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ABSTRACT

To explore the complexity of the game balance that gives rise to individual actions, the present study examined the multi-level nature of the game constraints that afford the action of a drive in basketball (dyadic attacker-defender versus inter-team relationships). On the basis of 33 play sequences including a drive, the positional data of the ten male professional basketball players were analyzed using an ecological dynamics approach. The results mainly revealed: a) that the pre-existing conditions that constrained the drives were only of inter-team level; the beginning of the action occurred after a lateral disturbance in the coordination between teams' geometrical centres combined with sustained lateral fluctuations in the stretch indices coordination; and b) the importance of time scale for observing these relevant fluctuations; we used 3-s, 1-s, and 0.5-s time intervals, but only the 0.5 time scale discriminated the significant variability differences. These results offer new insight into a team-oriented view of the game constraints that call for specific individual actions.

Key words: Basketball, Constraints-Led Approach, Ecological Dynamics, Interpersonal Coordination, Performance Analysis

INTRODUCTION

Gathering scientific data on athletic behaviours in an attempt to improve sports performance has gained widespread acceptance in the sports community. The general approach has been to use performance metrics referred to as 'indicators' to measure sports behaviours. Statistical processing then helps to describe game patterns and provides coaches with a

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description of players' and teams' actions that promise to enhance individual or team effectiveness. Recently, team sports analysts [1-3] have proposed that the game conditions that constrain (and are constrained by) players' actions should be investigated using alternative approaches, especially those that emphasise the role of changing interpersonal tendencies among players and teams. The proposed approaches follow the assumption that players' behaviours are strongly embedded in the dynamics of spatial-temporal relations that sustain interpersonal coordination. This means that the activity of a player at a given instant cannot be analysed without taking into account the other teammates and opponents who are acting at the same time. From this perspective, performance might be better contemplated as the result of the interactions of players and teams, with the interactions being considered as indivisible for the purpose of analysing game behaviours [4].

Researchers are thus pursuing new directions in their investigations, notably by focusing on team coordination and the processes through which teammates and opponents interact and contribute to game dynamics. In this context, an ecological dynamics approach has been proposed [1] and developed [5] as a reliable way to capture performance in team sports. The ecological dynamics approach measures how players act at each instant in relation to changes in the game environment [1] and has been one of the most promising [6] and fruitful [7] perspectives in the literature on team sports analysis in recent years. Our study was conducted in light of the recent findings of the ecological dynamics approach to team sports and was designed to provide an interpersonal and multi-level account of the game constraints that give rise to individual actions (i.e., driving to the basket by dribbling past the defender) in a naturalistic competitive basketball setting.

VARIOUS LEVELS OF DESCRIPTION OF INTERPERSONAL COORDINATION

In recent years, studies have identified spatial-temporal variables that can be used to explain the dynamics of the interpersonal coordination patterns that sustain players' and teams' behaviour in team sports. These variables account for different levels of analysis of the game constraints, from dyads to teams [2, 3, 7]. In the analysis of dyads, the focus has been on understanding the interpersonal patterns of coordination between teammates [2] or opponents that sustain a 1 vs. 1 situation near the try line in rugby [8], a shot at goal or a pass in futsal [9, 10] or a drive in basketball [11, 12]. To account for the game dynamics between two opponents, relative phase calculation (i.e., a measure of synchrony between players' displacement on space and time), relative velocities (i.e., a measure of variation on players velocity), and interpersonal distance (i.e., a measure of the spatial relations between players) have notably been used and combined. In the analysis of various sports teams, these variables are assumed to capture the informational constraints that support attackers and defenders behaviours [13].

Also, at a macroscopic level of description and to account for the dynamics of opposition between two teams, the variables used include the analysis on relationship between geometrical centre of each team (i.e., the imaginary point equidistant for all players) [3, 14, 15], the surface areas (i.e., the field area that each team covers at each instant) [16], the stretch indexes (i.e., the mean deviation of each player in a team from the geometrical centre) [3], and the team range indexes (i.e. the index between the length and the width of a team) [17,18]. For instance, Bourbousson et al. [3], adopting this level of description of the game constraints, suggested that the shot attempts in basketball could be embedded in a disruption within the geometrical centres dynamical relationships.

Under the umbrella of ecological dynamics, the variables used for dyadic and team analysis allow to improve the understanding of the game constraints that support the onset of critical actions during competitive games. To date, the investigations of the different levels of the game constraints have been conducted separately. The dyadic level of description (especially the coordination between attacker and defender) has mostly been analysed and yielded the most detailed descriptions.

