Tesis doctoral internacional / International doctoral thesis

ANÁLISIS DEL COMPORTAMIENTO TÁCTICO EN BALONCESTO NBA: ESTUDIO PREDICTIVO DEL USO Y EFICACIA DE LAS ACCIONES E INTERACCIONES DE LOS JUGADORES EN EL PASE INTERIOR

TACTICAL BEHAVIOUR ANALYSIS IN NBA BASKETBALL: PREDICTIVE STUDY OF USE AND EFFECTIVENESS OF PLAYERS' ACTIONS AND INTERACTIONS DURING THE INSIDE PASS

Departamento de Educación Física y Deportiva

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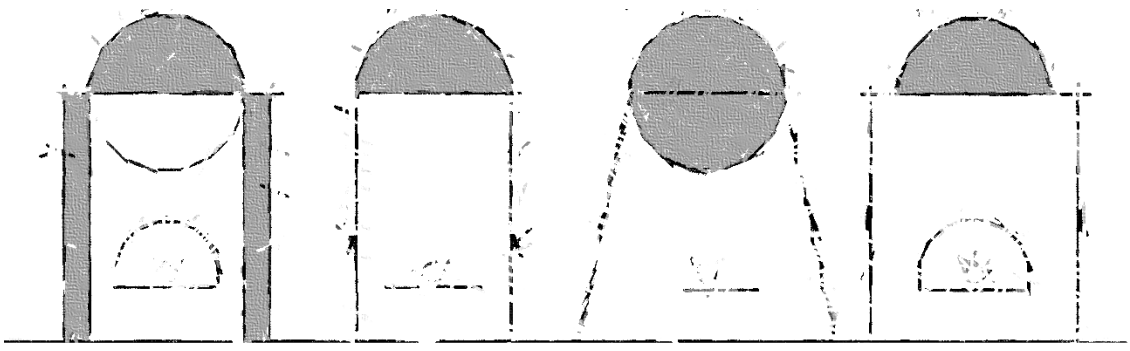

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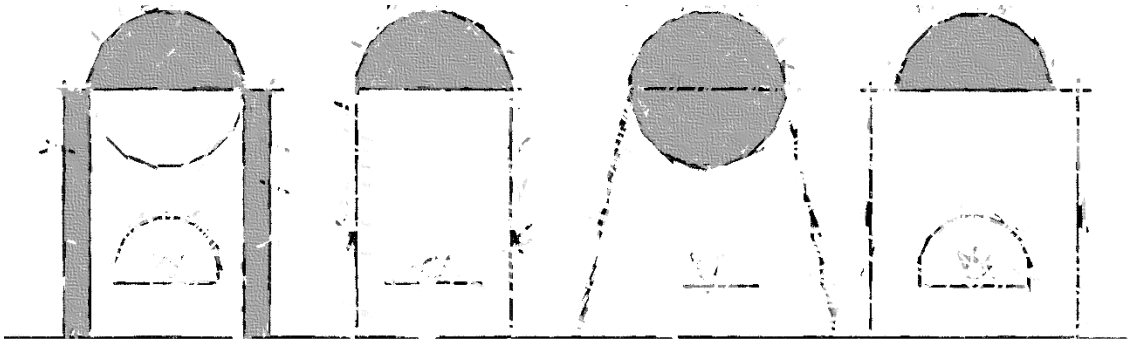
RESUMEN



La presente tesis doctoral titulada “Análisis del comportamiento táctico en baloncesto NBA: estudio predictivo del uso y eficacia de las acciones e interacciones de los jugadores en el pase interior”, consta de dos objetivos principales.

