teamwork contribute to conceptual confusion around what interdisciplinary collaboration involves (e.g., Burns & Collins, 2023). When sport science research, sports organisations, practitioners, or governing bodies use and discuss interdisciplinarity or interdisciplinary teamwork, this often involves the repetition, overlap, and occasional misuse of a number of terms (Graff, 2016). These include terms and concepts like holistic, multidisciplinary, integration, integrative,

problem-solving, specialisation, synthesis, and transdisciplinary (Graff, 2016). Such language and terminology are often complex and hard to understand, being neither inviting nor particularly clarifying (Graff, 2016).

For example, there is confusion with ‘specialisation’ and ‘synthesis’: Specialisation is focusing deeply on one area of performance, with little to no communication between disciplines or sub-disciplines (Montuori, 2022). Synthesis involves combining different ideas, information, and knowledge from various disciplines to address a common problem. At times it is wrongly assumed that interdisciplinarity is just about not specialising (e.g., being more of a ‘generalist’ or a ‘t-shaped practitioner’ (Burns & Collins, 2023), or that it's just a basic collection of specialisations. A T-shaped approach to professional practice is one that possesses depth in one discipline but has broad education and understanding across various disciplines (Burns & Collins, 2023) and is required to understand the multifactorial training process (Gleason et al., 2024). However, interdisciplinarity is more about synthesising or creating something new out of multiple viewpoints (Graff, 2016). The core idea is that interdisciplinarity is concerned with moving away from or going beyond working within one’s own discipline, thereby reducing or shrinking silos (DeWeese et al., 2023).

As with multidisciplinary, definitions of interdisciplinarity vary in the level of integration they imply (Burns & Collins, 2023). While there is a strong consensus on the need for multiple disciplines to work together, definitions of interdisciplinary teamwork differ primarily on the depth and nature of integration. Some definitions lean more towards combining or working together; for example, Balagué et al. (2017) define interdisciplinarity as a combination of different aspects of science, from techniques and methods to theories and concepts. Similarly, Burns and Collins (2023, p. 1879) characterise interdisciplinarity as “representing people or groups of people from different disciplines working on a common topic in parallel”, elaborating that in elite sport, this could involve a team of sub-discipline specialists working together on a performance problem or performer simultaneously or in collaboration. DeWeese et al. (2023) also define interdisciplinary teamwork as a collaborative approach where disciplines work with equal footing to address organisational needs, with organisational silos starting to shrink, emerging from more integrative working opportunities.

In contrast, other definitions emphasise a deeper integration or synthesis of disciplines, moving only beyond collaboration. For instance, Burwitz et al. (1994) recommended an interdisciplinary approach in sport science, considered as the integration of information from more than one sub-discipline from the outset, emphasising the need for stronger relationships, with experts operating in symbiosis throughout to fully integrate their expertise and knowledge. The Chartered Association of Sport and Exercise Sciences (CASES, n.d.) similarly defines interdisciplinary as two or more disciplines seeking to contribute to the body of knowledge or solve a real-

world problem in an integrated manner. CASES (n.d.) further clarifies that interdisciplinary sport and exercise scientists aim to align theoretical principles with practical application, utilising more than one core sub-discipline (e.g., biomechanics, physiology, or psychology) in a coordinated and integrated manner, in an attempt to solve real-world problems. French and Torres-Ronda (2021, p. 454) support this idea by defining interdisciplinary practice as involving “the cross-collaboration of individual disciplines, the integration of knowledge and methods, and the synthesis of unified approaches”. Supporting this view, Salcinovic et al. (2022) differentiate an interdisciplinary team by its integration of knowledge and collaborative behaviours. Freedson (2009) highlights an interdisciplinary approach as integrative among different disciplines, where the interaction of sub-discipline specialists works jointly together is vital for generating new knowledge and innovative ideas for practical applications. Furthermore, Rimer et al. (2024) propose that interdisciplinarity provides more athlete-centred, holistic health and performance support. Ultimately, clearly defining and distinguishing interdisciplinary from other forms of teamwork, like multidisciplinary, is critical because the degree of collaboration and integration may influence the quality, coherence, and effectiveness of performance support provided to athletes and/or teams. Without this clarity, efforts aimed at sport science specialists, athletes, and specialist coaches working jointly together may lead to confusion around the intended level of collaboration, coordination, and integration, potentially contributing to suboptimal performance support and athlete outcomes.

