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Collective behaviour in basketball: a systematic review

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Abstract

We aimed to review and organize current literature about basketball collective behaviour assessment to categorize the most common research topics, main findings and shortcomings of the analysis made. Literature was sought via an electronic search of three databases: Scopus, Web of Science, and SportDiscus. Systematic review principles were used to identify and select potential eligible studies according to defined inclusion and exclusion criteria. In total, 322 studies were identified in the original database search, including 45 after the screening process. Then, articles were classified regarding topic and tactical factors explored (game context, game phase and players' role, and game condition). Current findings contribute to a better understanding of tactical assessment and game structure in basketball. The set of results extracted and discussed provide accurate information about the state of art in basketball collective behaviour assessment. We detected a lack of studies exploring tactical behaviour from a complex, dynamic, and holistic point of view, as well as an absence of longitudinal designs. Besides, reports about the influences of game context in basketball tactical performance are sparse. Information reported might result of great interest for coaches and staff, contributing to better characterize match performance in basketball and subsequent development of tactical training enhancement programs. Additionally, the summary and classification provided may serve as a useful guide to future research in basketball.

Key words: Spontaneous behaviour, direct observation, interaction, sport.

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1. Introduction

In essence, team sports are defined by the collaborative and opposite relationship of two confronted teams, whose behaviours are determined by well-defined game objectives but in opposite directions. As so, while attackers try to make progress toward the goal or get the ball to effective scoring zones, the opponents try to avoid it, or while ones try to keep the ball, the others try to recover it (Cárdenas, Piñar, Sánchez & Pintor, 1999; Gréhaigne & Godbout, 1995). In this context, players are constantly solving problems by cooperating and interacting to perform collective actions focused on attacking the opponent's court, disturbing the defense to obtain an advantage, and defending their own court (Carling, Williams, & Reilly, 2007; Garganta, 2009). For this purpose, coaches and players develop a strategy (defined as a general plan and action guidelines before a match) and tactics (specific manoeuvres executed by the players during a match to adapt to the constant changes that occur during the confrontation) to achieve accordingly the collective aims required to deal with match demands (Gréhaigne, Godbout, & Bouthier, 2001; Gréhaigne & Godbout, 2013).

In sports practice, the assessment of collective behaviour is widely accepted since it offers useful qualitative and quantitative information to improve performance by supporting the training process and preparation for the match (Lames & McGarry, 2007; Lemmink & Frencken, 2013). As a result, there is an on-going challenge to obtain accurate and complex descriptions of game behaviours, quantified objectively, to provide meaningful information about the competition process (Carling, Wright, Nelson, & Bradley, 2014; Lebed, 2006; McGarry & Franks, 2007; Schmidt, A., 2016). For this aim, notational or match analysis constitutes a great tool for coaches, providing objective recording and examination of behavioural events of one or more players during training or competition to detect performance indicators (Hughes & Franks, 2004, 2007). These methods have gained interest since allow players to act in their natural environment, allowing the observation of emerging spontaneous and creative behaviours which enrich considerably the quality and external validity of records (Balague, Torrents, Hristovski, Davids, & Araújo, 2013; Memmert, 2013). This information results in great benefits for coaches in defining the game style and developing training programmes according to competition demands (Gréhaigne et al., 2013; Maslovat & Franks, 2008; McGarry, 2009; Sampaio, Lago, & Drinkwater, 2010). However, although during the last decade the research on performance indicators across team sports has grown considerably (Drust, 2010; O'Donoghue, 2009), there are some limitations from a tactical point of view (Lemmink & Frencken, 2013). Given the complex nature of basketball, tactical assessment should integrate as much factors as possible in order to better describe players' behaviours in a competition context. Reviewing the literature, we can classify three main factors to consider when performing tactical analysis (Table 1): (i) Game context: players' behaviour may be altered by the situation of the game (game period, game location, match status, quality of opposition)(Gómez, Lago-Peñas, & Pollard, 2013; McGarry, 2009). Likewise, specific team features such as age, gender or players' specific position, must be considered (Sampaio, Ibáñez, & Feu, 2004); (ii) Game phase and players' role: players' function relies on the specific position (e.g., guard, forward and centre) and the possession of the ball, therefore tactical aims will vary regarding the game phase (offence, defense, or transition). Additionally, these behaviours are much influenced by those of the opponent; in other words, to understand the reason for an offensive action, it is crucial to study the consequent defensive response (McGarry, 2009; O'Donoghue, 2009); (iii) Game condition: according to Garganta (2009), tactical performance must be analyzed considering latent variables such as the place of action (space), the action time (time) and the type of task (players' actions and interactions). Finally, tactical assessment needs to include an outcome

measure, not only focused on the scoring actions, finishing position in competitions, world ranking etc., but also on others that permit us to observe teams' production (e.g., opposition degree when shooting, numerical advantage situation).

Therefore, the purpose of this study was to systematically review and organize the current literature in basketball tactical assessment to identify the most common research topics, the main findings, the shortcomings of the analysis made but, at the same time, the gaps in the specific literature. Understanding the evidence of specific tactical behaviours in basketball, along with knowledge regarding sample, aims, and variables explored, may assist in optimizing future research designs, as well as helping coaches to improve the training process.

Table 1. Factors to consider when performing tactical behaviour assessment in basketball.