Por un lado, en el **Artículo 1** se realiza una revisión sistemática de la bibliografía perteneciente a las principales bases de datos (Scopus, Web of Science, y SportDiscus) sobre el análisis de la táctica en baloncesto, con el objetivo de organizar la literatura, categorizar los temas más comunes de investigación, y destacar los hallazgos principales y las deficiencias de los análisis realizados en trabajos de investigación que incluyan evaluaciones del comportamiento colectivo en baloncesto. Se incluye una tabla resumen que organiza los 45 artículos incluidos en el análisis por: año, autor, muestra, tema de estudio, factores tácticos analizados y principales resultados obtenidos. La discusión de los resultados se ha organizado en función de los aspectos tácticos estudiados: a) contexto de juego, b) fase de ataque y roles del jugador, y c) condiciones del juego. Se detectó una carencia de estudios que evalúen el comportamiento táctico desde un punto de vista dinámico, complejo e integral, así como una ausencia de diseños longitudinales. Se requiere por tanto explorar las relaciones entre jugadores, así como las consecuencias y aportaciones de sus comportamientos tácticos colectivos e individuales. Para ello, es necesario ampliar el espectro más allá del estudio de eventos aislados o de aquellas acciones que resultan eficaces en última instancia (lograr una canasta). Por ejemplo, desde el punto de vista atacante sería preciso estudiar aquellos comportamientos y relaciones que favorezcan las opciones de pase y lanzamiento óptimo, que generen desequilibrios defensivos, o que aumenten las opciones de rebote ofensivo. Atendiendo a estas necesidades ofensivas, el pase interior parece destacar como recurso táctico objeto de estudio,

siendo una acción colectiva en la que pasador, receptor, y jugadores de apoyo interactúan para lograr hacer llegar el balón cerca del aro, en donde se obtienen los porcentajes de acierto más elevados y se capturan el mayor número de rebotes.

Por otro lado, los **Artículos 2, 3 y 4** tuvieron como objetivo estudiar el uso y eficacia de las acciones e interacciones de los jugadores que tienen lugar como consecuencia del pase interior. Para ello se registraron mediante observación sistemática un total de 4207 posesiones de balón (808 pases interiores) correspondientes a 25 partidos de los Playoffs del año 2010 de la National Basketball Association (NBA). Los análisis estadísticos utilizados incluyen la regresión logística binaria a través del estudio de los Odds Ratio (OR) y sus intervalos de confianza, y el análisis del árbol decisional a través de la interpretación de los Residuos Tipificados Corregidos (Adjusted Standarized Residuals, ASRs). Se estimó el tamaño del efecto de las relaciones obtenidas a través del cálculo del coeficiente phi (φ), la V de Cramer (V), la erre cuadrado (R2). Cabe destacar que se ha seguido una estructura temporal lógica en la que las conclusiones de un estudio conducen a la justificación del siguiente.

En primer lugar **(Artículo 2)** se analizó el uso y la eficacia del pase interior en las posesiones de ataque, identificando y clasificando indicadores de rendimiento relevantes a través de un análisis de árbol de decisiones. Los resultados reafirmaron las expectativas, encontrando un uso elevado del pase interior (cerca del 20% del total de las posesiones estudiadas), siendo además entre un 44% y un 98% más eficaces ($OR=1.69$; $p<0.01$) que aquellos ataques en los que no se incluía este recurso colectivo. Además, el modelo de árbol decisional detectó tres indicadores de rendimiento principales del pase interior, definiendo su eficacia por: la actitud dinámica del

receptor (ASRs=3.4; φ=0.16; 70.2% de eficacia), desplazamientos desde lado débil previos a la recepción (ASRs=3.0; φ=0.14; 79.2% de eficacia) y la no aparición de ayudas defensivas (ASRs=3.4; φ=0.23; 86.7% de eficacia). El conjunto de estos resultados sugieren el desarrollo de acciones colectivas previas a la recepción, especialmente en el lado débil, es decir, el más alejado del balón, que favorezcan su recepción en condiciones óptimas.

En un segundo paso **(Artículo 3)** se exploraron aquellas interacciones pasador-receptor que resultaron en una mayor eficacia ofensiva. Desde el punto de vista individual, las acciones previas del pasador, como el dribbling (OR=1.91, p<0.01) o el uso de fintas con el balón (OR=2.02, p<0.01), favorecieron la aparición de opciones de lanzamiento inmediatas tras el pase y la recepción del balón ante una menor presión defensiva, respectivamente. Colectivamente, destacó el uso de bloqueos directos para hacer llegar el balón al interior (15% del total de acciones); sin embargo, se encontró una mayor ventaja cuando se realizaron bloqueos indirectos, reduciendo considerablemente el grado de presión defensiva cuando el bloqueo se realizó a favor del receptor (OR=15.13; p<0.01), así como tras continuación después bloqueo indirecto del futuro receptor (OR=11.91; p<0.01). Finalmente, las recepciones tras cortes hacia canasta resultaron ser las más eficaces, especialmente si previamente el pasador había botado (OR=4.99; p<0.01) o realizado una finta con balón (OR=3.47; p<0.01). No obstante, dado el elevado grado de especialización de los jugadores en el alto nivel (especialmente en la NBA), es posible que existan diferencias en los patrones de pase-recepción, así como en el uso y eficacia de las interacciones motrices de acuerdo a las características individuales de cada jugador.