Based on the literature, we propose that interdisciplinary practice can be defined as an approach in which individuals with different expertise work jointly to address a common problem, each contributing from their own disciplinary perspective, taking opportunities to engage in coordinated and reciprocal collaboration.

Transdisciplinarity

Transdisciplinary refers to an analytical approach that goes across, between, and beyond disciplines (McGregor, 2004). The term *trans* derives from the Latin preposition *trans*, meaning “across”, “beyond”, “over”, and “on the other side of” (Harper, 2026). Compared with mono-, multi-, and interdisciplinarity, transdisciplinarity is less commonly defined and operationalised within sport performance support. Transdisciplinarity is understood as an approach to understanding and solving problems that transcend disciplinary boundaries to create a more holistic analysis and interpretation of issues which may generate innovative solutions (McGregor, 2023; Montuori, 2013). It involves integrating knowledge, analytical methods, and perspectives from different professions, including scientists, non-scientists, educators and stakeholders (Morales, 2017), creating a community for shared

insights and knowledge to address the highly complex challenges and inter-connected problems that emerge in high-performance sports environments (Vogel et al., 2014).

Transdisciplinary teamwork goes beyond interdisciplinary collaboration by requiring team members not only to work closely together (Morales, 2017), but also to co-create a shared understanding and a common framework of principles that integrates and transcends their distinct disciplinary perspectives (Choi & Pak, 2006). Within such teams, goals as well as skills are shared (Young, 1998). Team members do not simply contribute discipline-specific expertise in isolation. Instead, skills are shared, blended, and co-developed as members learn from one another, adopt methods beyond their own fields, and often work outside traditional structures (Young, 1998). This collaborative process is grounded in mutual learning, trust, and confidence, enabling members to transcend disciplinary boundaries and form a shared understanding of the problem (Young, 1998). A transdisciplinary team is not simply a collection of disciplinary experts; it is a group of individuals committed to collectively solving a complex problem by integrating diverse forms of knowledge, including experiential and community-based insights (Morales, 2017). The focus is on a performance or training issue or idea itself, not on preserving disciplinary identities, allowing inquiry to guide the integration of relevant knowledge and frameworks (Montuori et al., 2022; Woods et al., 2021). This (re)-positioning of inquiry around complex performance and development problems, challenges coaches and other performance support staff to move beyond intra-paradigmatic ways of working, where disciplinary assumptions, methods, and ways of knowing are treated as the default way of understanding and addressing a performance problem (Woods et al., 2021). In contrast, transdisciplinarity can be understood as meta-paradigmatic (Montuori, 2013; 2022), as it encourages practitioners to recognise, move across, and weave together different disciplinary assumptions and perspectives when corresponding with complex performance problems (Woods et al., 2021; Woods et al., 2024). Put simply, transdisciplinarity does not only ask practitioners to share knowledge, it asks them to recognise how their disciplinary assumptions shape what they notice, value, and act upon. In this sense, a transdisciplinary team can be understood as a complex system, composed of many individual components which can interact together, leading to rich system outputs and behaviours (Nicolis & Prigogine, 1989).

Indeed, founded on the emergence of behaviour in complex systems, the outputs of transdisciplinarity reflect the fact that the sum of team involvement is often richer than the contribution of each component provided separately (Davids, 2014). Metaphorically, transdisciplinarity is like baking a cake (Choi & Pak, 2006). It starts with a diverse set of ingredients that, through the integrative act of blending and baking, transforms individual ingredients into a completely new whole (e.g., a cake), where the individual components (ingredients) are no

longer visible and distinct. Once baked, the cake contains all the original ingredients, but it is now impossible to identify them, as the cake has become completely different from the original ingredients. The integrative act of baking symbolises the essence of transdisciplinarity, where disciplinary contributions are synthesised into something novel and unified. This metaphor illustrates that transdisciplinarity does not mean becoming a “jack of all trades, master of none” (Montuori, 2013, p. 214), but rather involves individuals deeply engaged with the complexity of the problem itself, whose solution demands collaboration, interaction, synthesis, and integration.

