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Review Article

Sport expertise development and the constraints-led approach: a review exemplified by the case of brazilian soccer

Luiz Uehara¹
 Chris Button¹
 Keith Davids²

ABSTRACT

Objective: This review article delineates some important theoretical concepts that inform sport expertise acquisition studies. In particular, the principles of ecological psychology and dynamical systems theory have united together to form the ecological dynamics, a framework that provides the perfect platform through which to study the role of socio-cultural constraints upon sport expertise. **Methodology:** The body of information collected for this article was primarily extracted from peer-reviewed articles and academic books. This review article used Brazilian soccer as the case study. **Results and discussion:** Whilst the sports expertise literature has been guilty of somewhat polarising the influence of either practice or inherited attributes upon motor learning there are nonetheless many useful lessons to be learnt from this review article. For example, sport expertise development takes place over many years and includes numerous formal and informal pathways that athletes can take to excel. **Conclusion:** The constraints-led approach has been promoted as a framework for understanding how people acquire perceptual-motor skills for sport and physical activities. On a practical level, this approach suggests that the major role of the coach or teacher is to manipulate key constraints in order to facilitate discovery of functional movement behavior.

Keywords: Sport Expertise. Constraints-Led Approach. Perception-Motor Skills. Socio-Cultural.

¹ University of Otago, School of Physical Education, Sport and Exercise Sciences, Dunedin, New Zealand.

² Sheffield Hallam University, Centre for Sports Engineering Research, Sheffield, United Kingdom.

Correspondência:

Luiz Uehara. School of Physical Education, Sport and Exercise Sciences, University of Otago, PO Box 56, Dunedin 9054, Otago, New Zealand, Email: luiz.uehara@otago.ac.nz

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Desenvolvimento esportivo de alto rendimento e o modelo “constraints-led approach” de aprendizagem motora: uma revisão exemplificada pelo estudo de caso do futebol brasileiro

RESUMO

Objetivo: Este artigo de revisão delinea conceitos teóricos importantes para estudos de aquisição motora esportiva de alto nível. Em particular, os princípios da psicologia ecológica e da teoria dos sistemas dinâmicos se uniram para formar a dinâmica ecológica, um modelo que fornece a plataforma perfeita para estudar o papel dos fatores socioculturais nos quais tem uma função importante no desenvolvimento de aprendizagem motora esportiva. **Metodologia:** Os dados de informações coletadas para este artigo foi extraído principalmente de artigos científico revisados e livros acadêmicos. Este artigo de revisão utilizou o futebol brasileiro como estudo de caso. **Resultados e discussão:** O desenvolvimento esportivo de alto nível ocorre ao longo de muitos anos e inclui inúmeras vias formais e informais que os atletas usam para se destacarem. Por isso, a abordagem do modelo “constraints-led approach” foi promovida como uma estrutura para entender como as pessoas adquirem padrões de percepção motora para atividades esportivas e físicas, inclusive as de alto nível. **Conclusão:** Essa abordagem sugere que o papel do treinador ou professor é manipular fatores fundamentais no aluno/atleta, a fim de facilitar a descoberta do comportamento do movimento funcional.

Palavras-chave: Esporte. Alto Rendimento. Constraints-Led Approach. Percepção Motora.

Desarrollo deportivo de alto rendimiento y el modelo "constraints-led approach" de aprendizaje motora: una revisión ejemplificada por el estudio de caso del fútbol brasileño

RESUMEN

Objetivo: Este artículo de revisión delinea conceptos teóricos importantes para estudios de adquisición motora deportiva de alto nivel. En particular, los principios de la psicología ecológica y de la teoría de los sistemas dinámicos se unieron para formar la dinámica ecológica, un modelo que proporciona la plataforma perfecta para estudiar el papel de los factores socioculturales en los que tiene una función importante en el desarrollo del aprendizaje motora deportivo. **Metodología:** El cuerpo de información recopilada para este artículo se extrajo principalmente de artículos científico revisados y libros académicos. Este artículo de revisión utilizó el fútbol brasileño como el caso de estudio. **Resultados y discusión:** El desarrollo deportivo de alto nivel ocurre a lo largo de

muchos años e incluye innumerables vías formales e informales que los atletas usan para destacarse. Por eso, el enfoque del modelo "constraints-led approach" fue promovido como una estructura para entender cómo las personas adquieren patrones de percepción de las habilidades motoras para actividades deportivas y físicas, incluso las de alto nivel.