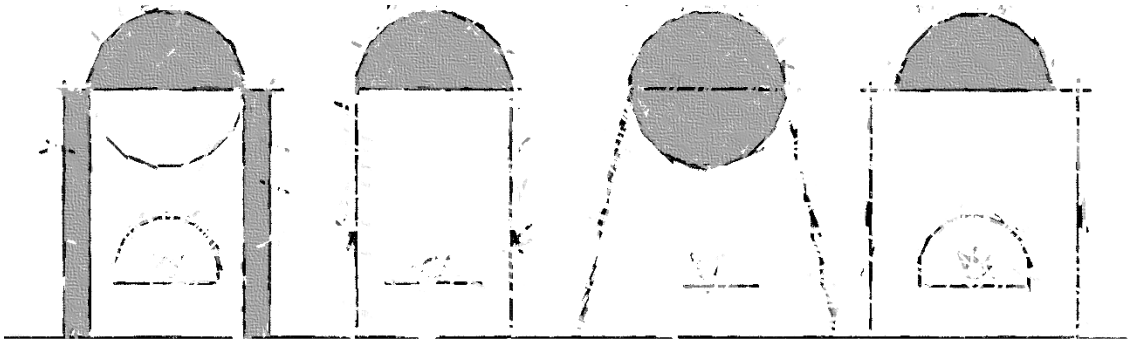
Es por ello que, finalmente **(Artículo 4)**, se analizaron las secuencias de pase y recepción más comunes en función de la posición específica de los jugadores (PG: Base, SG: Escolta, SF: Alero, PF: Ala-pívot; C: Pívot). De acuerdo a lo esperado, los jugadores exteriores fueron los principales pasadores (PG: 40.7%, SG: 22.8%, SF: 21.7%, PF: 10.7%, C: 4.0%), mientras que los jugadores interiores fueron los principales receptores (PG: 6.6%, SG: 6.2%, SF: 18.2%, PF: 38.8%, C: 30.2%). Se observaron importantes relaciones ($X2(16)=107.921$; $p<.001$; $V= .18$) entre los jugadores del perímetro y jugadores interiores, diferenciando siete parejas bien definidas: PG-PF (ASR=2.9), SG-SF (ASRs=3.4), SF-PF (ASRs=2.5), PF-SF (ASRs=3.3), PF-SG (ASRs=2.2), PF-PG (ASRs=2.0), and C-PG (ASRs=2.9). Destacan las secuencias de pase y recepción entre PG y PF a través del uso de bloqueo directo y continuación y de bloqueos indirectos en zona de pivot alto, entre PG y C a través del uso de bloqueo directo y continuación y de bloqueos indirectos en zona de pivot medio, y entre SG y PF/C a través de bloqueos indirectos y continuación o cortes hacia el interior. Más interesante resultó observar el elevado número de transiciones donde los jugadores interiores realizaron la función de pasadores, principalmente en zona de pivot alto.

En resumen, el conjunto de datos obtenidos permite extraer las siguientes conclusiones principales: a) el pase interior destaca como recurso táctico ampliamente utilizado y muy eficaz en baloncesto de élite; b) desarrollar un juego dinámico y colaborativo favorece las opciones de pase, aumenta las posibilidades de lanzamiento en condiciones óptimas y disminuye el grado de presión defensiva y la aparición de ayudas; c) se recomienda el uso de acciones previas tanto del pasador como del receptor para forzar desajustes defensivos; d) determinadas combinaciones básicas del juego de 2vs2 y 3vs3 resultan especialmente ventajosas para hacer llegar el balón al

interior; e) las relaciones entre pasador y receptor están marcadas por las posiciones específicas de juego y, por tanto, por las características individuales de cada jugador.