Unlike mono- and multidisciplinary approaches that may emphasise disciplinary silos, transdisciplinary thinking values synthesis over separation and reduction. Rather than beginning with fragmented disciplines and attempting to connect them later, transdisciplinary inquiry begins with relational, systemic, and contextual understanding (Hydes et al., 2026; Montuori, 2022; Vaughan et al., 2019; Woods et al., 2021). Reductionist thinking ignores context; it focuses on simplicity, which means eliminating complexity (Montuori, 2013). Specialised knowledge is frequently generated without adequate attention to contextualisation, interpretation, or integration (Morin, 2014). Transdisciplinarity calls for reweaving what has been “unravelling”, restoring complexity to inquiry and allowing for meaningful, context-rich knowledge production (Montuori, 2013, p. 217).

Transdisciplinary support in sport science and coaching embraces a complex systems orientation, prioritising a holistic, relational approach to viewing and addressing performance problems (Hydes et al., 2025; Woods et al., 2021). Fundamental to transdisciplinarity is a view of the world as a complex, interconnected, and interdependent system, where knowledge and understanding emerge from the integration of diverse perspectives and approaches (Montuori, 2022). This perspective demands a shift from simplification to embracing complexity as the foundation for inquiry (Woods et al., 2021; Vaughan et al., 2019; O’Sullivan et al., 2023). It calls for understanding the world as a whole and highly interconnected, viewing any problem or challenge in context and in terms of its relationships, rather than reducing it to its simplest components (Montuori, 2013; Montuori, 2022; Heath-Carpentier, 2022), or limiting it to an exploration of its parts (Jacobs & Nienaber, 2011). The paradigm of complexity thrives on synthesis, connection, and contextual insight. In sport, this means that performance problems are not treated as belonging to one discipline alone. For instance, Pocock et al. (2018) illustrated this principle in research on place kicking performance in elite Rugby Union by revealing that success is not merely a function of technical skill, but is significantly influenced by the complex interplay of spatial task constraints (e.g., distance and angle to goal posts), and contextual factors, such as time in match, score margin, and the outcome of the kicker’s previous attempt. Such findings highlight how individual constraints (e.g., thoughts, emotions, and fatigue) interact with perceptions and actions to shape emergent performance behaviours, requiring

a transdisciplinary lens that moves beyond isolated technical analysis to consider the full ecology of performance (for a detailed understanding of the concept of constraints, see Button et al., 2021; Davids et al., 2008; Renshaw et al., 2019).

Transdisciplinary collaboration is inclusive, involving scientists, non-scientists, and stakeholders in the co-development, co-design, and co-direction of problem solving. Rather than simply sharing knowledge, these collaborators work together to create a shared understanding and unified framework for inquiry. This framework synthesises discipline-specific theories, concepts, and methods while transcending the limitations of individual disciplines. Importantly, transdisciplinary approaches recognise that while disciplinary knowledge is necessary, it is not sufficient for addressing the complex challenges of the modern world (Morales, 2017; McGregor, 2023). Instead, transdisciplinarity represents a different way of organising and applying knowledge for performance support that is holistic, inclusive, and rooted in the complexity of real-world performance problems.

Moving towards transdisciplinary practice involves more than simply adopting transdisciplinary terminology or re-labelling existing ways of working. It may require a paradigm shift away from perspectives firmly entrenched in mono-, multi-, and interdisciplinary ways of thinking (McGregor, 2023), as well as implying changes to how practice is organised and how relationships between coaches, athletes, and performance support staff are structured (Rothwell et al., 2020). However, transdisciplinary practice should not be understood as an unproblematic solution. In applied sport settings, the challenge is not only to define transdisciplinarity, but also to consider how it can be operationalised in practice (Hydes et al., 2026). Moving across, between, and beyond disciplinary boundaries may require time, trust, facilitation, and a willingness to question, interpret and negotiate different disciplinary assumptions, values, and methods of inquiry (Augsburg, 2014; Woods et al., 2021). Individual and collective qualities are critical to this process. Transdisciplinary practice may require intellectual curiosity, willingness to learn from others, openness to teamwork, communication, active listening, and disciplined self-reflection (McGregor, 2023). It also requires individuals to recognise how their own assumptions, blind spots, and disciplinary practices shape how they frame and respond to a problem, while remaining willing to engage with ideas that may challenge existing ways of thinking (Augsburg, 2014; Morales, 2017).

