Strategy in Sport Performance: How Training Programmes Could Shape Dynamic, Adaptive Intentional Processes in Performers

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Estrategia en el rendimiento deportivo: Cómo los programas de entrenamiento pueden moldear procesos intencionales dinámicos y adaptativos en los deportistas

Strategy in Sport Performance: How Training Programmes Could Shape Dynamic, Adaptive Intentional Processes in Performers

Estratégia no desempenho desportivo: Como os programas de treino podem moldar processos intencionais dinâmicos e adaptativos nos atletas

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RESUMEN

Recientes avances en las ciencias del deporte han indicado que los modelos tradicionales de planificación del entrenamiento no son coherentes con la complejidad de los procesos adaptativos que surgen del entrenamiento y la competición. En este artículo, se defiende que la estratégia subjacente en los programas de entrenamiento y el desarrollo del rendimiento deportivo, pueden surgir de las interacciones continuas de los individuos en una causalidad transformadora no lineal, mostrando una intencionalidad transaccional. A partir de la comprensión y aplicación de las teorías de los complejidad y perspectiva de la dinámica ecológica del comportamiento humano, se pretende contribuir al proceso estratégico que fundamenta el desarrollo del rendimiento deportivo. Se pretende destacar que el proceso estratégico que fundamenta el desarrollo del rendimiento deportivo se basa en una "intencionalidad educada" que guía las acciones de los entrenadores (por ejemplo, la resolución de problemas y la planificación). Este punto de vista requiere un proceso de concepción coevolutiva y autonomía de decisión en el proceso de desarrollo del rendimiento deportivo para que los deportistas puedan adoptar comportamientos adaptables en contextos competitivos.

Palabras clave: complejidad; dinámica ecológica; intencionalidad; estrategia en el rendimiento; desarrollo del atleta.

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ABSTRACT

Recent developments in sports science have indicated that traditional models for planning training programs typically lack coherence for developing the complexity of adaptive processes that emerge from and are invited by training and competition. Here, we argue that the strategic management of training programs for sports performance development may emerge from continuous interactions between individuals in a non-linear transformative causality, displaying transactional intentionality. Based on the understanding and application of theories in complexity sciences, and from the perspective of the ecological dynamics of human behavior, it is intended to contribute to the strategic process that underlies the development of sports performance. Here, we seek to articulate how the strategic process that underlies sports performance development is based on an "educated intentionality" that guides the coaches' actions (e.g., problem-solving, decision-making, planning, and organization). This approach requires a co-evolving design process and decision-making in sports performance development so that athletes can implement adaptive behaviors in competitive contexts.

Keywords: complexity; ecological dynamics; intentionality; performance strategy; athlete development.

RESUMO

Os desenvolvimentos recentes nas ciências do desporto indicam que os modelos tradicionais de planeamento do treino são inconsistentes com a complexidade dos processos adaptativos que emergem do treino e da competição. Defende-se neste artigo que a estratégia subjacente aos processos de treino e ao desenvolvimento do desempenho desportivo pode emergir de interações contínuas dos indivíduos numa causalidade transformativa não linear, exibindo intencionalidade transacional. Com base na compreensão e aplicação das teorias da complexidade e sob a perspetiva da dinâmica ecológica do comportamento humano, pretende-se contribuir para o processo estratégico que consubstancia o desenvolvimento da performance desportiva. Pretende-se evidenciar que tal processo estratégico se baseia numa "intencionalidade educada" que canaliza as ações dos treinadores (por exemplo, resolução de problemas, tomada de decisões, planeamento e organização). Este ponto de vista requer um processo de conceção co-adaptativa e de autonomia de decisão no processo de desenvolvimento da performance desportiva dos atletas.

Palavras chave: complexidade; dinâmica ecológica; intencionalidade; estratégia no rendimento; desenvolvimento do atleta.

INTRODUCTION

"When the training session starts, the training plan becomes a cadaver" (Hermínio Barreto, influential Portuguese basketball Coach and Professor, born in 1935. Translated from Portuguese)[1].

