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Readiness for career affordances in high-level football: Two case studies in Portugal

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ABSTRACT

This study investigates the factors driving football players with identical training experience and genetics to have dramatically different career paths. We studied two paired cases from a pool of 32 talented U-20 players who were twice World Champions. The first paired case is a set of monozygotic twins that played football for exactly the same period of time yet only one of them was selected for the national team. The second paired case refers to an outstanding player who got injured and withdrew from his football career and the player who replaced him in the national team. Semi-structured interviews were conducted and then analyzed inductively. The results provide a description of opportunities (affordances) that could only be taken by those who were ready to act skillfully when such rare event occurred. To act on such affordances (or not) may dramatically change the outcome of a player's career. These results suggest that expert performance and high achievement emerge from circumstances resulting from the self-organization of several performer-environmental factors. Acting on such opportunities (affordances) implies being perceptually attuned to and ready for unpredictable events. This research builds on the ecological dynamics approach and provides a basis for further understanding of expertise and expert performance.

Introduction

Portugal, a country with only 10 millions inhabitants, has produced football stars like Eusébio, Figo, and Cristiano Ronaldo. Moreover, the Portuguese men's National football team won the under-20 World Championships of 1989 (Riyadh) and 1991 (Lisbon). The players who participated in these World Championships, under the leadership of coach Carlos Queiroz, were known as the "gold generation" of Portuguese football. Internationally

known players such as Luís Figo, Rui Costa, and Paulo Sousa belonged to this generation. But what happened to the other players? It could have been expected that these under-20 world champions would also become professional football players. In this study, we present two paired cases of highly talented footballers from this generation with very similar environments (practice) but different career outcomes. In one case, the paired individuals also share a genetic background (monozygotic twins). In the other case, a player who became world-known could not achieve such status if the paired case would not have a severe knee injury. In contrast to the nature or nurture dichotomy, expertise implies both an understanding of how individual abilities match environmental opportunities and of how they dynamically interact with different contexts or ecologies throughout the performer's life (Davids, Güllich, Araújo, & Shuttleworth, 2017). The role of rare career opportunities (affordances) and the perceptual attunement and readiness to act on them seems to be of paramount importance. This is the concern of the ecological dynamics' framework.

Key tenets of the ecological dynamics approach to sport expertise

For present purposes, we discuss three of the key theoretical assumptions that integrate the many facets of the ecological dynamics framework, and thus guide the interpretation of the paired cases we are addressing: (1) (expert) performance emerges from the performer-environment system; (2) to understand the performance of an individual, an analysis of the behaviors offered by his or her environment (i.e., affordances or opportunities for action) is necessary; and iii), performance emerges (as a result of self-organization) under interacting constraints for in-depth descriptions of the ecological dynamics approach to sport expertise, see (Araújo & Davids, 2018; Araújo, Dicks, & Davids, 2019; Araújo, Davids & Renshaw, 2020; Araújo, Hristovski, Seifert, Carvalho, & Davids, 2019; Davids, Araújo, Seifert, & Orth, 2015; Davids et al., 2017).

The unit of analysis of performance is the performer-environment system

Performer and environment function in a relational, symbiotic way, rather than independently. Performers act intentionally immersed in a wide range of circumstantial factors that are typically changing. Since athletes are participants in a complex dynamic system, each person's action continually must be re-adjusted with respect to changing circumstances. Also, what defines the performer-environment system at any moment is not fixed, but continually shifts as the focus of a performer's action changes. This consideration of performer-environment boundaries highlights that psychological processes commonly extend to incorporate aspects of the environment, such as "harnessing the team's commitment at the match," rather than

simply playing with teammates. This indicates that action is not just limited to processes occurring only in the person.

Contrary to this organismic-centered tendency, for the ecological dynamics approach, behavior is a reorganization of the organism–environment system, not an interaction of organism and environment (Davids & Araújo, 2010). The performer-environment system is, therefore, the base unit of analysis for understanding the dynamic development of expertise in performance contexts like sports, work, and education.