Based on the literature, we propose that a transdisciplinary approach can be understood as an integrative collaboration across, between, and beyond diverse scientific and non-scientific disciplines, involving key stakeholders, who work collectively to address a complex problem. Transdisciplinary practice is a problem-focused, inquiry-led approach in which understanding begins with conceptualising the issue or performance problem itself. Particular emphasis is placed on understanding how different aspects of athlete preparation and

performance may influence, interact with, or be influenced by one another. Integrated solutions may involve psychological, social, physical, cultural, perceptual, and emotional characteristics, for example. Questions and connections emerge from a rich understanding of the problem and the environment, guiding the integration and synthesis of relevant knowledge from multiple disciplines into a shared framework that transcends disciplinary boundaries.

The definitions offered in this paper are intended as theoretically informed working definitions for sport performance support contexts and may support more consistent use of disciplinary terminology across research, policy, and applied practice. These definitions provide the basis for comparing the key characteristics of each approach and considering how they may be applied in sport performance support.

Key characteristics of the disciplinary approaches

Across mono-, multi-, inter-, and transdisciplinary approaches, a consistent issue emerges: the terms are frequently used with varying degrees of conceptual clarity, leading to blurred boundaries between different ways of organising knowledge, collaboration, and integration. In applied sport and performance contexts, this lack of clarity creates a challenge for researchers, practitioners, and organisations seeking to intentionally design, implement, and evaluate their approach to communication, collaboration, and integration. As a result, approaches that differ in purpose, processes, and level of collaboration or integration are often conflated, with similar labels being used to describe substantively different practices. To support conceptual clarity and operationalisation, Table 1 presents a comparative overview of the defining characteristics of mono-, multi-, inter-, and transdisciplinary approaches.

Importantly, these approaches represent qualitatively different modes of organising knowledge, collaboration, integration, and problem framing. The table synthesises differences across key dimensions, including disciplinary boundaries, cohesion, collaboration, knowledge sharing, skills, roles, stakeholder involvement, and problem framing. By presenting these characteristics in a structured format, Table 1 offers a clear framework to support conceptual understanding and differentiation.

Insert Table 1 here.

Case Exemplar: Moving Towards Transdisciplinary Practice Through a Department of Methodology, Game Model and Associated Principles of Play

The following case exemplar considers how a transdisciplinary approach may be operationalised through the amalgamation of a Department of Methodology (DoM) (Rothwell et al., 2020), a unifying game model (Jones et al., 2026), and associated principles of play in team invasion sports. Within this exemplar, transdisciplinarity is understood as an overarching way of working through which coaches, athletes, practitioners, and applied scientists collaborate to address and resolve shared performance issues, challenges and problems. Ecological dynamics provides a viable theoretical framework for understanding athlete preparation and performance due its relational, contextual, and emergent foundation (O’Sullivan et al., 2025). The DoM offers an organisational and methodological framework for coordinating this deeply integrated work through sustaining shared language, common theoretical principles, and a collaborative practice design. Additionally, the game model and associated principles of play provide the performance-specific reference point that may support a team of sub-discipline specialists to align coaching, analysis and feedback, physical and psychological preparation, and other performance support services.

High-performance sport environments increasingly operate as a complex adaptive system in which multiple specialists contribute to athlete preparation (Pol et al., 2020). Although diverse sport science staffing structures have become the norm, the persistence of fragmented practice highlights the need for an overarching conceptual framework capable of aligning diverse forms of expertise. A DoM is a *transdisciplinary* group of athletes, coaches, practitioners, and applied scientists who collaborate and have integrative tendencies, based on a rich mix of experiential and empirical knowledge (Otte et al., 2022). Otte et al. (2022) proposed that ecological dynamics provides a unified theoretical framework for understanding performance regulation, learning and development of athletes in sport, capturing the relational transactions required of practitioners in their professional support work. Within this framework, ecological dynamics conceptualises athlete preparation and performance as complex, relational, and context-dependent, emerging from continuous transactions between the constraints of each individual, task, and the performance environment, including wider organisational and socio-cultural influences (Rothwell et al., 2018). This systems perspective can help practitioners organise knowledge of a performance problem, rather than around isolated disciplinary contributions, and may provide a shared language to support collaboration across coaching and performance support. Key concepts in ecological dynamics include: (i) a complex adaptive systems perspective, (ii) athletes and teams considered as nonlinear dynamical systems, (iii) performer-environment mutuality and reciprocity, (iv) understanding interacting constraints on action, (v) practitioners considered as designers, and (vi), representative co-design (for a more detailed rationale, see Otte et al., 2022). These concepts may help provide shared principles for coordinating practice within a DoM. The aim