Conclusión: Este enfoque sugiere que el papel del entrenador o profesor es manipular factores fundamentales en el alumno/atleta, a fin de facilitar el descubrimiento del comportamiento del movimiento funcional.

Palabras Clave: Desporte. Alto Rendimiento. Constraints-Led Approach. Percepción Motoras Socioculturales.

INTRODUCTION: SPORT EXPERTISE

Research on sport expertise has been analysed from different paradigms and a number of different approaches and theories have been proposed to explain how coaches and athletes should train and be trained in order to achieve excellence (DAVIDS; BAKER, 2007; FARROW; BAKER; MACMAHON, 2013). For instance, Newell and Rosenbloom (1981) proposed the power law of practice as the basis for performance improvement. Subsequently, Ericsson and colleagues (ERICSSON, 1996; ERICSSON; CHARNESS, 1994; ERICSSON; KRAMPE; TESCH-RÖMER, 1993; ERICSSON; WILLIAMS, 2007) have reinforced this idea that sport expertise is attainable as a result of intense prolonged effort to improve performance. This construct has been operationalised as deliberate practice and according to Ward and colleagues (2004), this construct was built on two propositions: 1) Expert levels of performance are achieved after an extensive involvement within a domain - the 10-year rule; 2) The 'innate' talent factor may influence some of the defining characteristics of expertise but the core of expertise attainment relies on the direct engagement in relevant activities (ERICSSON; KRAMPE; TESCH-RÖMER, 1993).

Somewhat, in contrast to the theory of deliberate practice is the notion of deliberate play postulated by Côté and colleagues (CÔTÉ; BAKER; ABERNETHY, 2007; CÔTÉ; HAY, 2002). In their view, they argue that expertise is not attained by simply accumulating a putative number of hours of practice, but also by being exposed, during the development stage, to a lot of hours of games that resemble sports (CÔTÉ; BAKER; ABERNETHY, 2007). Hence, deliberate play involves activities that foster adaptive skill (e.g., backyard games/street matches) and the focus is on enjoyment rather than skill improvement. Moreover, in Côté and Fraser-Thomas's (2008) view, the process of expertise attainment is dependent on the quality and quantity of coaching, playing and practicing. However, other variables such as physical and psycho-social environment constraints have also to be considered whilst acquiring sports skills (BAKER, 2003; CÔTÉ; BAKER; ABERNETHY, 2003; PETLICHKOFF, 1993).

In drawing attention to this issue, an increasing number of studies in sport science have highlighted the importance of physical as well as socio-cultural environmental constraints on the acquisition of sport expertise (KREBS, 2009), although the knowledge in the field is still lacking. As Araújo (2007) pointed out, there is a need to consider socio-cultural constraints as integral constraints on skilled action. As an example, we could ask why do certain nations have a consistent and outstanding record of producing talented athletes in certain sports? To name but a few, Canada with ice hockey, Kenya with distance running, Jamaica with sprinting, Australia with rules football, India with cricket, New Zealand with rugby, America with basketball, and Brazil with soccer. Each has been historically associated with high achievers in the international competitive arena. Under this context, a question of interest is: What are the

factors or constraints that influence a nation to become so successful in specific sports?