Tactical Analysis in basketball	
Game Context	
<i>Team features</i>	<i>Situational variables</i>
Age	Game Period
Gender	Game Location
League/Stage	Match Status
Physical/Psycho condition	Quality of opposition
Game phase and players' role	
<i>Game phase</i>	<i>Players' role</i>
Set offence/Defence	Specific position
Transition offence/defence	Attacker with/out the ball
	Opponent with/out the ball
Game condition	
<i>Latent variables</i>	<i>Outcome</i>
Space	Effectiveness/ efficiency
Time	Game result
Movement pattern	Offensive/defensive aim
Players' action/interaction	
Numerical situation	

2. Methods

2.1. Design

Systematic review principles were employed (Cartwright- Hatton, Roberts, Chitsabesan, Fothergill, & Harrington, 2004; Cummins, Orr, O'Connor, & West, 2013; Durlak & Lipsey, 1991; Webster & Watson, 2002) to conduct a search of three electronic databases (Web of Science, Scopus, and SPORTDiscus) using the following keyword combinations: Basketball AND ("collective behav*" OR "tactic* analysis" OR "tactic* performance" OR "tactical indicator*" OR "performance indicator*" OR "performance analysis" OR "match analysis" OR "notational analysis" OR "game analysis" OR "observational analysis"). The last search was carried out on September 2015.

2.2. Inclusion and exclusion criteria

Studies had to have (a) variables pertaining to tactical analysis in basketball, (b) players' behaviours recorded through observation of the competition, (c) been original studies, and (d) been peer-reviewed studies (source: Ulrichs web and journal available information). Exclusion criteria were: (a) wheelchair basketball, (b) unregulated basketball competitions, and (c) included sample matches before 2000, due to the modification of rules by the Federation of International Basketball Associations (FIBA) (i.e., reduced the time from ten to eight seconds for offensive players to move the ball forward into the offensive court, and time to take a shot once the offence takes possession of the ball from thirty to twenty-four seconds), and the evolution of technologies and devices used by researchers. Abstracts and conference studies were not included due to not achieving the rigor of outcome measures. No sample restrictions related to sex, age, or category was made. Studies written in the English, Spanish, Portuguese and Greek languages were included.

3. Identification and Selection of Studies

Figure 2 presents a PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) flow diagram summarizing the search results. In total, 322 studies were identified in the original database search (Scopus = 84; Web of Science = 113; SportDiscus = 125). After removing duplicates using a computer-based reference management system (EndNote X6, Thomson Reuters, New York, USA), two individual researchers performed the first-stage screening of titles and abstracts against an eligibility criterion over 202 studies. Authors of the publications were masked from the reviewers. References not eliminated were subjected to a second-stage screening of the full text based on inclusion and exclusion criteria. To ensure a quality appraisal of the review process (Wright, Brand, Dunn, & Spindler, 2007), an agreement measure between two individual researchers was performed using Cohen's Kappa calculation. Scores of $k = .91$ and $k = 1.00$ were recorded for the first- and second-stage screening, respectively. Disagreements were resolved by discussion or via a third researcher. Finally, to ensure a relatively complete census of relevant literature, one researcher performed a backward-forward references search, reviewing the references and citations of studies included (Webster & Watson, 2002). Moreover, a second-level backward references search was done by pulling the references of the references (Levy & Ellis, 2006). At the end of the process a total of 45 studies were included for current systematic review.

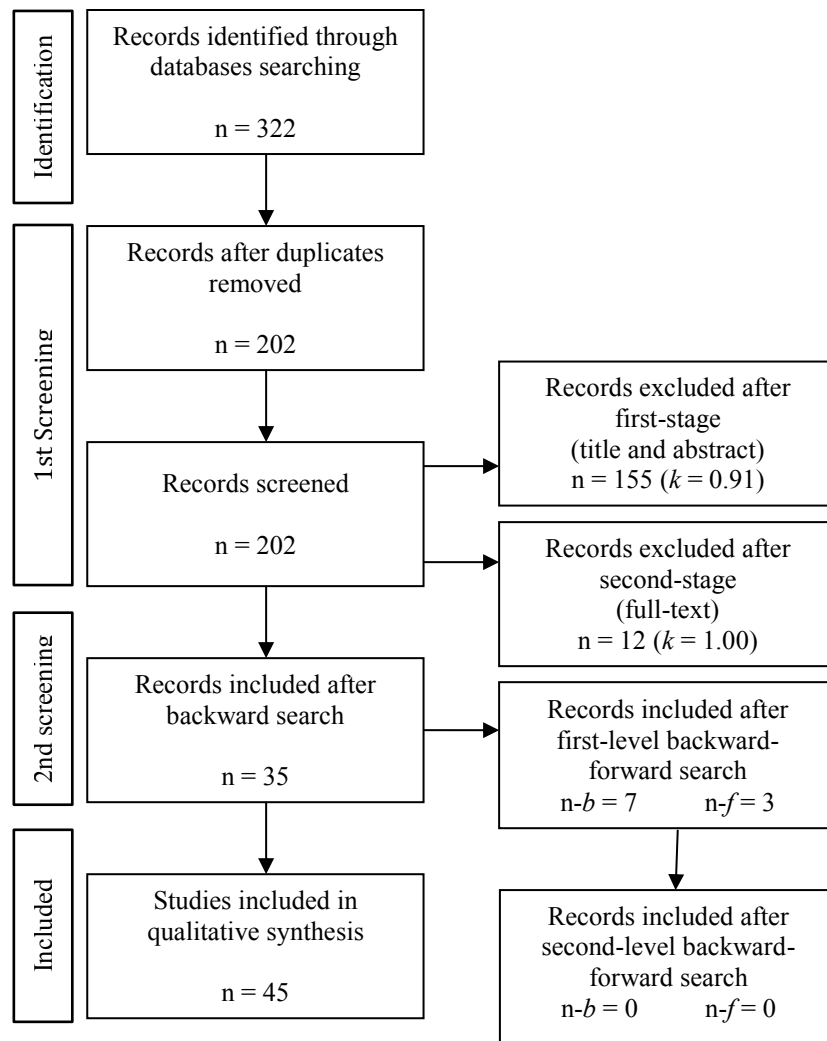


Figure 2. PRISMA flowchart illustrating the literature search at each stage. PRISMA Preferred Reporting Items for Systematic Reviews and Meta-Analyses.