Esta información resulta de gran utilidad a técnicos y entrenadores a la hora de planificar y diseñar programas y tareas de entrenamiento que respondan a las necesidades de la competición. Este tipo de tareas deben ir orientadas a la resolución de problemas tácticos, como por ejemplo, la creación de espacios libres a través de acciones colaborativas tanto en el lado fuerte (bloqueos directos con continuación) como en el lado débil (bloqueos indirectos, cortes, fintas). En definitiva, se recomienda desarrollar un estilo de juego dinámico, que favorezca la aparición de desequilibrios defensivos y el consecuente aumento de las opciones de canasta, a través de una interacción inteligente y coordinada de los jugadores.

ABSTRACT



This doctoral thesis entitled “Tactical behaviour analysis in NBA basketball: predictive study of use and effectiveness of players’ actions and interactions during the inside pass” consist of two main objectives.

On the one hand, in the **Article 1** we performed a systematic review of the literature on tactical analysis in basketball pertaining to the major databases (Scopus, Web of Science, and SportDiscus), aimed at organizing current bibliography, identifying the most common research topics, and highlighting main findings and shortcomings of the analysis made in basketball collective behaviour assessment. It is provided a summary table in which 45 included articles were organized by: year, author, sample, research topic, tactical factors explored, and main conclusions. Results are discussed according to the tactical factors analysed: a) game context, b) game phase and players’ role, and c) game condition. We detected a lack of researches studying tactical behaviour from a complex, dynamic, and holistic perspective, as well as an absence of longitudinal designs. It is therefore required recording individual and collective players’ relationships to assess their consequences and contribution to the ball possession. To this purpose, there is a need to broaden the spectrum beyond the study of isolated events or actions that ultimately are effective (achieving a basket). For instance, from an attacker point of view, it would be crucial to detect those behaviours and interactions that favour passing options and optimal shooting conditions, generating defensive imbalances and increasing offensive rebound options. In response to these needs, inside pass seems to stand out as a tactical resource under study, being a collective action in which passer, receiver, and supporting players interact to achieve to get the ball near the basket, from where the highest scoring percentages are obtained and the most of rebounds are captured.

Moreover, **Articles 2, 3 and 4** were aimed at studying the use and effectiveness of players' actions and interactions as a consequence of the use of inside pass. In total, 4207 ball possessions (808 inside passes) from 25 matches pertaining to the 2010 NBA (National Basketball Association) Playoffs series were recorded and codified through systematic observation. Statistical analyses conducted included binary logistic regression, the study of the Odds Ratio (OR) and confidence intervals, decisional tree analysis, and Adjusted Standarized Residuals (ASRs) interpretation. To obtain the effect sizes of relationships, we calculated the phi (φ) coefficient, Cramer's V (V), and R-squared (R2). Notably, we followed a logical temporal structure in which the findings of one study lead to the justification of the next.

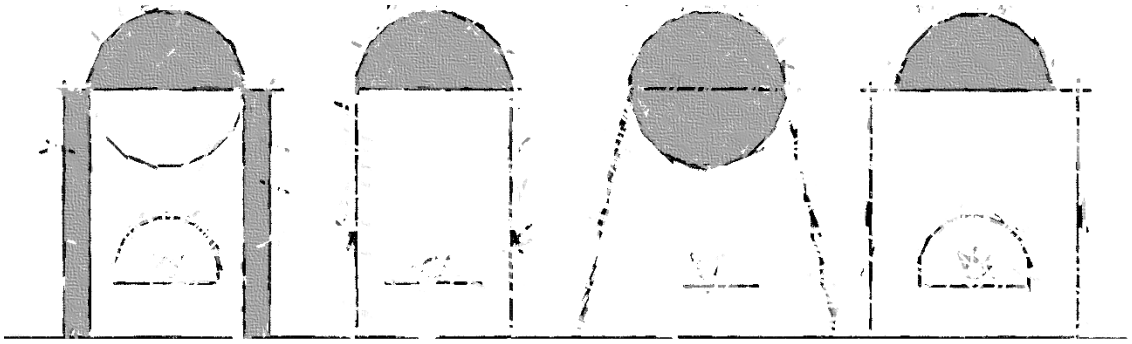
Firstly **(Article 2)**, we analysed the use and effectiveness of inside pass during the ball possession, identifying and classifying game performance indicators through a decision tree analysis. Results confirmed our expectations, finding a large use (nearby 20% of the total ball possessions) and effectiveness (from 44% to 98% more effective; OR=1.69; $p<0.01$) of the inside pass, compared to attacks without this collective resource. Besides, decisional tree model allowed the detection of three main game performance indicators which may define the inside pass effectiveness: the receiver attitude (ASRs=3.4; φ=0.16; 70.2% effectiveness), receiver's previous displacement from the weak side (ASRs=3.0; φ=0.14; 79.2% effectiveness), and the lack of defensive helps (ASRs=3.4; φ=0.23; 86.7% effectiveness). Overall, these results suggest developing collective actions prior to the reception, particularly in the weak side - this is, away from the ball – in favour to get the ball in optimal condition.