In exploring this issue further, Salmela and Moraes (2003, 2004) investigated the role of coaching, families, and cultural context on the development of Brazilian soccer expertise. Their results show that many players aged 16 to 17 years old received little to almost no structured coaching, in contrast to a multitude of unstructured soccer experiences played on the streets. Araújo et al. (2010) provided a position study delineating the role of ecological constraints on expertise development. Using also Brazilian soccer as a research vehicle and alluding to qualitative research in the form of document analysis, Araújo and his colleagues argued that unconventional, even aversive, environmental constraints may play an important role in the development of sport excellence. One of their key arguments, regards the notion of playing unstructured street soccer (i.e., *pelada* in Portuguese) from a very young age. Several former elite soccer players stated how important “*pelada*” was as part of their process of acquiring soccer skills. From a skill acquisition point of view, the benefits of this type of unstructured form of playing can be based on the notion of self-organization and discovery and/or intrinsic learning (UEHARA et al., 2018). Moreover, from a psychological point of view, “*pelada*” provides opportunities for playing purely for the love of the game which involves passion, pleasure and enjoyment.

In a similar line of focus, Uehara (2015) analysed Brazilian soccer expertise in his PhD research programme. As discussed further below, several socio-cultural constraints were identified as key variables influencing the development of soccer expertise of Brazilian football players. Bear in mind this is not a matter of cultural favoritism. Indeed, as pointed out by Araújo et al. (2010) Brazil provides rich and stimulating environmental constraints useful for the analysis of expertise in football.

THE CONSTRAINTS-LED APPROACH

The science of skill acquisition begun over a hundred years ago in the quest for knowledge on how humans attain and attune body movement coordination (DAVIDS; BUTTON; BENNETT, 2008; WILLIAMS; HODGES, 2004). Indeed, such an endeavor has inarguably augmented the standard of different fields of human society such as sports (e.g. breaking Olympic games’ records), health (e.g. motor rehabilitation), and safety (e.g. robots acting against terrorism). Skill acquisition can be described as the learning process of perceptual-motor skills, viewed under the scope of motor behavior. To this end, the school of motor behavior encompasses three disciplines of study: motor control, motor development, and motor learning. Motor control refers to studies

on how our neuromuscular system functions to activate and coordinate the muscles involved in performing motor skills. Motor development focus on studying the changes in human motor behavior over the lifespan, the process that underlie these changes, and the factors that affect them. Lastly, motor learning emphasizes studies on the acquisition, re-acquisition, and enhancement of perceptual-motor skills (DAVIDS; BUTTON; BENNETT, 2008). Bear in mind, however, although there are specific foci of these three areas of research, none of them unrelated. Hence, motor skills are acquired under an intertwined process of learning, developing and controlling at the same time.

Underpinning the discipline of motor behavior are the theories, approaches and models that have been developed along the history of skill acquisition (DAVIDS; BUTTON; BENNETT, 2008). For instance, we could name two models: the traditional information processing approach, and the contemporaneous ecological perspective. The information processing approach is the most prominent theory that has contributed to the literature related to motor control in the last century. According to this approach, information has to be represented and processed by a centre command within the central nervous systems to produce a motor response (ROSE, 1997). This process has three stages: stimulus identification, response selection, response programming (SCHMIDT; LEE, 1999). Criticism of this somewhat mechanistic approach has grown over the last 30 years. One of the criticisms concerns the fact that the information processing approach under-emphasizes the role of environment as an important source of information for action (ROSE, 1997).

An alternative paradigm to the information process approach is the ecological perspective, which suggests that the term skill acquisition refers to the adaptive and functional relationship between an organism and its environment. The ecological perspective comprises two distinct but related theories, which are the dynamical systems and ecological psychology theories (DAVIDS; BUTTON; BENNETT, 2008). In recent times these theoretical paradigms have been merged to form the overarching ecological dynamics framework (ARAÚJO; DAVIDS; HRISTOVSKI, 2006; SEIFERT; BUTTON; DAVIDS, 2013). The ecological dynamics framework underpins the constraints-led approach (DAVIDS et al., 2003), which explains the process of change in movement behavior allied to the process of learning and developing (ARAÚJO et al., 2004). For further clarification, I will present next an overview of the theoretical ideas underlying the constraints-led approach. This includes the notion of ecological psychology and the tenets of dynamical systems theory.