3. Results

3.1. Descriptive Characteristics of Included Studies

A summary of included studies in the systematic review is provided in Table 2. Considering information available, this systematic review included, at least: 1,179 matches (28.9 ± 33.5 in average; $n=41$), 92,298 ball possessions ($4,151.4 \pm 4,893.8$ in average; $n=19$), 7,892 shots ($3,946.0 \pm 602.0$ in average; $n=2$) and 2,143 fast breaks (428.6 ± 256.9 in average; $n=5$). The vast majority of studies exclusively described male samples (85.7%), especially from senior professional players pertaining to basketball clubs (57.1%). On the contrary, we found sparse research about female basketball, youth ages, amateur samples and national teams.

3.2. Classification analysis

Chronologically, although this review comprised articles from 2004, it was observed an important growth of publications about basketball tactics in the recent years (2009-2015: 29/45, 75.5%). According to specific tactical factors measured, authors mainly explored individual players' actions (71.1%) - particularly from the player with the ball – during the

set offence (82.2%), including variables related to space (57.7%), time (33.3%) and numerical situations (22.2%). Conversely, there is sparse research with regards to game context influences and players' interactions (i.e., how players' behaviour affects upon one another).

4. Discussion

Analysis of the literature allowed a clear understanding of specific research topics. The present review was based on a total of 45 studies from 2004 to 2015 aimed on investigating basketball tactical assessment. As a result, we were able to highlight main findings and the shortcomings of the analysis made, as well as identify gaps in existing knowledge. Previous reviews have been conducted on collective behaviour in sport (Mackenzie & Cushion, 2013; Moore, Bullough, Goldsmith, & Edmondson, 2014; Sarmiento et al., 2014). However, to the best of our knowledge this is the first systematic review exploring players' tactical assessment in basketball. This article may serve as a starting point for future research providing further insights into this research topic.

4.1. Game context

Although evidence suggests an important influence of game context in sport behaviour (Glazier, 2010), information available in basketball tactical performance is sparse. Age comparisons showed similar prominent tactical position regardless the competitive level (Clemente, Martins, Kalamaras, & Mendes, 2015). Likewise, Lamas et al., (2011) observed that young players used similar interactions to disrupt the defense (Space Creation Dynamics); however, there was a prevalence of dribble with the ball in younger players (U12 to U15 years), as well as on ball screen in older ones (U-16 to seniors). Moreover, an apparent players' specialization emerge since young stages, clearly defining players' position such as point guard (originates most of the passes for the team-mates) and post player (keeps the farthest distance from the point guard and the closest to the basket) positions (Ortega, Cardenas, De Baranda, & Palao, 2006; Ortega, Cardenas, Sainz de Baranda, & Palao, 2006; Ortega, Cárdenas, Sainz de Baranda, & Palao, 2006; Piñar et al., 2014). Nevertheless, despite the importance of tactical-decision learning during formation years in basketball (Gréhaigine, Wallian, & Godbout, 2005), there is a lack of studies regarding which game style will better promote and guarantee players' development. In this sense, it is suggested to focus on children's global concepts understanding as well as maximizes individual skills with the ball during initial stages (Mitchell, Oslin, & Griffin, 2013).

Concerning gender differences, Gómez et al. (2013) revealed greater influence of game context in professional female basketball compared to male one, particularly regarding league stage and match status. Further, players' positions and spatial factors had more implications in female basketball (i.e., higher effectiveness when forward players ended at the inside or 2-point regions). More specifically, Romarís et al., (2012) observed differences on game style among genders. Professional male teams used ball screens in three out of ten ball possessions, achieving high efficacy; in females, movements without ball, ball circulation, and off ball screens are the most favorable and effective actions for the completion. Moreover, Fylaktakidou et al. (2011) suggested differences on defensive game style according to gender, as female teams made more turnovers per every ten attack compared to males, mostly due to passing error in the perimeter and especially against zone defenses. Regarding transition game, Refoyo et al. (2009) found that females initiated more fast breaks through rebound and males through interceptions, achieving also greater effectiveness.

Related to game period, authors agreed that professional teams decreased their offensive effectiveness throughout the game due to an increment on defensive pressure (Gómez, Lorenzo, et al., 2013; Gómez, Tsamourtzis, & Lorenzo, 2006; Ibáñez, García, Feu, Parejo, & Cañadas, 2009; Ortega, Fernández, Ubal, Lorenzo, & Sampaio, 2010). Offensively, it was observed greater effectiveness when teams adopted faster game pace (i.e., shorter possession duration and less than one pass) at the beginning of the game; conversely, playing longer possessions and involving more players increased scoring options particularly during the last five minutes. This may be a consequence of teams' adaptation against defenses increasingly aggressive, being a strategy to secure the ball possession by slowing down the game pace and developing. Besides, the longer the team plays, the less time remaining for the opponent to overcome the score disadvantage. Defensively, teams should pay attention on screens, avoid inside passes, forced the opponent to end from far distance, and performing a variety of defensive systems, particularly during the last five minutes of the game. Interestingly, Gómez et al. (2013) observed greater point differences on the scoreboard in the first and third periods of the game, thus coaches should ensure keep the best combination players on court during these periods to increase winning options.