Sport practitioners[2] are charged with the finely-balanced challenge of preparing athletes of the present, as well developing athletes of the future (Woods et al., 2020). Planning and preparation for sport performance requires the organisation and elucidation of each athlete's individualised practice programme to provide a high-level of performance readiness for a specifically targeted competition in the future. Traditional perspectives on performance strategy and planning are based on different rationales and models, typically sub-dividing a training programme into a series of temporally sequential components, especially targeted at specific periods of preparation (Kiely,

[1] Verbally communicated in a lecture, at a ceremony, given by this Emeritus Professor at the Faculty of Human Kinetics, University of Lisbon-Portugal.

[2] In this article we use the term "sport practitioners" to represent coaches, trainers, sport scientists and related technical staff, managers, administrators and educators charged with preparing athletes for competition and developing their skills.

2018). This perspective on training equates strategy with detailed planning and micro-management, specified to provide sport practitioners with a high level of control over athlete development and preparation for competition.

With regards to the preparation for an imminent challenge or a competition, the unique unfolding of events and the significant impact of unexpected issues have demonstrated that the future is not a linear continuity of the past (Taleb, 2007), as assumed by the "formulation and implementation" view of strategy and training planning, which we define as traditional. Sophisticated social processes, such as sport practice ecologies, are rarely stable due to system complexity and interconnectedness and the emergent nature of events, challenges and conditions (Woods et al., 2020). Such events are common in high performance sport, exemplified when a team (or athlete) is surprised with a new tactic by an opposing team (or individual competitor) or when a key performer suffers a serious injury. Sport ecologies have solicited the implementation of performance planning models based on principles of nonlinear dynamics. A systems-oriented perspective has been advocated due to contextual interdependence and a sensitive dependence on local variations, key characteristics in emergent behaviours (Balagué et al., 2013).

Elite performance environments in sport are highly integrated and constantly changing, a point acknowledged by both elite practitioners and applied scientists. For example, Pep Guardiola, one of the most successful professional football club managers on the planet, proposed that: "Football is the most difficult game in the world because it is open, and every situation is completely different, and you have to make decisions minute-by-minute[3]". This inherent dynamism demands adaptation to contexts and is not limited to team sports. In individual sports like long jumping, highly-trained behaviours are influenced by unpredictability of momentary and local environmental and task constraints[4] such as wind direction, performance on previous jumps, adversaries' performance and the crowd involvement (McCosker et al., 2019). For this reason, the inherent linearity of traditional sports training planning and periodization models has been criticised. The dissonance between the demands of unpredictable competitive performance environments and the planned stability of training and performance preparation contexts have raised concerns about the robustness of forecasts on the evolution of the performance (Stacey, 2007; Whittington, 2001). The complex responsive process theory has demonstrated that strategic processes require the paradoxical integration of stability[5] and instability[6] in uncertainty contexts (Stacey, 2006; 2007). In understanding coordination in sports, conceptualised as nonlinear dynamical systems, these contexts of uncertainty have been termed 'meta-stable' regions of performance (Kelso, 1995).

A universal "optimal" periodization process could only be possible if humans respond to training loads in similar ways, adopting predictable trajectories, in generalized timeframes, and conforming to predictable "dose-response" relationships (Kiely, 2018). The key point is that traditional planning methods presume an inherent predictability, stability and controllability of athlete behaviours in response to training stimuli. However, a wealth of contemporary evidence demonstrates that this traditional position is no longer logically defensible (e.g., Afonso et al., 2017; Aicinena, 2013; Kiely, 2018). Rather, as espoused in ecological dynamics research (e.g., Araújo et al., 2006; 2020; Button et al., 2020), athletes tend to display an individualised adaptive response to training designs. The relationship between an athlete and a training programme emerges from a complex interaction between each individual's intrinsic dynamics (inherent tendencies, dispositions and characteristics that they bring to performance and practice) and their experiences throughout development, learning, and training. This relatively unique relationship is deeply influenced by specific individual, task and environmental constraints which challenge performance prediction (Davids et al., 2012). From this perspective, several limitations of traditional strategic planning, analysis and prediction become evident.

[3]Pep Guardiola, https://www.theguardian.com/football/2016/oct/07/pep-guardiola-exclusive-interview-johan-cruyff-unique.

[4] Constraints are information-regulated links among components. Whereas degrees of freedom refer to system micro-components, indicating how components can move, constraints indicate the information (related to each individual, task and environment) that shapes or channels such actions.