ECOLOGICAL PSYCHOLOGY

Ecological psychology is a theoretical paradigm that has in the last few

decades transcended the boundaries of psychology reaching strongly into the field of skill acquisition. Ecological Psychology is a term that, Gibson (1979) in particular, used to stress the importance of a synergetic relationship between a performer and the environment (DICKS; DAVIDS; ARAÚJO, 2008). Biological organisms, including humans, are surrounded by a great array of energy flows, that can act as information sources (e.g. optical, acoustic, proprioceptive) to support movement behavior, including decision making, planning, and organization during goal directed activity. Gibson (1979) stated that an organism's movement generates information that, in turn supports further movement in a cyclical process. The classical statement that best captures his ideas is: "We must perceive in order to move, but we must also move in order to perceive" (GIBSON, 1979, p. 223).

In sport, these ideas imply that learners need to assimilate relevant properties that produce unique patterns of information flow in a specific environment (DAVIDS et al., 2003). In fact, flow patterns act as invariant information sources to be picked up by individual performers to constrain their actions (DAVIDS et al., 2003). Thus, learning in sport depends on the fine adjustment of the functional relationships between movement and information in specific contexts, known as information movement coupling (DAVIDS et al., 2003). For instance, passing in soccer is an important skill used to maintain possession of the ball in an attempt to create opportunities for scoring goals. So, in order to pass the ball (action) we must perceive the positioning and distance of the receiver or the positioning of the opposing players to determine the passing direction, timing, and speed. However, in order to perceive the distance and positioning of other players we must also move with the ball first before passing it.

The importance of the performer-environment relationship was further emphasized by Gibson's (1966, 1979) theory of affordances. In this theory he asserted that an animal's behavior is visually guided by perception of the opportunities for action that are offered by objects in the environment (FAJEN, 2005; FAJEN; RILEY; JONES, 2003; TURVEY, 2009). Gibson (1966, p. 285) stated that "When the constant properties of constant objects are perceived (the size, shape, color, texture, composition, motion, animation, and position relative to other objects), the observer can go on to detect their *affordances*...What they afford the observer, after all, depend on their properties".

Similarly, Fajen, Riley and Turvey (2009) asserted that the theory of affordances should be considered as a powerful theoretical concept to study perception and action in sport. To this end, an important feature of ecological psychology is the emphasis on real world studies of behavior as opposed to the artificial environment of the laboratory. With this in mind, Gibson (1979, p. 239) regarded perception as "a keeping-in-touch with the world, an experiencing of things rather than a having of experiences".

In a similar line of focus another ecological psychologist Brunswik (1955) proposed the representative design framework to study the interrelations between a performer and the environment from which behavior has emerged (ARAÚJO; DAVIDS; PASSOS, 2007; DICKS; DAVIDS; ARAÚJO, 2008). Thus, representative design was proposed as a methodological framework for the design of experimental settings that should allow participants to exploit the inherent adaptive nature of their perceptual systems as evident during everyday interactions with the environment. In recent times, movement scientists have called for increased emphasis on representative designs within research studies in order to preserve the perception-action relations that are specific to an organism and a performance environment (PINDER et al., 2011; SEIFERT; BUTTON; DAVIDS, 2013).

DYNAMICAL SYSTEMS THEORY

Dynamical systems theory, also known as chaos, complexity, or nonlinear dynamics, originated in the mathematical and physical sciences to explain systems that change over time (THELEN; SMITH, 1994). In the words of van Gelder and Port (1995, p. 9), a dynamical system is “any state-determined system with a numerical phase space and rule of evolution (including differential equations and discrete maps) specifying trajectories in this space”. As Davids, Button and Bennett (2008, p. 32) pointed out, “the numerical phase space refers to all the hypothetical states of organization into which a dynamical system can evolve. In biological movement system these states correspond to patterns of coordination”. Dynamical systems can be developed along different trajectories and can reach different organizational states, mainly because they are ‘open’ systems surrounded by energy sources that can be used as constraints to organize stable functional patterns of organization (DAVIDS et al., 2003). In dynamical systems, these stable functional patterns of organization are called attractors, which are almost synonymous with coordination patterns from the viewpoint of human movement science (DAVIDS et al., 2003).