The implication of this idea is that performance can only be understood, not simply according to the characteristics of a performer, but symmetrically according to the characteristics of a performance environment. This idea seems obvious, however, a misconception is that the performer is typically regarded as the active agent, with the environment acting as a mere backdrop for individual' s actions (Araújo & Davids, 2011). The separation of person and environment leads to theorizing in which the most significant explanatory factors in behavior are located within the organism. The upshot is that performance failures are explained based on body or brain mal-functioning (e.g. Yarrow, Brown, & Krakauer, 2009). In ecological dynamics, all parts of the system (brain, body, environment) are dynamically integrated during action regulation (Araújo et al., 2020).

The environment conceived as opportunities for behavior (Affordances)

For a performer, the environment is experienced as being meaningful, implying that an understanding of performance should embed experiences in environmental properties, as Gibson (1979) theorized with his concept of affordances. Environmental properties can directly inform an individual performer about what he/she can and cannot do in a performance environment. The term affordance refers to those properties of the environment that have functional significance for a person (Heft, 2013). Or in other words, an affordance is a property of the environment taken with reference to the capabilities of a performer. Performers seek access to resources, and the capacity for locomotion, for example, widens possibilities for accessing resources. Thus, in evolutionary terms, perceptual processes evolved alongside action capabilities as a means for guiding them. Reciprocally, action facilitates the perception of environmental properties. Hence, rather than treat perception and action as separable processes, from a functional standpoint it is valid to view perception and action intimately linked (Gibson, 1979; Heft, 2013). Consequently, it is understandable that perceiving is a process of detecting information for action possibilities in the environment.

Performance emerges under constraints

Considering the performer–environment system, performance can be understood as self-organized under constraints, in contrast to the

organization being imposed from inside (e.g. the mind) or outside (e.g. coach's instructions). Performance is not prescribed by internal or external structures, yet within existing constraints, there are typically a limited number of stable solutions that can achieve specific-desired outcomes (Araújo et al., 2006). Newell's (1986) model of three categories of constraints (organism, environment, and task) is significant for understanding how behavior emerges under constraints, operating at different timescales. These timescales are the ones involved in the performance as in a match, learning as in a season, and development as in a career. In Newell's (1986) model of interacting constraints, these have been defined as boundaries or features which limit the form of behavioral solutions, that is, states of organization that will channel (or not) the performer-environment system to achieve specific task goals. When a system (i.e., the performer-environment system) establishes a state (i.e., behavior pattern) only because of the dynamical interactions among individual components within the system, the state is self-organized. External processes (e.g. coach's plan) do not cause self-organization, rather this process is generated by components within the system (e.g. player, teammates, adversaries, coach and technical staff, facilities). Behavior patterns that emerge are different from the components that make up the system, and cannot be predicted solely from the characteristics of the individual components.

Contrasting ecological dynamics with "organismic" and "environmentalist" views

Expert performance in sports is revealed by the solutions that emerge from the performer's self-organizing system components (Kelso, 1995) to respond to unique sets of constraints at specific moments in time (Davids, Button, & Bennett, 2008). Due to these continuous interactions, current descriptions of expertise based solely on personal (e.g. genes, mental representations, internal mechanisms) or environmental (e.g. geophysical and socio-cultural contexts) constraints are incomplete (Davids & Baker, 2007; Hambrick, Macnamara, Campitelli, Ullen, & Mosing, 2016).