[5] Is a structural quality of behaviour and results can be predictable in the short term (Stacey et al., 2000).

[6] Specific behaviour can deviate, inherently creating unpredictability in the long term (Stacey et al., 2000).

The aim of the position statement is to offer theoretical guidance related to the strategic process that underlies the development of sports performance. The approach used throughout the paper is based on a structured debate that guides readers through some limitations of traditional planning, on to alternatives based on complexity science theories of human behaviour, specifically considering complex responsive processes and the ecological dynamics perspective. Organizing a unique complexity view, from the contributions of these two theoretical approaches, we seek to provide theoretical guidance accommodating the inherent characteristics of sports performance and advancing principles and insights on the design of training programme strategies.

LIMITATIONS OF TRADITIONAL PLANNING: A STATIC, CONTROLLABLE, AND PREDICTABLE WORLDVIEW

Prescriptive planning

Strategy, seen as a key component for achieving "optimal" performance, was initially understood from a prescriptive, programmatic perspective (see Mintzberg, 1990, for a review), in which actions are planned in minute detail and directed towards establishing a highly stable, controllable, and unambiguous environment. As such, strategic planning has traditionally been characterized by the formulation of a static and predetermined, programmatic process before a performance event (e.g., Andrews, 1971; Ansoff, 1965; Porter, 2008).

In sport, the eminent Russian sport scientist Matveyev (1981), described a method of training planning based upon the experiential and scientific knowledge of the time. His work initiated the development of what became known as the "periodization of training". The main assumption for this prescriptive approach is that a limited and decomposed number of variables controls the future trajectory of the "athlete-competition" relationship (Kiely, 2011; 2012). Traditional periodization methods are grounded on the challenge of forecasting future performance outcomes, based on decomposing the preparation process for individual athletes, compartmentalising and discretising an established sequence of actions and events, and analysing and evaluating their effects (Denison, 2010). In sport performance preparation, the prescriptive approach typically tends to promote a rigid adherence to a universal "training plan", devaluing the importance of ubiquitous updating, adaptation and adjustment, remaining relatively independent of changes to the environment, the individual athlete(s) and opponent(s). Consequently, "sticking to the plan" is the imperative rule, and deviation from the original plan was almost viewed as a crisis and a reactive sign of failure, regardless of changing events and circumstances. This traditional approach is characterised as a disintegrated and monolithic (siloed) view of the different components of sports performance (physical conditioning, technical, tactical, and psychological preparation). In planning, it tends to adhere to a set of overvalued, specific, key performance indicators (e.g., maximum O2 consumption, number of maximum repetitions, amplitude or angular velocity of a segment in a given movement; Mills & Denison, 2013), and may not reveal the global and interactive adaptive effects of training programmes.

The adaptive process to training is highly complex and dependent on an interconnected network of components, highly sensitive to the transient conditions of the performance context and the state of the individual (e.g., biological, psychological, and emotional). Athletes can respond differently to identical training stimuli, and they can respond equally to different stimuli. This signifies that it is very unlikely that there are specific intervention patterns or progressions and/or load designs that are equally valid and applicable in all training contexts. The perception of the suitability of a given training program tends to be associated with carrying out all the training sessions and exercises as planned. The need to change the design of practice tasks, exercises or even the objectives of the training sessions, based on an assessment of varying circumstances of the moment (e.g., fatigue, emotional state, adaptation to the training load), is often interpreted as a lack of consistency or inadequacy of the defined training plan.

Descriptive planning

In the 1980s-90s the methods espoused by the descriptive schools of planning overcame prescriptive approaches (Mintzberg, 1990). Descriptive methods aimed to understand the process of strategy formation, based on the assumption that performance contexts are less stable and more variable and uncertain than performance preparation settings. Mintzberg advanced the concept of "crafting strategy", intended to capture the notion of strategising as an emergent process, demarcating it from the traditional bipartite prescriptive process of formulation and implementation (Mintzberg, 1987). From this perspective, strategy should be conceived as a pattern of actions embedded in a learning process and planning needed to include learning by experimentation (Mintzberg, 1987; Mintzberg & McHugh, 1985). A key point is that strategising should not be considered as a rigid adherence to a universal "training plan", as advocated in the prescriptive approach. However, the emphasis that an emergent strategy results from the individual efforts of a leader or a small executive team, still tends to maintain a top-down, hierarchical, prescriptive notion that a key role of a leader is to design and manage the organisational performance plan (Mintzberg et al., 1998).