According to Gómez et al. (2010), game location appears to slightly affect on defensive strategies. Although both home and away teams received the same amount of points regardless the defensive strategy adopted, home teams recovered more balls when using zone and press defenses. Nevertheless, which seem to be important here would be exploring if teams change their game style when playing at home or away. Finally, Gómez et al. (2013) detected that match status particularly affected on female teams, decreasing their effectiveness when scores were unbalanced (i.e., losing for 3 to 10 points). Likewise, women teams developed different game styles according to the league stage (i.e., regular league vs. playoff).

4.2. Game phase and players' role

Set offence was by far the most prevalence game phase studied, probably because more than eight out of ten total match possessions are played during a structured game. To increase scoring options, authors highlight the importance of 1vs1 situations, screens, ball circulation (pass and reception), and space creation dynamics during the set offence (Courel, Suárez, Ortega, Piñar, & Cárdenas, 2013; Gómez et al., 2015; Lamas, De Rose Junior, et al., 2011; Muñoz, Serna, Daza, & Hílono, 2015; Santana et al., 2015). Additionally, some authors have explored set defense, finding that man-on-man was the most used style, but half-court zone resulted more effective. Plus, specific dynamics like that derived from the use of switches and helps seem to have relevant influence on defensive performance, as the majority of shots in elite were done against high pressure (Álvarez, Ortega, Gómez, & Salado, 2009; Fernández, Ortega, Ubal, Gómez, & Ibáñez, 2010; Mexas, Tsitskaris, Kyriakou, & Garefis, 2005; Ortega et al., 2010). Nonetheless, these studies did not consider the influence of players and teams features and characteristics on collective actions, as well as they explored these actions in isolation. Future analyses should explore tactical patterns and combination of behaviours for better defining game styles and players' role during set offence.

Transition game has been widely studied due to the higher success rate of fast breaks, being a distinguishing factor between winning and losing teams (Cárdenas, Piñar, Llorca-Miralles, Ortega, & Courel, 2012; A. Garefis, Tsitskaris, Mexas, & Kyriakou, 2007; Refoyo et al., 2009; Tsamourtzis & Athanasiou, 2004). Overall, fast breaks accounted for the 15% of total game attacks in elite teams, mostly lasted between 3 and 6 s in duration, and reached a success rates of 75% in males and 66% in females. Besides, teams recovered the ball through

rebounding or stealing the ball, started with an outlet pass (preferably received in the frontcourt) rather than dribbling, and finished near the basket after a 1vs0, 1vs1 or 3vs2 situation. Regarding transition defense, full-court pressing accounted for 10–17% of defensive actions, and 25–40% included direct pressure against the player in possession of the ball during transitions (Álvarez et al., 2009; Fernández et al., 2010; Ortega et al., 2010). Nevertheless, as stated before, teams increased full-court press during the last five minutes as a potential strategy for achieving success if they were behind the score.

Concerning specific players' position, it seems easy to classify two major groups (outside and inside players) during formation stages, getting more specialized (point guard, shooting guard, small forward, power forward and centre) in senior and elite teams (Clemente et al., 2015; Gómez et al., 2015; Karipidis, Mavridis, Tsamourtzis, & Rokka, 2010; Muñoz et al., 2015). More interestingly, Leite et al. (2014) found higher offensive efficacy in an elite team when playing in 5x5 game format with a post player rather than a five-open system (i.e., without post player). As so, authors have defined specific aims that characterize players according to their specific position. For instance, point guards are responsible for organizing the attacking process, and dominate passing and ball dribbling skills (particularly in 1vs1 and screens situations). Outside players (forwards) are specialist in shooting for far distance and play an important role during fast breaks by receiving the outlet pass and finishing (either shooting or passing). Centre or post players need to dominate receiving and shooting skills (preferably at the inside and against defensive pressure), as well as being good rebounders and blockers. Moreover, players' role analysis has been chiefly focused on the player with the ball. However, most recent studies showed interest in exploring specific attacker and defender roles, particularly when performing on ball screens and using space creation dynamics (Gómez et al., 2015; Santana et al., 2015).

4.3. Game condition

Researchers have identified a variety of game conditions that may have an effect on tactical performance. Spatial analysis showed a higher predominance of actions performed at the perimeter (Karipidis et al., 2010; Mavridis, Tsamourtzis, Karipidis, & Laios, 2009; Mexas et al., 2005). Additionally, results indicated greater offensive effectiveness when getting the ball to reach the closest positions to the basket by an inside pass or dribbling towards the basket (Courel et al., 2013; Mavridis, Laios, Taxildaris, & Tsiskaris, 2003; G. Mavridis et al., 2009; Mexas et al., 2005; Muñoz et al., 2015). Therefore, players' inside-outside coordination would increase shooting attempt near the basket and enhanced unmarked long-distance shots opportunities by an open pass (Bourbousson & Sève, 2010; Bourbousson, Sève, & McGarry, 2010a; 2010b; Courel et al., 2013; Csataljay, James, Hughes, & Dancs, 2013; Lapresa, Alasua, Arana, Anguera, & Garzón, 2014; Lapresa, Anguera, Alasua, Arana, & Garzón, 2013; G. Mavridis et al., 2009; Mexas et al., 2005; Muñoz et al., 2015; Sachanidi, Apostolidis, Chatzicharistos, & Bolatoglou, 2013). Bazanov, et al. (2006) explored the influence of temporal parameters on tactical performance through developing the Intensity Index (i.e., ratio of offensive actions such as dribbles, passes, screens, and shots, per time of ball possession in offensive zone). They found higher effectiveness when performing 7 to 10 actions during possessions between 8 to 9 s in duration, and low results when using over 15 actions during possessions longer than 16 s. Furthermore, teamwork intensity increased through active player cooperation (e.g., performing screens off the ball) during limited ball possession time (between 9 and 16 s).