In terms of an excessive emphasis in the influence of the environment, there is currently an ongoing debate about the efficacy (or lack of thereof) of commercial cognitive training devices (Renshaw et al., 2019; Simons et al., 2016). Harris, Wilson, and Vine (2018) argue that whether these training methods improve performance in the sporting domain is unclear. These environmentally biased process-training programs are clearly driven by commercial interests, as revealed by the large number of popular science books on the topic. These books are not substantiated by scientific evidence and have not been subject to the rigorous scrutiny typical of academic literature (Moreau et al., 2019). Moreau and colleagues go as far as saying that such "process training" programs must be aware of the dangers of "[…]

overemphasizing the malleability of abilities and other traits." (Moreau, Macnamara, & Hambrick, 2018, August 2, preprint). Additionally, the influence of some environmental constrains (e.g. Relative age effect – RAE – and socio-cultural influences) in footballers were recently reviewed by Sarmento, Anguera, Pereira, and Araújo (2018). Although the influence of a player's RAE on talent identification has been extensively studied (e.g. Wattie, Schorer, & Baker; 2015; Skorski, Skorski, Faude, 2016), the research concerning socio-cultural factors is still scarce. However, it is well-accepted that several environmental factors influence the development of young athletes (e.g. Henriksen, Stambulova, & Roessler, 2010). However these should not diminish the role of personal characteristics.

Moreover, ecological dynamics does not endorse the view that hereditary, genetic constraints are the dominant factor driving expert performance. Some expertise development theories assume the environment enriches internal traits or dispositions that incur relatively permanent changes in an individual's capabilities (e.g. Gagné, 2015). According to this view, the aim of practice is to increase the "strength" of relevant performance characteristics that are intrinsic to the individual. These theories seek to differentiate experts from non-expert individuals by identifying specific traits employed during learning. Learning leads to the acquisition of an enhanced trait, or to an increase in the sophistication of mental structures. This personally biased theoretical stance has dominated psychology and sports science and is grounded on the separation between the performer and its performance context (Davids & Araújo, 2010).

For ecological dynamics, expertise and expert performance are the results of the interaction between components belonging to the personal, task, and environmental categories of constraints, which self-organize to result in behavior. Human performance can, therefore, be understood as an expression of self-organizing tendencies under constraints, rather than an organization exclusively imposed from inside (e.g. intelligence, VO2max, muscle mass) or outside (e.g. training regimen, social support) the individual (see Araújo & Davids, 2018).

If affordances are goal-relevant descriptions of the environment relative to the individual's capabilities; then, a performer that is in conditions to perceive rare affordances that open the path to a successful career need to be perceptually attuned and action-calibrated to such opportunities. Perceiving an affordance requires not only detecting information about the environment, but also action capabilities (skills) that allow to act on such affordances. If the performer is not ready or open to such opportunities, he or she may not perceive them. Conversely, he or she may perceive them, but may not have the action capability to act upon them (Araújo et al., 2019; Rietveld, Denys, & Van Westen et al., 2018). An individual's potential is not static, but rather is dynamic and continuously open to influences of task,

individual, and environmental constraints (e.g. genes, motivation, deliberate practice, fatigue, availability of facilities, coaching support) (Davids, Araújo, Hristovski, Passos, & Chow, 2012; Davids et al., 2015). Importantly, adaptation is not always successful, and opportunities for a successful change are not abundant.

In short, the athlete-environment system as a unit of analysis means that expertise scientists need to understand the biases involved in considering athlete performance separately (i.e., genetic composition, functional behaviors, or patterns of thinking) from the key constraints of a particular performance environment (e.g. a team games player's performance away from a game context in relation to diet, or social habits). Similarly, there are limitations in considering environmental influences only (such as the facilities where practice takes place as being solely responsible for behavior, or in environmental theories like Deliberate Practice), without regard for an athlete's individual skills, personal characteristics, and capacities that interact with key environmental properties. As mentioned, with experience and skill, athletes can become attuned to some affordances and not to others. However, some affordances are extremely rare, demanding even more from a performer to be ready to perceive them. At the same time, there are life events that may preclude the athletes to pursue their activities (e.g. injuries), because they are not ready to act on such affordances when they appear. This explains why only a few become expert athletes. This study aims to understand why such opportunities are taken (or not) by the performer and when are players ready to act upon career affordances.