In human movement science, human performers are viewed as complex interconnected systems composed of many interacting parts, which are capable of constantly changing their state of organization (DAVIDS; ARAÚJO; SHUTTLEWORTH, 2005). The interconnected systems correspond to the body systems (e.g. respiratory, circulatory, nervous, skeletomuscular, perceptual) and interacting parts are equivalent to human body components (e.g. muscle tissue, connective tissue, joints and limb segments) (GLAZIER; DAVIDS; BARTLETT, 2003). These components are labelled by Bernstein (1967) as motor system ‘*degrees of freedom*’.

For Bernstein (1967), understanding how coordination emerges in dynamical movement systems, with their huge number of degrees of freedom, was a major problem to be resolved (TURVEY, 1990). As Davids, Araújo and Shuttleworth (2005) highlighted, Bernstein's (1967) seminal definition of movement coordination precisely captures the degrees of freedom problem. Bernstein (1967) argued that the acquisition of movement coordination was "the process of mastering redundant degrees of freedom of the moving organ, in other words, its conversion to a controllable system" (p. 127). In short, despite the large number of degrees of freedom, dynamical movement systems show an efficient amount of order, and through the process of self-organization under constraints, movement coordination spontaneously emerges (CLARK, 1995).

SELF-ORGANIZATION

Self-organization is the process by which complex systems (e.g. human movement systems) tend to settle into attractors (stable patterns) because these systems are able to exploit energies surrounding them so as to allow functional patterns of behavior to emerge in specific contexts. As such, the biological systems seem to have evolved the ability to use the energy available in the environment to sustain a functional period of stability (DAVIDS; BUTTON; BENNETT, 2008). In fact, it has been discovered that a system's openness to energy flows can prevent disorder because these energy flows may be seen as a source of information, acting as a constraint on the system's behavior, and enabling it to maintain stability for a relatively short period of time (DAVIDS et al., 2003). It is important to note that constraints on motor development are by no means permanent, but instead are often temporary, and on different timescales they can strengthen or decay during their interactions such as, performer-performer or performer-environment interactions (GUERIN; KUNKLE, 2004). As Davids, Button and Bennett (2008, p. 42) pointed out, "The consequence for the behavior of emerging or decaying constraints is an increase or decrease in the self-organizing entropy of the system".

A particular focus of interest with regards to self-organization processes is the phase transition (the movement of micro components of a system into a different state of organization) that can emerge spontaneously in complex systems. It is when many micro components interact and begin to influence each other's behavior, that self-organization of a particular system into a different state occurs (DAVIDS et al., 2014). For motor behavior theorists, this idea of self-organization implies that "ideas, perceptions, memories, intentions, plans or, indeed, actions may be best conceived of as emergent, self-organizing macroscopic patterns or attractors formed by the interaction of the molecular constituents of the neuro-skeleto-muscular system" (DAVIDS et al, 2003, p. 57). For instance, these system components could be neurons in the brain firing together to form ideas, or groups of muscles and joints working together to form coordination patterns (Davids et al., 2003).

CONSTRAINTS

Since the 1980s, several scientists have been studying the emergence of human movement behavior under constraints (KELSO, 1995; KUGLER, 1986; KUGLER; TURVEY, 1987; NEWELL, 1986). Newell (1986) defined constraints as boundaries that both limit and enable the emergence of functional patterns of movement behavior in specific contexts. In other words, they limit some movement, but at the same time enable others, providing numerous channels through which specific movement patterns can emerge (HAYWOOD; GETCHELL, 2009). Thus, during goal-directed behavior, the neuromuscular systems are controlled by the interaction of key constraints, which channel the mechanical degrees of freedom of the movement system during learning, resulting in different movement coordination patterns that can be optimized with practice and experience (DAVIDS; BUTTON; BENNETT, 2008). The key constraints categorized by Newell (1986) are: task, environmental, and organismic constraints.