Concerning numerical situations, authors agreed that outnumbering situations increased offensive effectiveness, especially when using 1vs0, 2vs1 and 3vs2 during transition phase

(Garefis et al., 2007; Monteiro, Tavares, & Santos, 2013; Refoyo et al., 2009; Tsamourtzis, Karypidis, & Athanasiou, 2005). In this line, fast break opportunities were enhanced when the 'outlet pass' (i.e., the first pass once a team recovers the ball) was received in the frontcourt (Fotinakis, Karipidis, & Taxildaris, 2002; Monteiro et al., 2013), resulting in a shot attempt close to the basket (Fernández, Camerino, Anguera, & Jonsson, 2009; Garefis et al., 2007; Refoyo et al., 2009). Moreover, fast break effectiveness increased when performing fewer actions across a shorter time duration (Bazanov et al., 2006; Refoyo et al., 2009). Therefore, to increase the scoring success during fast breaks, it seems crucial to gain space in the first few seconds in order to achieve a numerical advantage. Additionally, to increase the chance of fast breaks after recovering the ball, it is suggested that the team acquire numerical and/or spatial advantage during defensive rebounding (Ribas, Navarro, Tavares, & Gómez, 2011; Ribas, Navarro, Tavares, & Gómez, 2011; Tsamourtzis & Athanasiou, 2004).

Individual players' skills with the ball such as those involved in 1vs1 situations have important relevance both in young and elite basketball, increasing offensive success by enhancing shooting options, particularly from near the basket (Arias, 2012a, 2012b; Garefis, Xiromeritis, Tsitskaris, & Mexas, 2006; Karipidis et al., 2010; Muñoz et al., 2015). Garefis et al. (2006) found differences on 1vs1 dynamics regarding players' position, as outside players tended to face the basket while inside players used the post up. Additionally, Bourbousson et al. (2014) highlight the importance of collective actions during 1vs1 situations in order to disturb the defense and generate spatial advantage in favour to the player with the ball. When individual players' skills are not enough to beat the opponent, on ball screens are the most common options.

Group-tactical behaviours have been also specifically explored, suggesting that collective players' interactions like screening on or out of the ball provide greater offensive advantages, especially when overlapping with teammates' displacement focused on misplace the defense (Remmert, 2003). Gomez et al. (2015) explored screens effectiveness finding that tactical behaviours during ball screens are dependent on time, space, players, and task performance indicators. During the 8 final seconds of possession, ball screens are likely to be more effective as a result of a defensive disorganization and fatigue. Further, when the screen was orientated to the central zone or to the baseline it generates more space and indeed more possibilities for triangle passes, give and go actions or passes to open teammates. Concerning the type of screen, back screens and hand-off screens obtained higher effectiveness than the lateral screens. Besides, the screeners got the higher effectiveness after action when continuing to the basket. They also identified that the dribblers' action after the screen and the orientation of the screen were the most important predictors of ball screen effectiveness.

More specifically, little research has inquired on players' interactions through Space Creation Dynamics (SCD) during the set offence for defensive disruption (Lamas, De Rose Junior, et al., 2011; Lamas, Rostaiser, et al., 2011), identifying and classifying seven situations: space creation with ball dribbled (BD); space creation with ball not dribbled (BND); post isolation (PostI); perimeter isolation (PerI); space creation without the ball (WB); on ball screen (OnBS); and out-of-ball screen (OutBS). More interestingly, they observed that OnBS (34.8%), BD (14.9%) and PostI (16.7%) were the most effective ways to increase scoring opportunities in national teams. Besides, they reported differences on teams' tendencies in terms of its SCDs preferences, that is, game style differs according to players' characteristics and specific contextual situation. More recently, Santana et al. (2015) explored classes of defensive actions (i.e., Space Protection Dynamics - SPDs) for containing offense in basketball and studied their interactions between SCD and a respective SPD. Each SPD

situation included: i) the SCD performed by offense, which defines the number of players involved in an offensive action and the respective number of players involved in the defensive action; ii) the relative body orientation or displacement performed by the defender in relation to the attacker. After the validation process, they were enabled to identify offense-defense interaction patterns in basketball, finding that short sequences were more frequent than long ones. Additionally, the most recurrent concatenated patterns were similar among teams (e.g., “on ball screen” and “second + away” - defender passes over the screen with his defensive posture preserved and staying between the attacker and the basket, but the defender does not constraint the attacker displacement as a consequence of a help defense or positioning error), whilst less frequent concatenation patterns presented a great diversity among teams (e.g., specific actions planned to respond to particular offensive behaviours).