Methods

Participants

We selected two paired cases among the 32 Portuguese male football players who were twice world champions (1989 and 1991) at the age of U-20, including a player who was not in the winning team but had played with the group from the age of U-16 until the U-21. All the players had finished their sports career at the moment of the interview. Additionally, the two coaches were also interviewed. The two paired cases were as follows: 1) a player from the champion team and his monozygotic twin brother who never pursued a professional football career but had the same football practice experience; and 2) a player who was seriously injured and the player that replaced him in the team and who continued to have a successful football career.

Procedure

Retrospective interviews were conducted to trace the entire career of the players. Each player was contacted by e-mail or by phone, informed of the

research goals, and then asked to participate in the study. Each participant took part in an in-depth face-to-face interview with the first author. The monozygotic twin brother who never pursued a professional football career was not interviewed. The information concerning his sport career was collected from the interviews carried out with his teammates, his twin brother, and also by documentary search in different databases (e.g. Website of Portuguese Football Federation) in order to check whether the information was consistent. All the interviews had a similar structure, were digitally recorded and lasted between 60 and 240 min. The variables were collected from the interview protocols of Côté, Ericsson, and Law (2005) and Fraser-Thomas, Côté, and Deakin (2008) and adapted to Portuguese, and specifically to football. The questions were organized in three main groups: (1) training patterns/training resources; (2) social influences (from parents, siblings, coaches, and peers), and (3) personal factors influencing the career. Coaches, members of medical staff, club officers, teachers from sports faculty, members of the governmental structures for sport, and journalists were asked to comment on club/school values, macro-environmental influences, historic dimensions, financial and human resources (Henriksen et al., 2010).

Data analysis

All interviews were transcribed and coded using an inductive approach. Transcripts were read repeatedly for familiarization with and immersion in the underlying data (Creswell, 2007). Following Henriksen et al. (2010), the inductive coding expanded the node tree when new categories or ideas emerged, and primarily involved low-order themes and the content of the themes. Next, the interviews were subjected to meaning condensation, whereby the informants' statements were condensed into more precise formulations and a summary of each node was written. The software QSR NVivo 12 was used to code the transcripts of the interviews.

Different techniques were utilized in this study to establish trustworthiness. The first author was trained in qualitative research methods, as outlined by several scholarly sources (Côté, Salmela, Baria, & Russel, 1993; Creswell, 2007; Lincon, 1995; Smith & Caddick, 2012). Performing participant checks is the most crucial technique for establishing credibility (Lincon, 1995). The first participant check occurred at the end of each interview during a debriefing session. The participants were given the opportunity to change any answer or idea given during the interview. In a second phase, full verbatim transcript of the interview was sent to the participants. The participants had the opportunity to clarify, add, or eliminate any comments from the interview. Additionally, trustworthiness was

ensured by a panel of three experts in sport psychology, which analyzed all meaning units, themes, and categories made.

Results

In the following sections, we present two paired cases: (1) a football player (Player 5) from the champion team U-20 and his monozygotic twin brother who never pursued a professional football career but had the same football practice experience; and (2) an outstanding player (Player 32) who was seriously injured and the player that replaced him in the team and who reached international level as a professional football player.

Paired-case 1 – monozygotic twins

Player 5 has a monozygotic twin brother. As a senior athlete, Player 5 reached the level of international A (10 internationalizations) and played for some of the best clubs in the world (e.g. Aston Villa, FC Porto, Sporting, etc.) in different European countries. However, and although these players had very similar training programs during their maturation as players, the twin brother only played in semiprofessional clubs in Portugal.

Both brothers lived with their parents (who remained married during their children's youth), attended the same school, and always played in the same clubs until reaching senior level (19 years old). They started to play in one of the best football clubs in Portugal at the age of 10 years old.