The descriptive school argued that strategic planning is an inherently nonlinear process, not reducible to simple cause (plan) and effect (execution) principles (Senge, 1990). In a practical terms, in the descriptive approach, planning requires continuous monitoring and adjustments for ongoing system regulation, based on emerging information from continuing interactions with the ever-changing environment, giving special prominence to the procedural and emergent character of strategy formation (Senge, 1990).

This theoretical change in conceptualising strategic leadership and planning is aligned with key ideas on sports training periodization. In fact, various researchers and practitioners have introduced novel designs for characterising training periodization, such as nonlinear (Brown & Greenwood, 2005) and block (Issurin, 2016) periodized training. But there remains a nuanced assumption that performance needs to be planned, requiring flexible adaptability in practice designs (Kiely, 2012). Importantly, these performance preparation models have emphasized a key message: that there is no "one-size-fits all" approach.

However, this approach is rather operational and there is a lack of theoretical conceptualisation underpinning how to utilise flexible adaptability in performance preparation. For example, there is an underlying operational assumption that variability in planning sports training arises from system errors, which cannot be avoided (Matveyev, 1981), providing a restrictive view of system variability. Kiely (2012) concluded that periodization was not the best way to induce much-needed performance variation. He argued that variability is a key issue for training and performance planning (for convergent criticism on this see also Farrow and Robertson (2017) and Otte et al. (2019)). However, it needs to be noted that random variability has often been confounded with functional (beneficial to performance) variability (Newell et al., 2006). This conceptual confusion is a problem, because it downplays the significance of this important feature of the environment and performance, and it tends to treat all variability operationally as a performance measure, such as standard deviation or standard error of the mean, in distributional statistics (Newell & Corcos, 1993). As the authors pointed out, the focus in ecological dynamics is on functional variability, especially its *structure* (the way it is organised and integrated with performance processes), whereas traditional emphasis on variability is on its *magnitude* (hence its definition entwined with statistical measures of performance).

Descriptive planning is characterized by defining medium-term guidelines, where the details of the loading dynamics are defined, based on evaluations of the adaptive effects promoted by training on the athlete/team. The athlete plays a fundamental role in the decision-making process in terms of orientation and the design of training sessions. The continuous evaluation of a set of performance indicators that make it possible to assess the state of readiness, the ability to return to training stimuli and how athletes are recovering (e.g., perceived readiness rating, heart-rate variability, intensity rating, technical execution, recovery stress, strain, pain ratio scale) (Kiely, 2011), will make it possible to adjust training objectives and, consequently, the dynamics of loads according to the needs that emerge. Planning must, therefore, co-evolve with the training process to respond to the athletes' actual needs.

In sum, traditionally, two stages can be identified in strategic planning: formulation and implementation, based on cause-effect and sequential relations and linear processes. However, it has been pointed out that formulation and implementation of a strategy should happen simultaneously in an organisation, as well as in sports training, through the involvement of individuals at several hierarchical and heterarchical[7] levels (Garcia, 2001; Groot, 2007; Whittington, 2001).

STRATEGIES FOR UNCERTAIN CONTEXTS: TRANSFORMATIVE CAUSALITY AND EMERGING GOALS

Understanding the regularity of performer-performance environment interactions may be linked to Stacey's (Boulton et al., 2015; Stacey, 2007) complex responsive processes (CRP) perspective. This theory defines strategy as evolving from patterns of individual and collective identities that emerge from communication and local interactions (Stacey & Mowles, 2016). Local (proximal) interactions, characterised by self-organization[8] under constraints, promote the emergence[9] of order from the various interacting surrounding elements. Emergence is central to the process of strategy (Stacey, 2007), insofar as the overall pattern ongoingly emerges from continuous interactions, including plans (Table 1).

Table 1
Comparative analysis of the complex responsive processes and traditional approaches to strategy.