5. Conclusions

The growth of interest in basketball tactical analysis clearly reflects its potential to significantly contribute within the research of applied coaching practice. This development of scientific description for sports behaviours will lead ultimately to a furthering of game understanding to the benefit of sports practice. Current systematic review adds relevant insights on basketball understanding, suggesting a change on current basketball research scope on tactical assessment to improve game knowledge by exploring three main factors: game context, game phase and players’ role, and game condition. It is provided a novel summary of existing knowledge according the tactical factor explored to identify the most common research topics, the main findings and the shortcomings of the analysis made, which may serve as a useful guide to future research in basketball. From a practical point of view, considering the complexity of the strategic and tactical elements involved in a team’s performance, the present systematic review may contribute in the design of specific play situations increasing players’ decision making according to real game constraints, promoting the development of tactical intelligence and creativity.

Studies including in-depth analysis of players’ interactions and specific tactical behaviours (e.g., 1vs1, screens, SCD-SPD, inside pass) gives more accurate information, resulting greater useful for coaches and contributing better characterize match performance in basketball. Nonetheless, the vast majority of studies did not provide information regarding the sequence of actions, limiting the interpretation to isolated events rather than discovering effective tactical patterns. Besides, despite evidence suggests an important influence of game context in sport behaviour, there is a limited explanatory capability of basketball tactical performance due to the lack of contextual variables assessment. Finally, it is worth noting that we were not able to find any longitudinal study exploring players’ collective behaviours in basketball. This is interesting given that coaches’ aim is to lead one team to success along a season, thus researches would presumably provide better and accurate answers to actual competition problems across longitudinal assessments. Further, specific information about one-team game style evolution will results of great interest for discovering how these players change and adapt their behaviours to solve problems an succeed.

To the best of our knowledge, this is the first systematic review made on basketball tactical analysis, so we believe the information reported may have implications for future research in basketball, and subsequent development of tactical training and performance enhancement programs. On the one hand, classifying and summarizing the state of art of basketball collective behaviour boost the quality of future research by contributing in improving aims, methods and data interpretation. On the other hand, for coaching goals, definitions and

explanations on how players' act, interact, and cooperate may support both the training (designing tasks according to game constraints and demands) and competition process (helping in the match preparation and the selection of effective game plans and strategies).

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Table 2. Summary of included studies.

N°	Study	Sample	Topic	Factors				Main results
				<i>Game context</i>	<i>Game phase and players' role</i>	<i>Game condition</i>	<i>Game outcome</i>	
1	Clemente et al. (2015)	40 players (10 players U14; 10 players U16; 10 players U18 and 10 players in amateurs with more than 20 years)	Team-members cooperation	Age	Set offence Specific player position	Space Movement patterns	Effectiveness	Point guard was the prominent position during the attacking organization and that social network analysis it is a useful approach to identify the patterns of interactions in the game of basketball.
2	Gomez et al. (2015)	20 close games for playoff games of the Spanish Basketball League (2008–11).	Screens-on-the-ball	Game Period	Set offence Set defense Specific player position Attacker role Defender role	Space Players' actions Players' interactions	Effectiveness	Group-tactical behaviours during ball screens are dependent on time, space, players, and task performance indicator. The dribblers' action after the screen and the orientation of the screen as the most important predictors of ball screen effectiveness.
3	Santana et al. (2015)	6 games from Barcelona F.C. in Liga ACB – Spanish championship (2010-11)	Space Creation and Protection Dynamics (SCDs-SPDs)		Set offence Set defense Attacker role Defender role	Space Time Players' actions Players' interactions Numerical situations		Teams' utilization of sequences of SCDs and SPDs was similar and short in length. Additionally, combining a second action with the first positively impact on offense success.
4	Muñoz et al. (2015)	3 games from F.C. Barcelona Regal in the King's Cup in Spain (2013-14)	one-on-one and screens-on-the-ball		Set offence Specific player position	Space Players' actions Players' interactions	Effectiveness	Using one-on-one and screens-on-the-ball increased offensive success by enhancing shooting options (particularly from near the basket).
5	Bourbousson et al. (2014)	10 male professional basketball players	Players' relationship when driving the ball		Set offence Set defense Specific player position	Space Movement patterns		The beginning of the action occurred after a lateral disturbance in the coordination between teams' geometrical centres, thus learning to start a drive in basketball may be embedded in a collective training task.
6	Lapresa et al. (2014)	3 games from male Real Madrid in Minicopa 2012 (U14)	Offensive construction		Set offence Set defense	Space Time Movement patterns	Effectiveness	It would be a good idea to adapt the game of basketball in the youth category based on the clear difficulty that players find in proving themselves competent at making outside shots.

7	Piñar et al. (2014)	12 games from U14 male players	Game characteristics		Set offence Set defense	Time Players' actions	Effectiveness	U14 players may be likely to improve if it change some of the values obtained in the analyzed variables.
8	Courel et al. (2013)	9 games from 2012 male Euroleague Playoff	Inside pass		Set offence Attacker role	Space Time Players' actions Players' interactions	Effectiveness	Attack phase including inside pass were more effective and achieved a larger amount of points. Plus, passer location and immediate receiver action determinate a successful inside pass, being the outside pass with an inside reception the most effective option.
9	Csataljay et al. (2013)	26 games from Hungarian male first division basketball teams (2007-08)	Defensive pressure		Set offence Set defense		Effectiveness	Winning teams achieved more effective shooting percentages as the consequence of better team cooperation, because players could work out more opened scoring opportunities without any active defensive presence.
10	Gómez et al. (2013)	40 games (20 regular season and 20 playoff) from Spanish male and female professional basketball leagues (2006-07)	Ball possession effectiveness	Gender Game period Game location Match status League stage	Set offence Set defense	Space Time Players' actions Numerical situations Players' interactions	Effectiveness Game result	There were important differences between male and female basketball teams performance regarding match status, game period, screens, and possession duration, ending and starting zone and players' position.
11	Lapresa et al. (2013)	3 games from male Real Madrid in Minicopa 2012 (U14)	T-patterns		Set offence	Space Time Movement patterns Players' actions	Effectiveness	Regular structures in the game that show the detected T-patterns, equally in sequences that result in a basket as in those that lead to a miss, have allowed us to obtain particularly relevant information concerning the development of effective and ineffective sequences.
12	Leite et al. (2013)	13 games from regional and national competitions U14 players (2009-10)	Offensive game style		Set offence	Time Players' actions Players' interactions Numerical situations	Effectiveness	When playing in 5x5 game format with a post player, the teams obtained higher values in offensive efficacy.
13	Monteiro et al. (2013)	12 games from female and male U16 Porto basketball season (2009-10)	Fast break	Gender	Fast break	Movement patterns Players' actions Numerical situations	Effectiveness	Females initiated fast break by defensive rebounds, and males through interceptions. Both developed fast breaks by pass. The most common situations were 1 x 1 and 1x0 and finishing with a lay-up. Male teams completed a larger number of fast break and more efficiently.