> When we started playing at the club, my parents had no financial means to pay the public transport, since we had to catch two buses each way. The club only offered one free pass for the bus per player but, as we were two and needed to catch two buses, we needed four passes. Then, at the age of 10 years old, we decided that three times a week we would go to the lessons walking. And so it was, every year, in rain or sunshine, we walked to the sports club.
>
> Player 5

During their sports training from 6 to 18 years old of age, Player 5 and his brother accumulated 2505 h of structured activities and 2940 h of unstructured activities. Street football was one of the main unstructured activities practiced by the brothers.

> At the weekends, our days were like this: we left home around 10.00am and only came back at 1.00pm. After lunch, we left home at 2.00 pm and only returned home at 8.00 pm. We spent the day on the streets playing football. All day playing football … The overwhelming majority of days were always spent playing football and were always intensive, always!
>
> Player 5

In the career trajectory of Player 5, there was a moment that seems to have been decisive for his sporting success: there was a change in his match position, which proved to be advantageous.

> I played as a forward, but in a certain training session one player was missing in the right-back position. The coach asked me if I would like to play in that position. Of course, I wanted to play in whatever position I could. That's how I started playing in the first league, and how I was called up to the U-20 national team. This was the key moment of my career. I ended up always playing as right-side defence.
>
> <div align="right">Player 5</div>

Such an opportunity was never offered to his brother.

Paired case 2 – outstanding youth player (Player 32) who never become a football professional, and the player who substituted him

Player 32 never played in any World Championship, in contrast to all the other 31 players interviewed. However, this player played with the Portuguese men's national football team at an international level 42 times, since he was at U-16 to U-21 levels. During interviews with the other world champions, it was often mentioned that the most talented player of this football "gold generation" was Player 32. We asked the other players why this outstanding young player did not achieve a professional level.

> Player 32, in my opinion, was the best player in our team. Shortly before the World Cup he had a knee injury … and no one ever wanted to know about him …
>
> <div align="right">Player 1</div>

> Player 32 was an outstanding player but ended up being out of the World championship.
>
> <div align="right">Player 14</div>

> Shortly before the world championship in Lisbon, I suffered a complete tear of the anterior cruciate ligament. In that national team, I was always selected to be part of the initial team in every game, but I could not play the world cup due to my knee injury. I remember seeing the first game lying in the hospital bed.
>
> <div align="right">Player 32</div>

Due to Player 32's knee injury, a player who was not normally selected for the national team had the opportunity to play the world championship. Consequently, this substitute player went on to have an international sports career of enormous success, playing in some of the best clubs in the world (e.g. Ac Milan, Fiorentina, etc …) and being called more than 90 times to play with the Portuguese national team as a senior.

Who benefited from his absence was [name of the substitute player], who normally did not play, and ended up making a tremendous tournament and after that, a brilliant career ...

Player 14

Until the U-18 European Championship, the [name of substitute player] was not part of our national team. He began to be called only for the under-18 years-old team. I avoid thinking about my injury. My career would have been very different had I not had that injury. Playing a World Cup is a unique opportunity that I did not have. Due to my injury, there were other players who normally did not play so regularly as I did, who have had this possibility. It was a launch pad for senior football.

Player 32

It is interesting to note that even within the sports club, this substitute player who had a top world career at a senior level, was often removed from the talent development process, as described by his club coach.

[name of the substitute player] was managed very carefully during the training years. (…) He was short and had no ability to clash with the older players. (…) But we knew that his technical capacity was very high. He just started playing regularly at the age of 18 years old, after the pubertal growth.

Coach 3

Discussion

In this study, we aimed to understand how opportunities for career development are seized by football players, and whether players are ready to act upon career affordances. The two paired case studies matched in terms of practice and genetics (case 1) and in terms of practice, but not skill (case 2), indicate that key environmental events can dramatically change career paths, independently of personal or practice characteristics.