Task constraints refer to the rules of a sport, the implements or the equipment used during motor learning, and augmented information such as instructions and feedback (DAVIDS et al., 2003). In sport, coaches and teachers often manipulate task constraints in order to help learners search for functional and individualized movement pattern solutions (ARAÚJO et al., 2004). For instance, soccer juggling drills may be conducted with balls of different sizes in an attempt to facilitate skill acquisition and improve close control of the height of the ball. Another important task constraint that athletes can use to coordinate actions is the information available in specific performance contexts (for further details see section above on ecological psychology).

Environmental constraints can be physical in nature, such as ambient light, sounds, temperature, surfaces, and gravity (DAVIDS et al., 2003). A coordination movement pattern for a particular task may be adjusted according to the environmental constraints available. Consider for example, a soccer chip kick on grass as compared to a chip kick on a wooden gym floor. If the kicking task criteria is the same for both surface conditions (e.g. achieve the same distance and height of the ball), the lift of the ball might be facilitated on grass due to the softer surface. Thus, if a performer wants to achieve a similar distance of the ball landing position and height of the ball when kicking on a wooden gym floor, then he/she may have to adjust the coordination movement pattern. For instance, such adjustment could be achieved by increasing the kicking foot velocity.

However, as Haywood and Getchell (2009) pointed out, some environmental constraints can be socio-cultural rather than physical, including

gender, socioeconomic status, ethnicity, societal expectations, values, and beliefs. Although studies of the relationship between socio-cultural environment constraints and the development of motor skills are not new (see NEWELL, 1986), only a few studies, undertaken mainly in Africa, have addressed this issue (e.g., SUPER, 1976, 1981). In one such study, Super (1976), investigated infant development for three years in a Kipsigis farming community in Kokwet in Western Kenya. Teaching children to sit, stand and walk is part of the culture of this community, as Super (1976) found that over 80% of the mothers in Kokwet deliberately teach their babies those motor skills. A total of 64 healthy children, as well as their mothers, participated in the study. The data were collected once a month for their first year of life, and babies' daily life was observed at random once a week. In addition, the babies' mothers were interviewed about their ways of rearing their children and their views on motor development. Findings showed that babies in Kipsigis were able to sit, stand and walk significantly earlier than babies in America (SUPER, 1976).

It could be argued that an additional key constraint manipulated in Super's studies was the task constraint (i.e., teaching strategies), as well as the socio-cultural environment constraints. As Newell (1986, p. 51) pointed out, Super's cross-cultural studies, amongst others "...are primarily manipulating task constraints rather than environmental constraints, as the key feature of rearing and cross-cultural studies is the specific task interactions that the child experiences rather than the effect of the relative time independent constraints of the environment per se". More recently, Haywood and Getchell (2009) have dedicated an entire book chapter to socio-cultural constraints in motor development, pointing out that some of the socio-cultural constraints that influence the development of motor skills are: gender, family, peers, race, ethnicity, and socioeconomic status. Although the authors do not offer any critical analysis of the relationship between socio-cultural constraints and motor development, it is still an important contribution, especially in terms of '*opening the door*' for more related discussion, which in turn may generate further empirical research.

Organismic constraints refer to the structural and functional characteristics of the individual performer. Structural characteristics can be a performer's weight, height, and body mass composition, whereas functional characteristics can be the performer's connective strength of synapses in the brain, cognition, motivation and emotions (DAVIDS et al., 2003). Two other important characteristics of an individual performer are the skill level and the level of motor learning (DAVIDS et al., 2003).