GAME CONSTRAINTS AND DYADIC VARIABLES

Dyadic studies mainly describe how the ball-carrier's actions are constrained by the properties of his relationship with his immediate opponent. For instance, studies of one-on-one tasks have highlighted the impact of the interpersonal dynamics between a ball-carrier and a defender in rugby [8], soccer [19, 20] and basketball [1, 10, 11]. In basketball, the attacker was specifically shown to drive to the basket when interpersonal distance and the defender-attacker-basket angle reached a critical value [1], with the direction of the drive being influenced by the defender's posture [11] (attackers performed more drives to the side of the most advanced foot of the defender). More recently, Esteves et al. [10] revealed that the coordination tendencies changed according to the position of the attacker/defender dyad relative to the basket. With regard to the coaching process, these studies emphasise the properties of the attacker/defender coordination that coaches can manipulate or highlight in order to promote players' attunement to these properties so that they can better explore their possibilities for action. However, despite the relevant knowledge that comes from previous works on attacker-defender relations, the action of dribbling past the defender in a complex setting like a basketball game cannot be explained only on the basis of a dyadic relationship between ball-carrier and defender. An account of how the relationships with other teammates and opponents in space and time constrain the onset of the action is also needed. In sum, the spatial-temporal relations between players that give rise to the attacker's action of a drive may be constrained not only by the immediate opponent, but also by the relationships developed with other teammates and opponents.

EXTENSION OF CONSTRAINT ANALYSIS TOWARDS MULTIPLAYER VARIABLES

Although not as fully developed, the analysis of game constraints has been extended in recent studies to include more players in order to more fully capture the conditions that afford passing and shooting actions [21, 22, 12]. For instance, Correa et al. [21] examined the game constraints on the passing direction in futsal by including the ball-carrier, the ball-receiver, and their respective defenders. Travassos et al. [12] studied ball interception (i.e. by a defender) and included both the two nearest concerned defenders and the two attackers involved in making the pass. This extension of the players' behaviour under study helped to contextualize the relationships that support players' decisions and actions during competitive games.

Apart from the valuable results of the previous studies, it remains unclear, for example, which informational constraints give rise to critical ball-carrier actions during a basketball game. For instance, in a five-on-five basketball match, one assumes that the drive to the basket (i.e. dribbling to the scoring target) is not only constrained by the immediate defender but also depends on the space behind the defender being free. This allows the attacker to have a reasonably wide path to the basket and could be a pre-existing condition for other acting constraints (i.e., attacker/defender-related constraints). Since the ball carrier's actions are continuously constrained by the nature of interpersonal information that is available over time, including the positions of other attackers and defenders, several authors have assumed that a multi-level approach to the spatial-temporal relationships between players and between teams is required to understand how players' actions are guided during a team sports game [2, 3, 7, 10]. This assumption was initiated in the preliminary and general multi-level description of a basketball game by Bourbousson et al. [2, 3] and in futsal by Travassos et al. [10], who observed that variability in playing dyads produced more stable and functional behaviours at a team level of analysis . The purpose of our study was to better understand the role played by the interaction of various levels of game constraints (i.e., dyadic attacker-defender and inter-team dynamical relationship) in order to determine which factors guide the action of dribbling past an opponent in basketball.

We therefore measured the dynamics of the relationships between the attacking and defending players for each drive under analysis using: a) the dyadic level of constraints (i.e., attacker/defender interpersonal coordination); and b) the inter-team level of constraints (i.e., Team A/Team B interpersonal coordination). We expected to capture fluctuations in the interpersonal patterns of coordination at different levels of team analysis that would support the action of a drive in basketball.

Based on previous works, we assumed that the fluctuations in the interpersonal patterns of coordination would support the action of a drive in basketball. We thus expected to capture fluctuations at different levels of team analysis. More specifically, we expected the drive in basketball would be: a) preceded by a change in the attacker-defender interpersonal coordination (i.e., assumed to be the main game event constraining the ball-carrier), b) immediately followed by variability in the relationship between the two teams (i.e., assumed to be the main outcome).

METHOD

PARTICIPANTS AND PROCEDURE

Ten male professional basketball players (five from Team A and five from Team B) participated in the study (M = 27.4, SD = 3.13 years). Prior informed consent was obtained and the experimental protocol was conducted in accordance with the declaration of Helsinki and standard research practice in France. It was approved by the local university ethics committee.

DATA COLLECTION

The data used in the present study were recorded in 2008. A part of this recording data was previously processed and discussed [2, 3]. During a men's official professional basketball game in France, the movement displacement trajectories of the players were recorded using a digital camera at 25 Hz located 15 m above and to one side of the long axis of the basketball court. After identification of each player on the field, each player's movement data were obtained in sequential fashion using Dartfish Darttrainer Teampro 2.5 software. The pixel data from the player's displacement were then processed using a second-order 1-Hz low-pass Butterworth filter before transformation to pitch coordinates using planar geometry. By convention, the bottom left corner of the basketball court was assigned zero coordinates. The x axis represents longitudinal movements and the y axis lateral movements on the court. For each player, the coordinates of the lateral and longitudinal movements on the court were recorded.