Traditionally, genetic influences (case 1) have been associated with specific psychological and physiological factors related with sport performance. In football players, a polymorphism in the ACTN3 gene has been associated with endurance (Pussieldi et al., 2013) and predisposition for injuries (Massidda et al., 2017), while greater frequency of a polymorphism in the COL5A1 gene is linked to sustained effort and severity of injuries (Massidda et al., 2015). Evidence of the role of genetics in sports performance is scarce (Klissouras et al., 2001), in contrast to other activity domains, for example, in music (Mosing & Ullen, 2018). However, there are a number of cases in football of monozygotic twins with successful careers, such as the Dutch twin brothers Frank and Ronald de Boer, and the Brazilian-born twin Fabio and Rafael da Silva.

Examples of twin studies in other sports include Klissouras et al. (2001), which examined the performance of an Olympic gold medalist and his twin brother in 20 km walking competitions. Both twins had undergone the same strenuous, long-term training for 19 years since the age of 15 under the guidance of the same coach. However, their performance was substantially different, as one of the siblings was thrice an Olympic winner but the other only won one competition, when his brother was not competing. The authors measured psychological and physiological variables and concluded that success may be largely influenced by psychological traits.

Research on the development of sports performance by monozygotic twins is still very scarce. It is not our intention to draw general conclusions from the case of the twin pair presented here, because other cases exist where both brothers had successful sports careers, such as the case of the brothers De Boer or the case of the Brazilians footballers Fábio Silva and Rafael Silva. It would, therefore, be interesting to see by how similar were the key environmental events offered to these pairs of brothers. In addition, a relevant aspect that may be studied in the future is the individual's readiness to act upon the career-changing affordances (e.g. playing in a functional position in a different field).

Although the scientific literature on talent identification and development in sports in general (Rees et al., 2016) and in football in particular (Sarmento et al., 2018) has increased exponentially over the last 10 years, it has been fundamentally focused on analyzing task, performer and environmental constraints individually. Thus, specificity and amount of practice, psychological factors, technical and tactical skills, relative age effect, and anthropometric and physiological factors have been analyzed in detail, albeit in isolation. How these constraints interact between them and what influence each has on the others, as well as how they promote expertise and expert performance remains unclear.

The second paired case in our study is an interesting example. Contrary to the available evidence (Forsman, Blomqvist, Davids, Liukkonen, & Konttinen, 2016; Hirose & Seki, 2016), the most successful player at senior level showed the least potential at junior level and had unfavorable physical traits, such as lower height and less strength. Indeed, at the junior level, this player was never selected to play in international competitions and did not practice with older peers. However, he showed strong technical and tactical skills (Kannekens, Elferink-Gemser, & Visscher, 2011; Zago et al., 2016) and high motivation to play (Forsman et al., 2016). Importantly, our results are consistent with previous reports (Davids et al., 2017; Güllich, 2017) showing that developmental participation patterns likely leading to early junior or to long-term senior success are not identical. Rapid juvenile success is characterized by early specialization, intensification of sport-specific practice/training, and reduced involvement in other sports. More accomplished juvenile athletes consistently accumulate more sport-specific activity than

their less successful peers. In contrast, world-level senior achievement results from a career trajectory whereby practice interacts with variable, nonspecific activity experiences. Adult world-class athletes do not necessarily accumulate more organized sport-specific childhood/adolescence practice/training than their national-class counterparts.

Given that expert performance and expertise are emergent and dynamic, explanations of these phenomena based solely on either personal, task, or environmental constraints are essentially limited (Davids & Baker, 2007; Hambrick et al., 2016). The present study reveals that key moments for career progression may occur at the senior level during adulthood. Thus, footballers with similar training experience, deliberate practice, and social influences during their youth, may ultimately lead very distinct sports careers based on career-changing affordances and their readiness to response to them. The opportunity to play in a different match position (paired case 1) or to replace an injured player (paired case 2) were affordances that constrained specific behaviors, and the players were ready to seize the opportunity and act accordingly (Araújo, Hristovski et al., 2019). The coupling between affordances and skills offers a more complete explanation than just environmental or personal characteristics.

Disclosure statement

No potential conflict of interest was reported by the authors.

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