Complex Responsive Processes	Traditional Approaches
Strategic patterns emerge from local interactions	Strategy is part of a global plan implemented top-down
Emergence is central to the interaction process. It is not the result of chance, but embedded in agents' ongoing and developing interactions with the environment	Emergence is not central to the process, arising and shaped by chance, emphasising random variations
Practices are local activities, embracing constrained variations shaped by changes, communication, power and choice	Practices are routines captured in a system of management
Open ended, there is not a defined system as a whole, recognising that there are many influences from the environment and within	Systems tend to be closed and controlled internally as a whole
Feedback is considered as information that regulates system trajectories, resulting in the internal and spontaneous capacity for evolution	Feedback is a retroactive mechanism for correcting and responding to system deviations from planned behaviour
The leader acts as a constraint to induce generative and adaptive properties in performance process and development, privileging interaction and adaptability	The leader formulates the strategy based on their vision and the top-down change efforts, giving priority to maintaining management, alignment with pre-determined objectives and control

Note. Adapted from Stacey (2007, p. 265) and Uhl-Bien et al. (2007, p. 314).

[7] The term heterarchy replaces the concept of hierarchy, as the relationships that A establishes with B may be of hierarchical superiority in one specific aspect, but of subsidiarity relation in another (Garcia, 2001). Thus, it is possible to state that complex systems present a stratified autonomy, that is, a hierarchy that is not guided by principles of vertical control, but by more or less intense coupling between micro and macro levels.
[8] A process presents self-organization when a pattern at the global level results from the interaction of local system components.
[9] Emergence occurs when a complex entity exhibits properties that its parts do not display on their own.

Strategy in Sport Performance

According to the CRP theory (Stacey, 2006, 2007), strategic processes require the paradoxical integration of order and disorder and stability and instability in order to navigate conditions of uncertainty and ambiguity. From this perspective, the process of human interaction is paradoxical in that it is necessarily continuous and potentially transformative, and at the same time repetitive and potentially mutable. Processes of interaction feature "transformative causality"[10], referring to a notion of causality that diverges from the universal cause-effect type. Rather, strategy, learning, adaptation or performance co-evolves from the interaction of multiple constraints, and from which trivial and innovative solutions can emerge and develop (Stacey et al., 2000).

In this view, learning and development emerge as social activities amongst interdependent people, predicated on the transformational capacity of learners (Stacey et al., 2000), which could be transferred for sport performance development and to athletes. To facilitate transformative causality: i) a rich pattern of human transactions tends to spontaneously produce change to a cohesive social pattern, without the need for an overarching plan (Stacey & Griffin, 2006); ii) diversity and inter-individual variability is a relevant constraint. When performers differ from each other, nonlinear interactions can amplify their distinct contributions, resulting in the emergence of rich and innovative patterns of behaviour (Stacey et al., 2000); and iii), discussion of evolving designs of learning/training activities (emergent goals) is extended to performers. The research developed by Pereira et al. (2015, p.102) also reinforced the role of the different stakeholders in the strategic direction, showing as a "strategic management of an event portfolio was co-evolving in the interaction of multiple intentions and dynamics that led to innovative strategic goals; the nautical events were also constituted as a platform for connectivity and diversity, offering a space and time for local communicative interaction, facilitating the evolution dynamics, on the ground of transformative causality.

The CRP is a paradigm that frames complex processes in human beings. In this vein, it provides an important basis for guiding future applications in understanding sports performance contexts. The CRP provides insights on the process dimension, highlighting that it is a co-evolving process, in which, patterns emerge from local interactions, and that practitioners should focus on what is actually occurring in practice and performance, not so much on prescribing what should happen.