DATA ANALYSIS

From the collected data, two expert national coaches independently identified all the drives to the basket during the game and pinpointed the exact moment when the ball-carrier started the drive using a frame-by-frame mode (25 Hz). The coaches re-analysed any sequences about which they did not agree in order to obtain consensus. Selected for analysis were the sequences: a) with the drive occurring in the offensive half-court; and b) about which consensus between the two observers was reached at the first step of notational analysis. Thirty-three drives (13 by Team A and 20 by Team B) were retrieved for further analysis.

With regard to the brief time span in which the action of a drive has to be performed in basketball, only the 3 seconds preceding and the 3 seconds following the start of the drives were analysed. To capture the spatial-temporal conditions preceding and following the start of each drive using a multi-level approach, we calculated four variables for lateral and longitudinal displacements on the field: a) the relative phase (RP) of the ball-carrier's and his immediate defender's movements (Att/Def-RP) (i.e., symmetry of the players' displacements); b) the RP of the respective geometrical centres of the two teams (GC-RP) (i.e., symmetry of the teams' displacements); c) the RP of the stretch indexes of the two teams (SI-RP) (i.e., symmetry of the teams dispersion on the field); and d) the relative stretch index between the teams (RSI) (i.e., space difference between the teams' dispersion on the field). The RP of each variable was calculated using the Hilbert transform method, which provided a measure of the instantaneous synchrony (i.e., phase and amplitude) of relation between signals [23]. It should be noted that the relative phase calculation synthesises the synchrony between both players and teams in space and time [23, 24] and was applied after centring the data around the zero value, a required procedure for RP calculation. The standard deviation of the relative phase was calculated over time in order to identify fluctuations in the mode of coordination between them [25].

Based on the notion of time scales used to study (interpersonal) pattern stability [26, 27] (i.e., time interval needed to capture the patterns' properties), the standard deviations of RSI, GC-RP, Att/Def-RP and SI-RP were computed at three time intervals (0.5 s, 1 s and 3 s). The initiation of the drive served as the sequence reference (0 s). Thus, for the 0.5-s interval, 12 periods were determined from the first period [-3 s; -2.5 s] to the 12^{th} period [+2.5 s; +3 s], in lateral and longitudinal directions. For the 1-s interval, six periods were considered, and for the 3-s interval, only two periods were considered.

Three one-way ANOVAs with repeated measures 2 (period) ×6 (period) or ×12 (period) as appropriate, were carried out for each aforesaid dependent variable. If the sphericity assumption in ANOVA was violated (Mauchly's test), the corrected tests of significance were used [28]. Least significant difference comparisons were used for post-hoc tests following significant effects. For each analysis, the level of significance was $p < 0.05$. Partial eta square ($_p\eta2$) values are reported as measures of effect size, with moderate effects considered for $_p\eta2 = 0.07$ [29].

Inferential statistical analyses of the entire data set were performed, but we included a complementary qualitative description of the dynamics of the variables for a single trial illustrating the results obtained from the analyses of variance.

RESULTS

IDENTIFICATION OF THE DRIVES TO THE BASKET

The notational analyses of the two national coaches identified 33 drives. Table 1 describes the main characteristics of the actions selected for further in-depth analysis. We observed that 54.5% of the drives were identified as 'Position play' (i.e., occurred at the time of an offensive sequence during which defenders all together are positioned near to their basket) and 45.5% as 'fast play' (i.e., occurred at the time of an offensive sequence during which some defenders did not yet came back from their preceding offense). However, in a preliminary exploratory analysis, the ‘position play’ and ‘fast play’ sequences did not reveal any difference on spatial-temporal relationships between players and teams. The relationships between the attacking and defending teams were therefore analysed for all trials.