of a DoM is to support a community of professionals to work within a unified framework to: (i) coordinate activity through a shared language and common principles, (ii) effectively communicate coherent ideas, (iii) collaboratively design practice landscapes that provide affordances (opportunities for action; Gibson, 1979) and information for athletes to regulate performance, and (iv), collectively facilitate the emergence of multi-dimensional athlete behaviours (e.g., psychological, physical, emotional and social). Recently, Hydes et al. (2026) investigated the feasibility of a DoM in high-performance sport organisations by gaining consensus on a range of theoretical- and practitioner-informed recommendations for its successful implementation.

Ribeiro et al. (2019, p.3) described a game model as “tactical patterns of play, considered of fundamental importance for system (team) organization and functioning”, and associated principles of play as “a set of basic game rules (previously defined by the team coaches) that constrain the actions of the players and the teams toward intended performance outcomes for specific sub-phases of play”. When positioned as a global constraint that organises behavioural intentions across a performance system, the game model can shape both the actions of players and the coherence and integration of the transdisciplinary team. Ribeiro et al. (2019) have argued that team sport behaviours arise through the interplay of global to local and local to global self-organising system tendencies. At the global level, collective principles of play act as constraints on the emergence of functional synergies (e.g., a high press strategy in soccer influencing the collective behaviour of unit play). At the local level, individual and small unit interactions shape and sometimes reorganise team level behaviours. These reciprocal and bi-directional self-organising tendencies require a shared conceptual framework to ensure that practitioners support the emergence of adaptive behaviours rather than inadvertently over constraining them.

By way of example in the team sport of soccer, a Head Coach could start the transdisciplinary process through a problem-focused, inquiry-led approach by posing a question to the team of sub-discipline specialists. The performance problem is identified through the observation of match performance, and in this instance is based around limiting the attacking teams forward momentum. The Head Coach could ask the question “can we design a game model that prevents the team playing out from the back (defensive unit)?” This could lead to the team of sub-discipline specialists suggesting that the team implement a high pressing game model, which has immediate physical, psychological, tactical and social characteristics to operate effectively. The game model, therefore, will not only influence players’ behaviour, but can also act as a global constraint (i.e. intentionality) on the collective behaviour of the individuals within the performance support team. When embedding this game model and associated tactical principles of play into the wider performance programme, it has the potential to serve as a constraint on practitioners to integrate and synthesise relevant knowledge to solve the performance issue at hand.

For instance, the performance analyst can interpret collective self-organising behaviour to identify where the model is emerging and where it breaks down. Through the analysis process key data can support the coach in framing training around the opportunities for action and synergies that the model values. The strength and conditioning staff can design load profiles, movement demands and conditioning tasks that preserve the representative features of the performance environment, specifically aligned to the game model (i.e., high-press). Here, the transdisciplinary emphasis is not simply on coordinating disciplinary inputs, but rather on using the DoM and game model to organise shared language, common principles, collaborative working, continuous knowledge exchange, and integrative practice design, framed around a specific performance challenge or problem (Hydes et al., 2026). Support activities and services, operating in a more cohesive way, with a focus on the task goal, can facilitate system-wide alignment (e.g., Davids, 2014), and provide the structural coherence needed to analyse and interpret performance and design training tasks.