14	Sachanidi (2013)	3 games from U15 male basketball teams	Passing skills and performance		Set offence	Players' actions Numerical situations	Effectiveness	Performance in passing skill test was not correlated with passing efficacy or with total performance in the games. On the contrary, passing efficacy in the games was significantly correlated and could clearly predict the overall performance of the athlete.
15	Arias (2012a)	16 games from U12 male basketball teams	One-on-one		Set offence	Players' actions Numerical situations	Effectiveness	The relationship between opportunities and success in one-on-one situations was .89, increasing shooting opportunities and shooting with success.
16	Arias (2012b)	24 games from U12 male and female basketball teams	One-on-one		Set offence	Players' actions	Effectiveness	Over one per each two possessions included one-on-one situations. Further, one-on-one situations increased shooting attempts and possession success.
17	Cárdenas et al. (2012)	12 games from male Eurobasket finals (2009)	Fast break		Set offence Fast break	Space Movement patterns	Effectiveness Game result	Winning teams made more fast breaks, were more effective (especially near the basket), and received the outlet pass in more forward zone. So significant differences between winners and losers in the transit zones
18	Romarís et al. (2012)	26 games from Spanish male and female Professional leagues (2009-10)	Completion action	Gender	Set offence Fast break	Players' actions	Effectiveness	Screens-on-the-ball are the most use an effective completion in males (in women, movements without ball, ball circulation and individual moves). Fast breaks are conditioned by the type of offence they belong; completion action is associated with the completion area.
19	Fylaktakidou et al. (2011)	43 games from female Greek Professional league (2005-10)	Defensive effectiveness		Set offence Fast break	Space Time Players' actions	Effectiveness	Two out of ten possessions stops after turnover, mostly due to passing error, during the set play and at the outside. Zone defences are quite common for female, being more effective for winning teams
20	Lamas et al. (2011a)	12 male games from 2008 Olympic Games	Space Creation Dynamics (SCDs)		Set offence Attacker role	Space Players' actions Players' interactions		The seven SCDs situations are a valid observational system for classifying the offensive behaviour related to defensive ruptures of a basketball team.
21	Lamas et al. (2011b)	46 games from all categories of 2008 Campeonato Paulista de Basquetebol Masculino (U12 to Senior amateur)	Space Creation Dynamics (SCDs)	Age	Set offence Attacker role	Space Players' actions	Effectiveness	SCDs diversity and effectiveness presented no significant difference among all age groups. However, "Dribble with the ball" was mostly used for younger players (U12 to U15 years) and "screen on the ball" for the older (U-16 to seniors).

22	Ribas et al. (2011a)	46 games from Top 16 Euroleague (2009-10)	Defensive Rebound		Set offence	Players' actions Numerical situation		Outnumbering situations (both offensive and defensive) increased rebounding options.
23	Ribas et al. (2011b)				Set offence	Space		Near 91% of all rebounds were obtained inside the paint while there were no rebounds in three point zone. When shoots were taken inside the paint, rebounds were obtained at the same side.
24	Bourbousson et al. (2010a)			1 men's professional basketball game in France (2008)	Space-time coordination	Set offence Set defense Fast break	Space Time Movement pattern	
25	Bourbousson et al. (2010b)	Set offence Set defense Fast break	Space Time Movement pattern				Relative-phase analysis of the spatial centres demonstrated in-phase stabilities in both the longitudinal and lateral directions, with more stability in the longitudinal than lateral direction	
26	Fernández et al. (2010)	13 games of the Dimayor Chilean Championship Playoffs (2006)	Defence		Set defense Transition defense Defender role	Players' actions	Effectiveness	The most used defense type was man-to-man. In contrast, pressure in transition, switches, and helps were not often used. Few inside passes are done or allowed, and low opposition was the most frequent degree of shot opposition.
27	Gómez et al. (2010)	10 games from Spanish men's Baskeall League (2005-06)	Defence	Game Location	Set defense Transition defense Defender role	Players' actions	Effectiveness	It may be beneficial to change defensive (and offensive) strategies according to game location.
28	Karipidis et al. (2010)	80 games from 2003-07 European Tournaments (National Teams)	Control Offence Effectiveness		Set offence Specific player position	Players' actions Players' interactions		80% of offenses led up to a control offense 5x5. 40% of outside game offenses included a screen (specially pick and roll), resulting greater effective. Although the offenses were organized far from the basket, the centres had higher values on the statistical indexes.
29	Ortega et al. (2010)	12 games of the Dimayor Chilean Championship Playoffs (2006)	Defence	Game Period	Set defense Transition defense	Players' actions	Effectiveness Game Result	Throughout the game, winning teams alternate more between man-to-man and zone defences. Losing teams use more pressure in the transition in the last two periods. Switches, helps and inside passes do not differentiate winners and losers.