Table 1. Main characteristics of the 33 actions to drive selected for analysis

Code of the 6-s sequence	Team of the ball-carrier	Beginning of the drive (time code)	Intervenient players	State of the Play
1.1	B	13"08	B5 V A5	Position play
1.2	B	18"15	B3 V A3	Position play
1.3	A	31"40	A2 V B2	Fast play
1.4	A	34"00	A4 V B5	Fast play
1.5	B	1'00"68	B1 V A1	Fast play
1.6	B	1'05"10	B3 V A3	Fast play
1.7	B	1'14"50	B2 V A2	Position play
1.8	A	1'33"23	A2 V B2	Position play
2.1	B	26"78	B3 V A1	Fast play
2.2	A	33'32	A3 V B4	Fast play
2.3	B	49"00	B5 V A4	Fast play
2.4	B	53"50	A2 V B1	Fast play
2.5	A	57"05	A5 V B4	Fast play
2.6	A	57"95	A3 V B5	Fast play
2.7	B	1'11"38	B2 V A2	Position play
2.8	A	1'25"93	A5 V B4	Position play
3.1	B	2"35	B2 V A2	Position play
3.2	B	15"27	B2 V A1	Fast play
3.3	A	26"09	A1 V B4	Fast play
3.4	B	52"68	B3 V A3	Position play
4.1	B	14"80	B5 V A5	Position play
4.2	B	18"58	B1 V A1	Position play
4.3	B	21"33	B2 V A2	Position play
4.4	B	32"08	B1 V A5	Fast play
4.5	A	46"88	A1 V B2	Fast play
4.6	A	58"57	A1 V B1	Position play
4.7	B	1'11"88	B5 V A4	Position play
5.1	B	53"45	B2 V A2	Position play
5.2	B	56"88	B1 V A1	Position play
6.1	B	39"69	B2 V A2	Position play
6.2	A	50"42	A2 V B2	Position play
6.3	A	53"60	A3 V B3	Position play
6.4	B	1'01"77	B1 V A2	Fast play

Note: Intervenient players’ names are formulated in order to account for Team A (A), Team B (B), Point guard (1), Shooting guard (2), Small forward (3), Power forward (4), Center (5). According to state of the play taxonomy, Fast play refer to the drives occuring in the half offensive court but short after a counter-attack, making the offensive actions occuring just before the position plays. Position play refers to sequences for which the point guard had announced a specific position play.

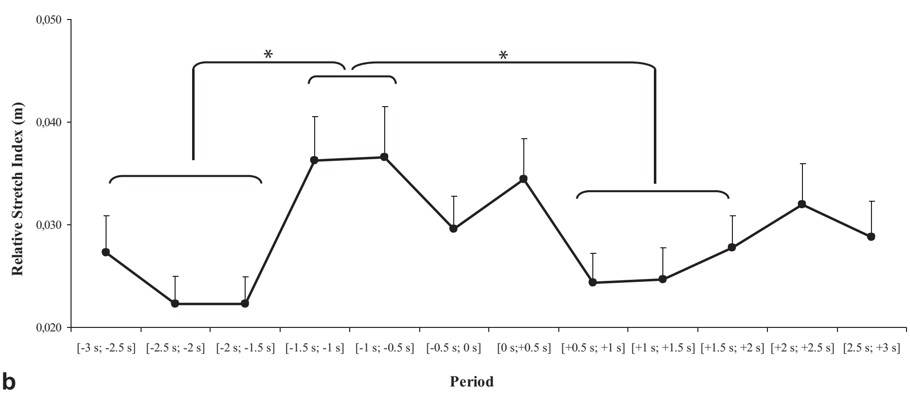
VARIABILITY OF INTERVALS

Variability of 3-s and 1-s intervals. All the ANOVAs failed to reveal a significant effect for any of the dependent variables (all Fs < 2.08, ns).

Variability of 0.5-s interval. For the SI-RP and Att/def-RP dependent variables, the ANOVAs revealed no main or interaction effects (all Fs < 1.517, ns). Concerning the RSI, the analysis revealed the main effect of Period in the lateral direction [$F(11, 341) = 2.394$, $p < 0.01$, $_{p}\eta 2 = 0.072$). Overall, the post-hoc tests indicated significant differences in variability between the first three periods (from -3 s to -1.5 s; mean = 0.024 m) and periods 4 and 5 (from -1.5 s to -0.5 s) (mean = 0.036 m, i.e. +50%; $p < 0.05$). The RSI variability was also lower for the last periods (8, 9, and 10, from 0.5 s to 2 s; mean = 0.026 m) compared with periods 4 and 5 (+38%; $p < 0.05$) (Figure 1a).

A main effect of Period was found for the GC-RP in the lateral direction [$F(11, 341) = 1.893$, $p < 0.05$, $_{p}\eta 2 = 0.052$). The post-hoc analysis showed the greater variability of GC-RP for period 4 [-1.5 s; -1 s] (9.45°) compared with all other periods (mean = 4.38°, i.e. +115%; $p < 0.05$) (Figure 1b).