Bernstein (1967) highlighted the formation of functional muscle-joint linkages, also known as coordinative structures, as a solution for constraining the huge amount of degrees of freedom available in the human movement system. Coordinative structures act as physical constraints and these constraints can

identify how an individual movement system's degrees of freedom can become mutually dependent (DAVIDS; ARAÚJO; SHUTTLEWORTH, 2005). Based on this insight, Newell (1985) proposed a model of learning that can be a useful framework to understand the process of movement coordination patterns. This model of learning was classified into three stages: coordination, control and skill stages.

The coordination stage of learning is the stage where the learner is engaged in assembling the basic movement coordination pattern in order to achieve a task goal (NEWELL, 1985). At this stage, learners tend to freeze the degrees of freedom as a means of reducing the control problem, but with the consequence of limiting movement around key joints (NEWELL, 1985). These characteristics of novice performance have been identified in tasks such as pistol aiming, dart throwing, simulating skiing, and soccer (DAVIDS et al., 2002). Once novices have acquired the basic movement coordination patterns to achieve a task at the basic level, then they need to learn how to vary the basic movement to fit changing environmental task demands. Learners who can flexibly adapt these basic movement patterns to different environment conditions are at the control stage of learning. Finally, in the skill stage, expert performers can vary the parameters of the action (e.g., force, duration and amplitude of the movement pattern) in an energy-efficient manner in order to fit changing circumstances in the dynamic environment (DAVIDS et al., 2003).

A soccer kicking study conducted by Anderson and Sideway (1994) revealed support for this idea of stages of learning. In their study, the range of motion of the hip and knee during the kicking practice was very small compared to more skilled and experienced players, who showed coordinative structures characterized by greater values of hip and knee flexion and extension. After 10 weeks of practicing, the coordinative structures of novices and skilled players were quite similar. This result supported Newell's (1985) model of learning, based on Bernstein's (1967) insights.

BRAZILIAN SOCCER: A CASE STUDY

The '*constraints-led approach*' to skill acquisition postulates that perceptual-motor skills emerge from the interaction of three constraints, categorized as organismic, task and environmental constraints (NEWELL, 1986) (see Figure 1). In applying this model, Brazilian football provides a useful example. In other words, this model is particularly relevant to the development of football expertise of Brazilian players who, independent of the stage of learning (i.e. organismic constraints), tend to play varied forms of football such as mini-games, futsal, beach soccer, street soccer, and 11-a-side. Young Brazilian players typically practice on different ground sizes and surfaces (i.e.

physical environment constraints) under different rules and with different equipment (i.e. task constraints).

Figure 1 - The Constraints-Led Model showing how perceptual-motor skills (in the form of functional information-movement coupling) emerge from the interaction of key constraints on the performer (adapted from the ideas of NEWELL, 1986).

This notion of Brazilian soccer can be best illustrated by the film documentary entitled “Ginga: The Soul of Brazilian Football” which was produced and released in 2006 by O2 Filmes (LEVINE; MACHADO; ALVES, 2005). In a nutshell, this film summarizes the passion for football throughout Brazilian society as well as its diversity. Regardless of their geographic, economic, and socio-cultural context, Brazilians seem to play for the love of the game, but also influenced by other motivations such as social mobility, identity expectations, and careers opportunities. As a matter of fact, for some, football will be their best chance of improving their socio-economic prospects. Overall, as the film portrays, *ginga*, the sway, is embedded in almost everything that Brazilians do, the way that they walk, talk, and approach everyday life. As a result, this sway has arguably been incorporated into the way that Brazilians play football.

FINAL REMARKS

It is important to note that there is a large body of empirical research on organismic constraints (e.g., coordinative structure: ANDERSON; SIDEWAY, 1994; VEREIJKEN et al., 1992); (emergence of walking in infants: THELEN; RIDLEY-JOHNSTON; FISHER, 1983); (focus of attention: UEHARA; BUTTON; DAVIDS, 2008; Wulf, 2007) and task constraints (e.g., size of equipment: BEAK; DAVIDS; BENNETT, 2002; BUTTON et al., 1999); (instruction and feedback: AL-ABOOD; DAVIDS; BENNETT, 2001; HODGES; FRANKS, 2001); (interceptive actions: DAVIDS et al., 2002). However, there is a paucity of skill acquisition research on the physical environmental constraints (e.g., birthplace effect: CÔTÉ; BAKER; ABERNETHY, 2007), as well as, and especially, on the socio-

cultural environmental constraints (e.g., pelada: UEHARA et al., 2018).