30	Álvarez et al. (2009)	9 games from 2008 Olympic Games (2008)	Defence		Set defense Transition defense	Space Players' actions	Effectiveness	Man-on-man was the most used defense, but half-court zone resulted more effective. Helps were used in 60% of game phases, but switches only in 8%. Plus, 39% of the shots were done with high opposition.
31	Fernández et al. (2009)	5 games of one team from Spanish Basketball League (2007-08)	Game construction		Set offence	Space Players' actions	Effectiveness	This investigation proposes a new model of analysis for studying the effectiveness and construction of offensive basketball plays in order to identify their outcomes.
32	Ibáñez et al. (2009)	39 games from NBA league	Shot efficacy	Game Period	Set offence Set defense Specific player position	Space Players' actions	Effectiveness	6 out of 10 shots were attempted from the 2-point area. Game period, technique, defensive pressure, zone, player position and previous actions were related to shooting effectiveness.
33	Mavridis et al. (2009)	40 games from the Euroleague Championship and 40 game from NBA league(2000-08)	Inside game	Type of competition	Set offence	Space Players' actions		The dominant pass to centres in Europe was the bounce pass (in NBA, the overhead pass). In Europe, the centres received the majority of passes in post up position (in NBA, more players received the ball in post up position). In Europe, 73% of the control offence concerned the outside game (in NBA, 55%)
34	Refoyo et al. (2009)	30 games from 2008 Olympic Games (2008)	Fast break	Gender	Fast break Transition defense Specific player position	Space Time Players' actions Numerical situation	Effectiveness	For men, variables pertaining to duration, completion area, and opposition to its completion were related to fast break effectiveness. For women, there was a weak association between fast break result and the opposition to its completion.
35	Garefis et al. (2007)	25 games from men's A1 Greek Basketball League (2001-02) and 25 games from 2001 men's European Championship.	Fast break	Type of competition	Fast break Transition defense Specific player position	Space Players' actions Numerical situation	Effectiveness	Emphasis should be given to completing transition from the 3 rd area and practice 1x1 primary, and 4x3 secondary transition to enhance the effectiveness of fast-breaks in these situations.
36	Bazanov et al. (2006)	8 games from Divison One of the Estonian league	Teamwork intensity		Set offence Fast break	Time Players' actions	Effectiveness	High intensity in successful fast brake situations included one dribble/one pass in offensive zone in 5s duration. Set offence, included 3-4 screen off's in 10s. possession in frontcourt and 4 players without the ball reaching the offensive zone before 9s-16s.
37	Gómez et al. (2006)	8 games from Spanish Basketball playoffs series (2004-05)	Defence		Set offence Set defense	Time Players' actions	Effectiveness Game result	Winners made more ball possessions, got more points, made more number of passes and played longer possessions against different types of defensive systems.

38	Ortega et al. (2006a)		Ball possession performance		Set offence	Time Players' actions Players' interactions	Effectiveness Game result	Winners had higher values than losing teams in the following variables: 2-point field goals and free throws made, dribbling opposed, time of movement, dribble time, use of screens, fast breaks, attack phases from 1-5 s, attack phases with 2 and 5 players participating.
39	Ortega et al. (2006b)	24 games of the men's U16 finals of the Championship of Andalusia (Spain)	Competitive participation		Set offence Specific player position	Time Players' actions		Results showed an early specialization of the players, because each player's position realized only specific functions which goes against a polyvalent formation proper for youth.
40	Ortega et al. (2006c)		Final actions		Set offence Specific player position			Youth teams used similar play styles than senior teams in formation years, in which each player is specialised in specific actions. Thus, game styles and rules need to be adapted to the characteristics of the youth players and not vice-versa.
41	Garefis et al. (2005)	46 games from 2001 men's European Championship.	One-on-one		Set offence Specific player position	Space Players' actions Numerical situation	Effectiveness	1x1 situation was the most frequently used offensive situation irrespective of the tactics chosen by the coaches. Outside payers tended to face the basket, while inside players used the post up.
42	Mexas et al. (2005)	25 games from men's A1 Greek Basketball League (2001-02) and 25 games from 2001 men's European Championship.	Control Offence Effectiveness	Type of competition	Set offence Set defense	Space Players' actions	Effectiveness	Attacks finished at the inside area present the higher rate of use and success. Man-to-man defense represents the most usual form of defense, while the perimeter players are responsible for the majority of offensive efforts compared to the post players.
43	Tsamourtzis et al. (2005)	130 games from men's FIBA Leagues (1999-2002)	Rebound		Set offence	Numerical situation	Effectiveness	Rebounds were mostly grabbed in the same zone (or across) from where the shot was attempted.
44	Mavridis et al. (2004)	80 games from European leagues and 80 games from NBA league (2000-2001)	Return Pass Outside	Type of competition	Set offence	Space Players' actions	Effectiveness Game result	Offensive effectiveness increased when shooting after a return of a pass from the central to the guard and forward positions for both winners and losers.
45	Tsamourtzis et al. (2004)	26 games from men's FIBA Leagues (2002-2004)	Fast break		Fast break	Space		3x2 was the most frequent fast break situation. Winners made more fast breaks, with more successful two point shots and finishing in 1x0 situation.