1a



1b

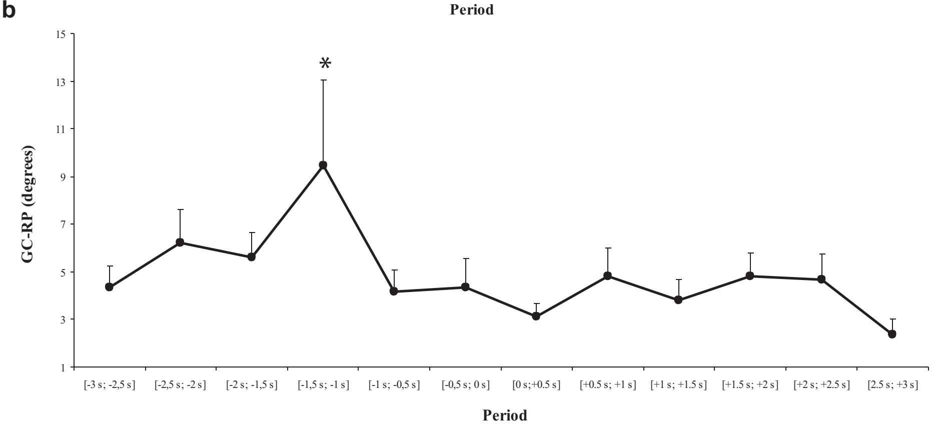


Figure 1. Significant effects observed. 1a. Relative stretch index (in metres) as a function of period (×12) in the lateral direction. 1b. Relative phase between the geometrical centre displacement of each team (GC-RP) (in degrees) as a function of period (×12) in the lateral direction. Note: Error bars correspond to the standard error.

TIME SERIES PLOT AND QUALITATIVE DESCRIPTION OF A TYPICAL SINGLE SEQUENCE

Figure 2 shows the dynamics of each performance indicator for the lateral and longitudinal directions used in the analysis of a single drive (i.e., the drive coded 2.2 in the notational

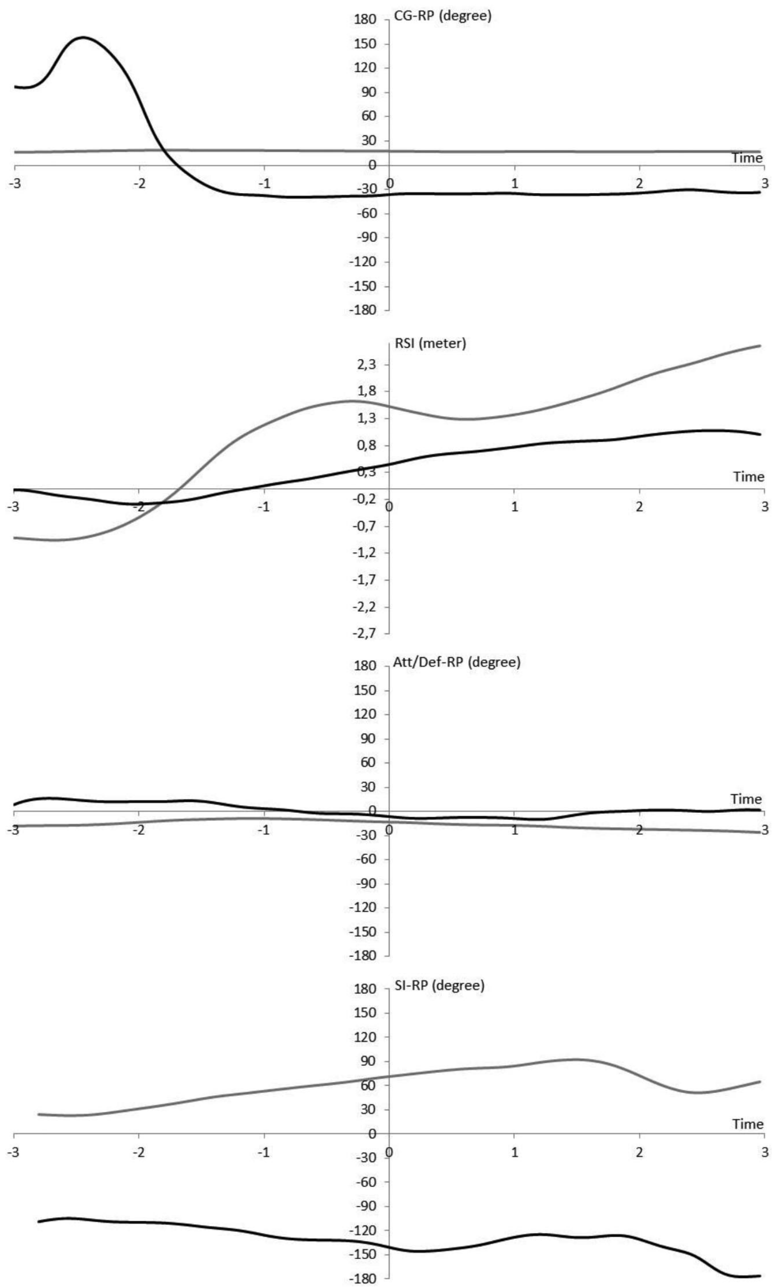


Figure 2. Typical individual sequence: Time series plot of the single sequence coded 2.2. The drive included in this sequence began at the 0-s time code.