DEVELOPMENT OF SPORTS PERFORMANCE AS A DYNAMIC ADAPTIVE INTENTIONAL PROCESS

In an ecological dynamics rationale, the contingencies of each performance context provide unique contextual constraints that dynamically and continuously shape the emergence of competitive performance behaviours (Araújo et al., 2006; 2020; Button et al., 2020). Behavioural patterns in biological systems (including humans), generally, have an inherent nonlinearity and are extremely sensitive to the constraints of the surrounding environment (Stacey, 2007), which requires embedding variability in the functionally adaptive processes of training programmes. The system property of emergence highlights the unpredictability of evolving local interaction patterns, since it is not possible to plan, nor predict, the precise nature of long-term interactions in dynamic circumstances. For instance, no one can accurately predict the precise role and contribution of each individual in an opposing team in any given context and situation. The transactions among individuals emerge during performance and form a co-evolving process. They evolve according to self-organized interactions, only constrained in a limited way by an over-arching plan or pre-determined instructions. However, performance in sport does not evolve randomly, because it is supported by bi-directional tendencies channelled by local interactions of participants loosely constrained by broad "global" planning to frame these activities (Ribeiro et al., 2019). Self-organization in this context is a broader process of how nature works (e.g., Boulton et al., 2015).

[10] Transformative causality indicates steps forward to an unknown, but bounded, result; through which individuals are simultaneously forming and being formed via processes of local interaction. Novel change is viable and self-organization is a process of exploration and potential transformation (Stacey, 2007).

Affordances and the importance of "strong anticipation"

Performers perceive the environment in terms of affordances, according to their unique characteristics (effectivities: e.g., dispositions, tendencies, skills and capacities; Gibson, 1979). In ecological dynamics, affordances are possibilities for behaviour offered by the environment, this means that to perceive an affordance is to perceive how one could act with respect to an environmental layout. They imply considering behaviour at the level of the performer-environment system. Perceiving the environment in terms of affordances implies each individual's active intentionality[11] and performance engagement, which transforms action-independent perceptions into action-oriented perceptions (Mace, 2018). This approach is not dependent on probabilistic predictions for inferring the future, because the future is continuously specified by available information and affordances in the present (Stepp & Turvey, 2015). This state of affairs sharply contrasts with mainstream theorising about performance that derives its power from imperfect, probabilistic, statistical models of the future, calculated by the mind of the leader or by the mind of the performer. After Dubois (2003), Stepp and Turvey (2015) labelled prediction of the future based on a mental probabilistic modelling as potentially available but providing only "weak anticipation". They contrasted this view with "prospectivity" relying on systemic lawfulness and (information) coupling, labelled as "strong anticipation"[12]. Whereas "weak anticipation" places the burden of anticipation on a performer with constructive and interpretive powers in their mind, strong anticipation emphasizes the embedding of the performer in the middle of transactions with the changing environment. Anticipation emerges as a lawful regularity of the ever-evolving performer-environment system.

In this sense, it is relevant to consider the need for training programme designs where continuous refinements, adaptations and adjustments to performance are emphasized. These dynamic performance modifications need to be informationally regulated. Since preparation and training aim to enhance performance and successful outcomes, they need to integrate situations of "functional variability"[13], not "random variability", allowing the exploration of pre-considered possible outcomes and consequences, based on athletes' perceptual attunement to affordances which is developed in practice (Araújo et al., 2019; Araújo & Davids, 2016).

The amount and type of variability of information added in practice environments can be designed by sport practitioners to channel the emergent behaviours of performers. Constrained variability helps learners to refine their search of the fields of the surrounding affordance landscape and explore a specific task to seek and discover functional performance solutions (Araújo et al., 2021). Exploration during practice could be co-designed by practitioners and athletes together, through carefully considered manipulations to specific tasks and environmental constraints (e.g., designing pressure situations, creating specified changes in training routine, organising schedules based on particular needs). When implementing variability in practice, practitioners and athletes could co-implement processes of guided discovery in learning and exploration, and divergent (creative) learning. An important challenge is for a learner to find themselves poised in a metastable region between stability[14] and instability[15], certainty and uncertainty, to facilitate possible transitions between performance behaviours that could accommodate the specificities of each dynamic performance environment (Araújo et al., 2019, 2021). As advocated by Marín-González et al. (2024), tailored interventions designed for improving socio-emotional performance are crucial for sustainability in elite athletes.

Affordances provide invitations to scope how the future emerges in performance. They guide how future-oriented actions can accommodate emerging situational constraints to achieve task goals. Intentionally acting on affordances open to transformative causality guides the processes associated with performance strategy.

