Eco-Dynamics Approach to the study of Team Sports Performance

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Abstract: The main goal of performance analysis in team sports has been the identification of data frequencies or sequences of actions in a temporal line, based on the assemblage of numerous discrete variables. This focus may be deemed as not displaying the foremost team sport feature, i.e., the dynamics of the interaction between two teams. In order to better understand the dynamic patterns of the game, the methods commonly applied must be furthered in a functional perspective. Underpinned in the Ecological Dynamics approach to decision making in sport, this paper regards performance analysis as a process of synthesis and parsimonious explanation of game's functional nature. Accordingly, we argue the importance of the following three aspects: i) game must be viewed considering different levels of analysis; ii) there is a functional role of variability in players' behaviour that must be included in the analysis; iii) human behaviour is better understood if we consider how the dynamics reflects individual and collective perceptual-action couplings.

Keywords: Performance analysis, collective behaviour, space-time patterns, couplings.

INTRODUCTION

Performance analysis is commonly regarded as a hefty arrangement of data from player's performance compiled in an extensive report format. According to the recent technology development (e.g., game analysis software) it became possible to improve the collection of performance data in real time, both in training and competition. As this advancement only focused on grouping large amounts of data, game analysis became extremely reductive [1].

To improve performance analysis in sport a functional perspective is needed in order to easily comprehend the emergent dynamic patterns of the game.

The rational of this paper regards performance analysis as a process focused on the synthesis and parsimonious explanation of the functional nature of a game. Following the Eco-Dynamic approach, these processes entail a multidisciplinary approach to the analysis of performance [1].

CONCEPTION OF TEAM SPORTS

Team Sports are a result of the cooperation between players within a team and the competition between teams in a complex synergistic relationship [2]. The game should be held as the balance between a predictable dimension, originated by the principles of the game (the coach "strategy"), and a non predictable dimension, that results from player' s autonomy (i.e., self-organized behaviour) [3].

In contrast to the reductionist approaches Grehaigne, Bouthier and David [8] propose the analysis of the game as a dynamic system as a mean to access some of their relevant properties. Other empirical studies in sport performance [1, 4, 5] also emphasized the need to develop new methodologies to synthesize the game. Hence, it urges an approach matured on concepts and tools of dynamical systems to understand phenomena that occur at the scale where the relationship between individuals and their environments is defined – the ecological scale [1].

Team sports are characterized by the formation of spontaneous patterns through self-organization processes. This organization emerges on a system that embraces many degrees of freedom [4]. Additionally, the dynamics of these systems present transitions between different configurations (from symmetry to anti-symmetry states) [1, 4, 6]. Conceived as a dynamical system, team behaviour can also be regarded as an emergent process that results from the interaction between individual, environment and task constraints [1, 7].

Three aspects must be emphasized to study team sports: i) a view of the game that considers different levels and scales of analysis; ii) the role of variability of behaviour as functional and as a result of the interaction between different constraints; iii) human behaviour is better understood if we consider the dynamics of different perceptual-action systems [7].

TEAM SPORTS PERFORMANCE ANALYSIS

Traditional methods of performance analysis define individual or collective performance through isolated variables, frequencies of data or sequences of actions in a temporal line [3, 8]. The goal is to identify who performs the action, which and what kind of action is taken, and finally when action is taken. For instance, the most famous match analysis software, like "Amisco" or "Prozone", exhibit the capacity to collect an extraordinary number of variables during the game (delivered to the coach after the game). However, the process of analysis is strongly dependent on coach perception and

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expertise to define which variables should be brought into analysis and how to interpret them.

Dynamical system approach may assure an important role in the description and measurement of the space-time patterns that emerge in the game. In this context, some studies (e.g. [4, 8,]) focused on the identification of perturbations and critical incidents in the analysis of game patterns have been published recently. McGarry *et al.* [4] suggests that attractors that result from the interactions between players and teams can be recognized by dynamical methodologies. Other proposals have been made like the measurement of the centre of gravity of the teams, stretch index and relative phase [9]. These recent approaches express a tendency to search for collective parameters that may express the collective state of the team throughout time.

AN ECO-DYNAMICS STANCE OF TEAM SPORTS PERFORMANCE ANALYSIS

Our purpose is to claim for an ecological dynamics conceptual to game analysis, that is, to describe the game in terms of functional variables that show the organizational state of adaptive behaviour in different levels of analysis. The best way to understand the dynamics of an apparent self-organizational system is to focus on different scales of analysis in order to access the general laws [9].

The decomposition of the game in subsystems/functional units allows the analysis of the game based on the relations between intra and inter-coupling among players [4]. So we can define the relation between players and teams in three main levels of analysis: i) inter couplings; ii) intra and inter couplings between players and iii) intra and inter team couplings. If we consider an inter-coupling level (AxB) the goal is to understand the nature of the opposition between two players. Using both intra and inter couplings levels (A1+A2xB) the goal is also to understand the relation of the opposition between players and in addition the cooperation among them. At the last level – inter and intra team couplings - we consider the relations in a large scale as the relation between teams.

The explanation of these player's interactions and its relations depends on the identification of behaviour patterns and moments of phase transitions as well the definition of the competition system's attractors. McGarry et al. [4] consider that attractors may influence the cooperation or competition (intra and inter teams) for the possession of the ball or space. By attractors we mean the points, cycles or spaces where the players' action system achieves stability over the game [4].

As an example of interesting practical problems with different dimensions that urge to be fulfilled in the field of research and match analysis we propose the following questions:

Are there distinct patterns of interaction between one-on-one relations in a zonal vs individual defensive strategy?

Which parameters differ in the dynamic of a 2x1 situation in an organized situation or in a counterattack?

What is the relationship between the defensive block size and the capacity of penetration by the opponent team?

CONCLUSIONS AND IMPLICATIONS FOR FUTURE RESEARCH

This paper has shown that there is a need to enfold an eco-dynamic theoretical framework directing data gathering and subsequent interpretation.

Moreover, it was displayed the necessity to synthesize game in order to express the continuum of behaviour in the relation with the environment. A better understanding of interactions between players in different game settings, may allow coaches to make use of more useful information to improve training and competition management.

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