analysis). This drive was particularly representative of the statistical results obtained in the inferential step of analysis. The 0 second on the timeline of the graphs is the moment at which the drive was initiated. This offensive sequence was qualified as a 'fast play' in the notational analysis. The graphs show two main variations in CG-RP and RSI. At -2.5 s the variations correspond to the moment at which the offensive wing player of Team A received the ball in the left wing of his offensive half-court. At this time, most of the Team B defenders were around the lateral centre of the field or on the other wing, whilst most of the players of Team A were around the lateral centre of the field or on the left wing. This difference explains in part the disruption observed in the relative phase between the two geometrical centres of the two teams. Immediately, most of the Team B defenders collectively contracted in both longitudinal and lateral directions in order to ensure the equilibrium of their occupation of the field (-1 s to -0 s on the timeline) and to get closer to the ball. This collective movement can be mainly observed in the dynamics of the relative stretch index from -2 s to 0 s in the lateral direction. Together, the acute offset in the geometrical centres and the ongoing contraction of Team B provided the A3 player an affordance to drive (0 s on the timeline). No specific event or disruption was observed in the dynamics of the relative phase of the attacker-defender dyad. During the drive, the defender was a little delayed but followed the attacker up to the basket. This single case illustrates how a drive was performed in relation to inter-team events and the dynamics of these events. No particular game constraints were identified within the attacker-defender dyad or the relative phase of the respective team stretch indexes.

DISCUSSION

The results of this study are discussed from three perspectives: a) the multi-level nature of the constraints leading to a drive in basketball, b) the relevant time scale for observing game constraints, and c) the practical implications for basketball.

THE MULTI-LEVEL NATURE OF THE CONSTRAINTS LEADING TO A DRIVE

Our results of the dyadic analysis showed that the beginning of the drive was not preceded by a disturbance of the dyadic relationship between ball carrier and immediate defender (i.e., there was no significant differences in variability in the attacker/defender relative phase [Att/Def-RP] in lateral or longitudinal directions). However, fluctuations preceding the initiation of the drive were pointed out at a team level. In inter-team coordination, significant differences in variability were observed for the relative phase between the respective team geometrical centres (GC-RP) and the relative stretch index (RSI), although only in the lateral direction for both. After the drive, no significant fluctuation was observed in the lateral or longitudinal direction. The results thus seem to suggest that the action of a drive during an official basketball match is mainly constrained by inter-team spatial-temporal relations, which suggests the need for an inter-team-oriented approach to individual action understanding.

These results allow us to suggest that the multi-level nature of game constraints should be more systematically considered in the analysis of individual actions in basketball, and more generally in team sports. Although dyadic study of the interpersonal coordination tendencies surrounding crucial actions is useful (e.g. attacker/defender dyad) [11], this level of investigation may be considered as complementary to one focused on inter-team-related constraints. In addition, researchers should bear in mind that the game constraints under study at a particular time are inevitably non-exhaustive. Thus, with respect to research assumptions, the informational constraints that sustain players' and teams' possibilities for action might be identified carefully due to the complex relations forged and broken continuously. For example, our findings suggest that informational constraints identified at higher levels of analysis than the attacker/defender relationship (e.g., inter-team level of constraint) may have a greater impact than the dyadic one in a given situated action. Consequently, the local constraints [30] that support the dynamics of the activity may also be considered as macroscopic in nature, as is the case for the inter-team coordination dynamics [15-18] that supported individual actions in the present data set.

Based on multiple performance indicators used to account for the game constraints, the results of the present study revealed that certain performance variables may also be especially relevant to account for the game dynamics in basketball in a general point of view. The significant role of fluctuation in the relationship between geometrical centres highlights the value of GC-RP variable and notably reinforces the first observations of Bourbousson et al. [3] in the description of the conditions for shooting attempts. This preliminary study of the conditions that sustain shots to the basket suggested that disturbances in GC-RP partially explain the emergence of a shot to the basket (i.e., particularly those shots identified as arising from previous teamwork). The present results complement these findings and indicate that deviating from an in-phase relationship between geometrical centre dynamics may also be a pre-existing condition for a drive to the basket. Indeed, it may be a critical parameter for understanding the balance of power in basketball and thus calls for further investigation to test training methods based on this inter-team performance indicator.