[11] Intentionality is the manifestation of directionality towards other objects.
[12] "Anticipation is weak if it arises from a model of the system via internal simulations. Anticipation is strong if it arises from the system itself via lawful regularities embedded in the system's ordinary mode of functioning" (see Stepp & Turvey, 2010, pp. 148).
[13] Functional variability is the explicit consideration of the functional role of variability, contrasting with tendency of simply considering it noise.
[14] A system is stable if its behaviour remains bounded in a given environment or returns to equilibrium after a disturbance.
[15] A system is unstable if it changes without bound or deviates from equilibrium indefinitely after a disturbance.

Education of leader intentionality

Although practitioners may lead the strategic perspective of a team, they are only one of a number of influential participants in the performance preparation process. Although planning design is broadly possible, the predetermination and orchestration of the specific responses of athletes in any situation is impracticable. Plans can be useful for providing an overarching framework for highlighting possible features of certain performance environments (e.g., facilities). But it should not constitute a prescriptive list of actions for each athlete: there is so much uncertainty in performance environments which cannot be fully predicted that it is impossible to ascertain and control the whole range of intervening variables to which performers need to adapt. The implication is that a leader may emphasise the quality of communication among participants (Stacey, 2007, 2011) and seed generative (i.e., adaptative) properties instilling day-to-day performance (Uhl-Bien et al., 2007). Leadership can influence future patterns of action and communication (i.e., strong anticipation) through implementing strategies on the formation of local relationships (synergies between key individuals), intentionally guided by transformative causality. Leaders can guide the emergence of self-organized solutions, by highlighting available affordances and establishing functional connections, remaining open to contributions of other participants, in a climate cultivating self-regulation in performers and the autonomy for decision-making (Pol et al., 2020). Leaders can design tasks which solicit actions from the athletes. By using a 'design' approach to practice, rather than instructing and prescribing solutions, they are making available some affordances in chosen tasks, rather than others. The athletes then will pick up, or not, the affordances in the task design, according to how they are perceiving information when exploring the performance context. This process of transactional intentionality implies that leaders have an important role in task design, but they are not the only participants in such a design process. Although Freire et al. (2022) revealed the association between the task orientation and perfectionist efforts by athletes, highlighting the importance of task orientation to improve performance, the line of approach based on the complexity and ecological dynamics highlighted in this paper advocates the role/interaction of all the actors in the design process of the task orientation.

In such an organisational culture, goals and activities should be continuously (co)designed and adjusted (by athletes and practitioners). This collaborative activity may help to gradually develop procedures, which may provide diversified stimulation sources and enhance motivation, system intelligence and intensive interactions between performers to create meaningful activities as the study by Vives-Ribó and Costa-Sánchez (2022) demonstrated. Therefore, an ecological orientation to performance strategy in sport proposes the development of clear intentionality at the level of the coach-performance environment system, founded on the "education of intention" (Araújo et al., 2019).

In specific performance contexts, certain opportunities for perceiving and acting are more functional than others. With experience, individuals learn how to select relevant affordances (enhancing strong anticipation). Different intentions during learning can frame the way that perception and action are coupled by individual learners. For example, evidence has shown that educating the intentions (and attention) of learners helps them to perceive information when performing interceptive actions which specified their properties for learners (Jacobs et al., 2001). These findings revealed how learning and development are dependent on identifying key sources of information, detected during interactions with a task. According to key ideas of CRP, performance is a continuous process, with advances and deviations, where data from the process is a crucial part to guide it (Stacey, 2007). Data suggest how leaders can be challenged to help individual learners to perceive specifying (most relevant) information for affordances by "educating their intentions": that is by guiding them to intentionally seek opportunities for enhancing learning by enriching their "knowledge of" performance environments, which emerges during direct engagement with it (Gibson, 1979). In coach education, the same process is important (Wood et al., 2022). Coaches can be facilitated to co-design their own learning trajectories in professional development by enhancing their "knowledge of"[16] the coaching environment. To educate the intentions of coaches and leaders, professional

[16] In 1966 (p. 91) Gibson wrote: "In this book, a distinction will be made between perceptual cognition, or knowledge of the environment, and symbolic cognition, or knowledge about the environment. The former is a direct response to things based on stimulus information; the latter is an indirect response to things based on stimulus sources produced by another human individual".

developers need to consider how and when intentions arise, as well as how they manifest themselves in the professional activities of the coach/leader. In learning, the education of intention is an information-guided process which is affordance-regulated. Intentionality plays its role by setting up a perceptual system of any individual in learning and development to become better attuned to information appropriate for a to-be-perceived property or for a to-be-undertaken action (Araújo et al., 2019).