There are some compelling applied case examples in high-performance sport of practitioners aligning practice to deliver a game model. For instance, McKay and O'Connor (2018) demonstrated the importance of aligned practice to deliver a game model in rugby union. In this example, the performance analysis of possession sources indicated that 56% of possessions ($N = 29$) per game occurred from unstructured play (e.g., kick receipts, unexpected turnovers, breakdowns and 50m and 22m restarts). This empirical insight informed the team's attacking game model, which focused on exploiting perturbations in the opposition defensive structure (due to unstructured turnovers). Rather than treating this as a monodisciplinary analytic observation, the coaching staff, performance analyst, and strength and conditioner collaboratively redesigned training to reflect the reality of competitive task constraints on athletes undertaking collective performance. During practice coaches allowed attacking phases to start through unstructured possessions rather than terminating practice at the breakdown of structured patterns. Strength and conditioning staff integrated conditioning demands into these more variable and uncertain attacking phases to ensure that physical stress emerged through the same action opportunities encountered in competition, and the analyst monitored to what extent the behaviours emerging in training aligned with those actions which emerged in matches. Such an approach exemplifies how a game model can act as a unifying conceptual framework to integrate the work of all sub-discipline specialists.

To summarise, framing performance problems through the DoM framework and game model can shift the focus from coordinating separate disciplinary contributions to co-designing meaningful contexts for performance. When all practitioners align their work to the same set of global constraints, the (staffing) system

becomes more coherent, collaborative, and integrative, leading to a transactional way of working that is more likely to enhance the adaptive capacity of athletes and performance outcomes.

Limitations and Future Research

Several limitations should be acknowledged. First, the distinctions presented in this paper are intended to support conceptual clarity by highlighting how different definitions imply different expectations for communication, collaboration, and integration processes and systems in high-performance sports organisations. However, distinctions in disciplinary approach noted in this position statement need to be further investigated in implementation. There is a need for future research to understand how transdisciplinarity may be interpreted, adopted, or operationalised within different high-performance sport organisations. Second, although the exemplar illustrates how a DoM and game model may support transdisciplinary collaboration around complex performance problems, future work could seek to better understand how such practice may be specifically operationalised and evaluated within different sporting organisations. Transdisciplinary work may also create practical challenges, including the need for shared language, common principles, collaborative practice design, continuous knowledge exchange, and ongoing negotiation between disciplinary assumptions (Hydes et al., 2026). There is a need to adopt a theoretical framework which is powerful enough to sustain such complex interactions between practitioners. Here, we proposed ecological dynamics as one such framework. Future empirical research is therefore needed to examine not only whether these approaches are adopted, but how they may be experienced by coaches, athletes, and performance support staff in high-performance sport. Furthermore, a separate comparative analysis of how mono-, multi-, inter-, and transdisciplinary approaches frame the same performance problem differently could exemplify how these different perspectives would lead to different insights, reflections, and conclusions.

Conclusion

Clarity around how disciplinary approaches are defined and operationalised is essential for effective collaboration and integration between multiple disciplines in high-performance sports organisations. This paper has highlighted how mono-, multi-, inter-, and transdisciplinary approaches are defined and used with varying degrees of clarity across research, policy, and applied practice, blurring meaningful distinctions in purpose, process, collaboration, and integration. By offering greater conceptual clarity, this paper may support sport organisations in making more informed decisions about how they structure teams, design collaborative processes,

and evaluate practice. Future research should examine how these approaches are operationalised across different sporting contexts, and how a DoM can support meaningful collaboration and integration in practice.

For coaches, the distinctions outlined in this paper have practical implications for how performance support and athlete development may be understood, planned and supported. A clearer understanding of mono-, multi-, inter-, and transdisciplinary approaches may help coaches and organisations recognise whether performance support is being provided in the form of isolated advice, additive information, coordinated collaboration, or integrated problem framing. This clarification may be used to support coaches in asking more precise questions of performance support staff, creating clearer expectations for collaborative and integrative work in using sport science support more effectively, through designing more sophisticated practice environments. These ideas also have implications for coach education, where developing coaches' understanding of different disciplinary approaches may support more informed engagement with sport scientists and other performance support staff.

Importantly, this paper does not suggest one disciplinary approach is universally superior. Rather, it argues that clearer understanding of the distinctiveness between these approaches may help sport organisations better align their ways of working with the aims, demands, and constraints of their specific performance environments. Where performance problems are complex, relational, and distributed across multiple dimensions of athlete preparation and performance, transdisciplinary approaches may offer a useful way of organising collaboration around the problem itself. Future research should examine how these approaches are operationalised across different sporting contexts, and how frameworks such as a Department of Methodology can support meaningful collaboration and integration in high-performance sport environments.

Disclosure statement

The authors report there are no competing interests to declare.

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