The significant fluctuations in the relative stretch index dynamics suggested properties that have never been described in basketball before. A previous investigation of the correspondence between game events and the relative stretch index showed that major variations in this collective variable were coupled with changes in ball possession [3]. However, shot attempts were shortly followed by the remarkable variations in this indicator (i.e. not preceding them), suggesting that these fluctuations may be an outcome rather than constraints that help to predict the key game events. The fluctuations before the beginning of the drive in the present study nevertheless suggest that a change in RSI can be a pre-existing condition to start the drive action. This result is of interest for future studies on the dynamics of RSI as an indicator that partially predicts game events.

THE RELEVANT TIME SCALE FOR OBSERVATION

Our results showed that the time scale for comparing the evolution in fluctuations was important. We used 3-s, 1-s, and 0.5-s time scales, but only the 0.5 time interval discriminated the variability differences. This result highlights the brief time suitable for capturing the game constraints in basketball, and thus the critical time available to high-level players for capturing relevant information for action. It points out the dynamic nature of the flux of interpersonal behaviours (i.e., social affordance) that help players to act. Moreover, given the apparently high complexity of the information supporting the action to drive (mainly grounded in the dynamics of inter-team variables), the short time span for anchoring players' behaviours in the game constraints seems to argue for a non-representationist view of cognition, or at least for highly embodied cognition [1, 31].

It is also possible that the fluctuations highlighted in this study were preceded by fluctuations in variables not captured in our investigation, and therefore the status of game constraint attributed to the GC-RP and RSI dynamics should be carefully considered. At the very least, we propose that researchers should investigate how players anticipate complex inter-team constraints using local perceptual cues and whether the fluctuations in inter-team dynamics are associated with prior fluctuations in variables (i.e., game constraints) not investigated here. Furthermore, the longer time span during which some variables fluctuated (i.e., significant fluctuations in RSI lasted 1 s, while fluctuations in GC-RP lasted 0.5 s) might encourage researchers to identify 'less-labile' information (i.e. informational constraints that are available for a longer time in the game dynamics) supporting the activity of players. Greater clarity on this point might offer practitioners an easier way to anchor players' actions in the fast game dynamics.

In sum, to explore the complexity of the game balance that gives rise to individual actions, the present study pointed out the team-level nature of the game constraints that afford the action of a drive in basketball. It also suggested that the information captured to act is dynamically complex and used in a brief suitable time interval.

PRACTICAL IMPLICATIONS

Our results demonstrated that the action of a drive in a real competitive basketball game was grounded in teammates' and their opponents' movements, especially the dynamics of the relationships between the teams (i.e., relationships between stretch indexes and geometrical centres). In sum, learning to start a drive in basketball may be embedded in a collective training task and not reduced to a one-to-one setting, which is usual in analytical training practices. In our opinion, the present study suggests the need for practitioners to prioritize the reading of inter-team offsets when they are teaching the drive. Players have to be attuned to the following inter-team offsets to optimise the selection of the drive action: a) an offset in the contraction/extension inter-team dynamics; and b) an offset in the dynamics of the synchronous movement of coordination between the two teams. A collaboration process with French basketball coaches involved in talent development and high-level coaching made them able to develop new training tasks. The task design described in Figure 3 illustrates a way to consider the present results.

First, the task is designed to be collective and competitive. In the illustration, it integrates three attacker/defender dyads playing together. Second, in order to facilitate a disruption in GC-RP, one player is added to the attacking team as a freely-screening player – that is, a "joker" – a player who systematically plays with the attacking team, but cannot shoot a basket – and is responsible for disturbing the defenders in making screens only for non-ball-carrier attackers. Third, to allow the drives to be anchored during a contraction/extension offset, it was assumed that the expected drive will start after the defenders significantly move from their standard stretch index. For this reason, it was proposed to add a rule: 'the drive immediately following a drive scores double', with this second drive having a high chance of starting in an expansion/contraction fluctuation. Together, these elements constraint the game dynamics and supply a background against which coaches can then teach the who, when and how of driving conditions, ensuring that the players capture some of the pre-existing competitive conditions and facilitating their reading of the collective context that calls for a drive [32].

PERSPECTIVES

As we worked with competitive real-world settings, we could not build our study in directly manipulating the game and informational constraints. Therefore, fluctuations and disturbance of the indicators' dynamics (i.e., variability) were used to identify how the interpersonal variables under investigation were linked to the drive action (i.e., action to go to the goal) [25]. We thus assumed that variability would have meaning and would reflect some of the acting constraints that called for a given action under consideration.