For coaches, what this means is that assuming a particular intention is a crucial aspect of co-evolving design practice, required to ascertain which informational variables are relevant at any moment to each performer or team (Araújo et al., 2021; Gutiérrez-Capote et al., 2024). When the intention of a performer corresponds to a specific task goal, the exploratory actions for the performer may be stimulated to help them autonomously find a solution, however rudimentary.

It is not surprising that initial intentions (e.g., when one is becoming a coach) may be more constraining, expressing similar actions to achieve the same goal. At an initial stage of intention education, the coach or the performer actively searches for information "that works" in the form of ready-made heuristics, but this does not mean that better (specifying sources which are more functional) information is not already available in the performance environment (Jacobs et al., 2001). Coaches or performers can be encouraged to continue and increase their exploratory actions to find specifying information, overcoming challenges and difficulties in selecting which properties of the environment constitute information to achieve intended task goals. Exploration of what is available in a performance situation can reveal what environmental properties are (more) informative in relation to a specific intention, and thus may be used for transformative causality grounded on strong anticipation.

CONCLUSIONS

This paper outlined key concepts that could provide the basis of the theoretical framework for a strategic approach for sports training aligned with principles of complexity science theories of human behaviour, particularly the complex responsive processes and the ecological dynamics approaches. This theoretical guidance aimed to provide a unique, integrated and complex process-oriented view. It proposed that the design of the training process results from continuous interactions based on the development of a transactional intentionality and functional perception-action[17] couplings, established over time. The continuous interactions of an athlete/team with a performance context can support the adjustment of the training process (based on educated intentionality), in which an overall strategic performance pattern emerges, continuously updating goals and activities. Intentionality is a 'work-in-progress' which frames and emerges from local interactions of performers with a performance environment, based on coordinated perception and action. These interactions could create new and innovative patterns and emerging performance goals in a transformative causality process. To facilitate the transformative causality process in sport performance development, it is important to guarantee a rich pattern of interactions, diversity and inter-individual variability in practice, extending the discussion and the evolving design of learning and practice activities to include performers. Thus, sports training does not need to be based on biological 'dose-response' predictions (a prescriptive approach) or mechanical repetition or rehearsal of tasks and behaviours (a descriptive approach). Rather, the training process should be evolving an exploration of tasks, resulting in the emergence of goals and behaviours, which constrain future intentions and perception-action couplings.

A "practice plan" should be based on an overarching framework related to an open-ended, not pre-established defined system. This is because there are many influences on the dynamic interactions among performers and between performers and environment. From this perspective, strategising in sport performance is an emergent and constantly co-evolving process. Although a long-term vision is relevant, it cannot be based on pre-defined behaviour planning for extended periods of time. According to this theoretical rationale each training session must

[17] Following Gibson (1979), perceptual systems are never passively stimulated, but are rather actively engaged in the detection of information about the environment. The ecological approach argues that perception and action are therefore reciprocal and should be understood and studied as a single unified system (perception-action systems) — to study perception is to study action (and vice versa).

constitute a test-action of strategising and planning, which implements a dynamic approach to planning, embedded in a transformative causality.

In this perspective, performance strategy should be conceived as the bases that underlie the intentionality that guides training, so that, during the process, the necessary conditions are evolving to achieve competitive success.

PRATICAL IMPLICATIONS

Considering complex responsive processes and the ecological dynamics perspective, sports performance may be seen as an emergent process from the continuous interactions of individuals in a non-linear transformative causality.

This paper presents a unique view of complexity, based on the two theoretical approaches mentioned above, and seeks to provide theoretical guidance that takes into account the inherent characteristics of sports performance and advances principles and knowledge on the design of training programme strategies.

The approach used throughout the paper is based on a structured debate that guides readers through some limitations of traditional planning, on to alternatives based on complexity science theories of human behaviour, specifically. from the contributions of es.

The coaches' actions should be based on educated intentionality and a co-evolving-design process is required in order to leverage adaptive performance behaviours in competitive contexts.

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