Arguably, this is understandable due to the fact that research is shaped by historical, philosophical and traditional roots, as well as by the nature of the topic (DENZIN; LINCOLN, 2000). In this sense, while the task and individual constraints can be best measured reductively by examining cause and effect relationships amongst variables, the socio-cultural environmental constraints cannot, because they are likely to be too complex and dynamic constraints. Environmental constraints change constantly as society's norms and patterns are in constant transformation, which makes it difficult to identify specific variables (CRESWELL, 1998). Therefore, socio-cultural analysis demands other forms of inquiry, such as qualitative methods, which enable the researcher to inductively explore evidence in situ, so that a more contextualized understanding of the topic can be accomplished (CRESWELL, 1998; DENZIN; LINCOLN, 2000).

With this in mind, an analysis of the socio-cultural environmental constraints is fundamental to expanding the knowledge of skill acquisition and in turn further elucidating the constraints-led approach. Under this context, Uehara (2015) investigated the relationships between socio-cultural constraints and the development of perceptual-motor skills of Brazilian soccer players. On this basis, the central question of his research was:

- What are the influential environmental constraints on the development of perceptual-motor skills and expertise of Brazilian soccer players?

To be able to address these questions effectively, Uehara's (2015) study investigated a variety of socio-cultural contexts of Brazilian soccer through a multi-qualitative methodological approach, based primarily on a proposed framework termed: "contextualized skill acquisition research" (CSAR). The theoretical foundation of the CSAR framework is rooted in the principles of the Constraints-Led Approach conjoined with the philosophical assumption of the interpretive paradigm, the methodological principles of Bronfenbrenner's bioecological model, and with the ethnographic strategy of inquiry. Under this perspective, the key tenets of the interpretive paradigm provided suitable philosophical assumptions for the required form of qualitative methods demanded for this kind of research. Additionally, Bronfenbrenner's bioecological model of human development served primarily to organize constraints according to their socio-cultural environment context. Further, the ethnographic strategy of inquiry was useful to guide data collection which was generated by the triangulation of three techniques commonly employed in this type of research: open-ended interviews, participant observations, and historical-contextual analyses. Historical analyses of the socio-cultural environmental constraints of Brazilian soccer were conducted first to inform the later interviews and participant observation methods (UEHARA et al., 2014).

To this end, key findings show that the development of expertise in Brazilian soccer players is a function of informal, even aversive variables ranging from the microsystemic level under the context of *pelada*, mesosystemic level under the context of *home* and *federated clubs*, exosystemic level under the context of *poverty* and macrosystemic level under the context of *samba*, *capoeira*, and *malandragem*. These variables fit the notion of the socio-cultural environment constraints of the constraints-led approach. As a result, the interaction of these socio-cultural environment constraints with other constraints such as the individual and task ones shape the development of soccer expertise and skills of Brazilian players.

SUMMARY

This review article delineated how different theoretical ideas such as the ecological psychology and the dynamical systems theory came together to inform the epistemological and methodological assumptions of the constraints-led approach. The constraints-led approach has been promoted as a framework for understanding how people acquire perceptual-motor skills for sport and physical activities. This approach suggests that the major role of the coach or teacher is to manipulate key constraints in the learner in order to facilitate discovery of functional movement behavior. To further clarifying these issues, this review article used Brazilian soccer as a case study and findings from Uehara (2015) study shows that the development of soccer expertise and skills in Brazilian players emerges from the interactions of key constraints, including the socio-cultural ones.

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