The approach we used might be of interest in match analysis in that it offers new insights

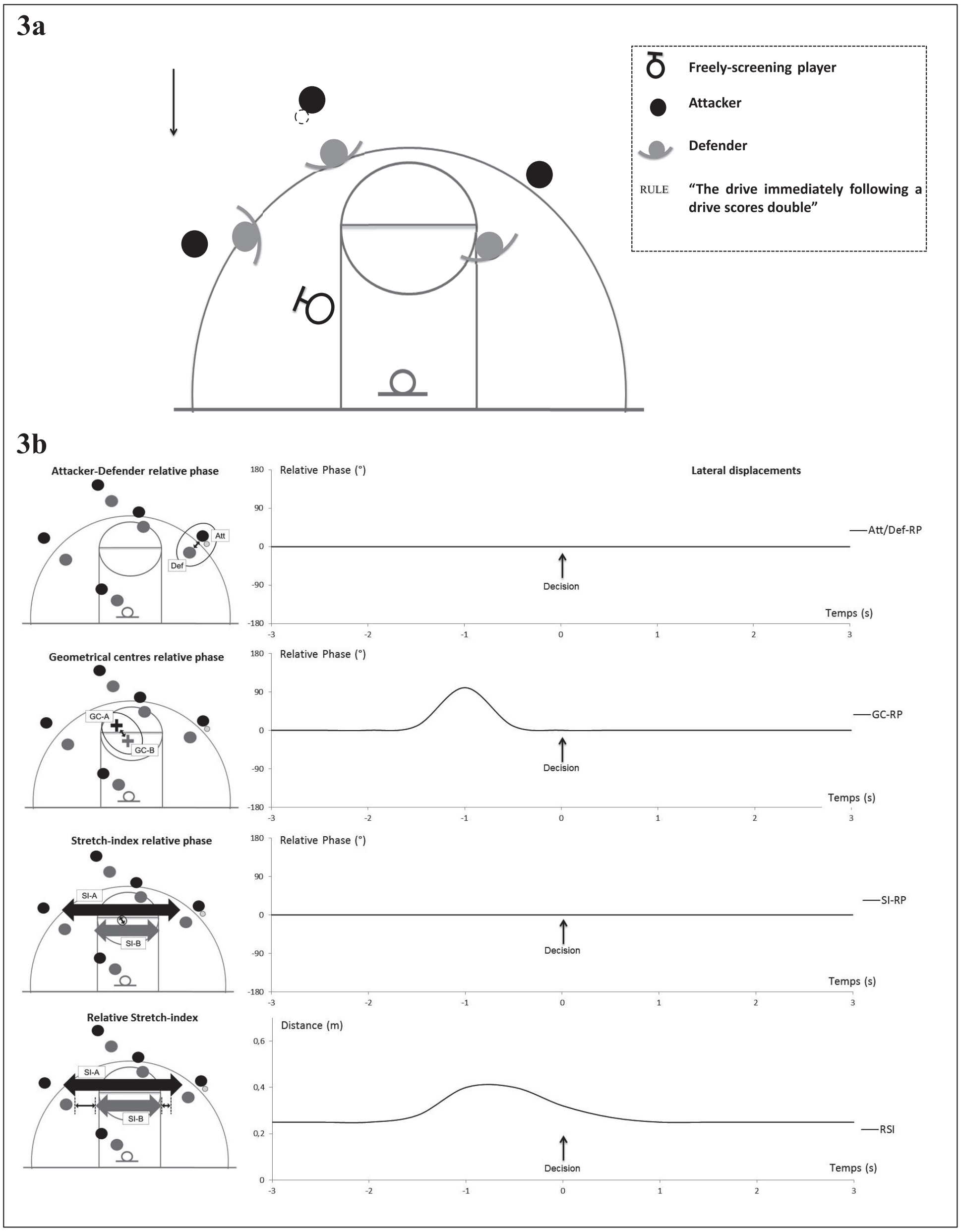


Figure 3. Illustrative training task design. 3a. How to decide to start a drive is taught in a collective three-on-three contest. The freely-screening player and the additional rule aim to help players to focus on the team-related constraints. 3b. Variable dynamics that are particularly expected from this training task and from the constraints imposed on the performer-environment interactions.

into team-oriented game constraints. We thus assume that conceptualizations in which the game constraints may be locally driven [30], but account for a more macroscopic level of description [15] are needed within the ecological dynamics framework.

CONCLUSION

From a research point of view, the multi-level approach offers new directions for future experimental studies, particularly with regard to building the ecological validity of the protocols. From a practical point of view, shifting from a constraints-led approach to a multi-level constraints-led approach may constitute a valuable contribution to the debates on team sports training, particularly those dealing with the need (or not) for team-oriented training in individual decision making.

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