Secondly **(Article 3)**, we explored those passer-receiver interactions that may result in higher offensive effectiveness. Individually, passer's previous actions like dribbling (OR=1.91, p<0.01) or faking with the ball (OR=2.02, p<0.01) enhancing shooting options right after the reception and let getting the ball in lower defensive pressure, respectively. Collectively, it was highlighted the use of on ball screens to reach the ball reception at the inside (15% of total actions); however, a major advantage was observed when using out-of-ball screens, greatly reducing the defensive pressure when the screen was performed in favor to the receiver (OR=15.13; p <0.01), as well as if rolling after an out-of-ball screen made by the future receiver (OR=11.91; p<0.01). Finally, receptions after cutting towards the basket were extremely effective, especially if the passer was previously dribbling (OR=4.99; p<0.01) or faking with the ball (OR=3.47; p<0.01). Nevertheless, given the high players' specialization degree in elite basketball (particularly in the NBA), there may be differences in pass-and-reception sequence patterns, as well as in the motor interactions use and effectiveness regarding the individual players' characteristics.

That is why, lastly **(Article 4)**, we studied the most common pass and reception sequences considering players' specific position (PG: Point Guard, SG: Shooting Guard, SF: Shooting Forward, PF: Power Forward; C: Center). According to our expectations, outside players were likely to pass the ball (PG: 40.7% SG: 22.8%, SF: 21.7%, PF: 10.7%, C: 4.0%) whilst inside players received it (PG: 6.6%, SG: 6.2%, SF: 18.2%, PF: 38.8%, C: 30.2%). We detected strong pass and reception relationships (X2(16)=107.921; p<.001; V= .18) especially if including outside-and-inside interactions, distinguishing seven well-defined pairs of players: PG-PF (ASR=2.9), SG-SF (ASRs=3.4), SF-PF (ASRs=2.5), PF-SF (ASRs=3.3), PF-SG (ASRs=2.2), PF-PG (ASRs=2.0), and C-PG (ASRs=2.9). Moreover,

sequences pattern of passing and reception between PG-PF were likely to be used through on-ball screen and rolling in the high post, PG-C performed on ball and out-of-ball screens in the middle post, and SG-PF/C included mostly out-of-ball screens and rolling or cut toward the basket. More interestingly, we observed a high number of transitions in where the inside player took the role of passer, mainly from the high post area.

JUSTIFICACIÓN



ANÁLISIS DEL COMPORTAMIENTO TÁCTICO EN BALONCESTO

Los deportes de equipo como el baloncesto se definen esencialmente por la relación de colaboración y oposición de dos equipos enfrentados, cuyos comportamientos están determinados por objetivos del juego bien diferenciados y de sentido contrario. Así mientras los atacantes intentan progresar hacia la meta o desplazarse hacia posiciones de culminación eficaz, los oponentes tratan de evitarlo, o mientras unos procuran conservar el balón, los otros intentan arrebatárselo (Cárdenas, Piñar, Sánchez y Pintor, 1999; Gréhaigne y Godbout, 1995). En este contexto, los jugadores están constantemente resolviendo problemas mediante acciones colectivas que surgen de la interacción con los otros, y que se centrarán en atacar el campo contrario, desorganizar la defensa para obtener una ventaja, y defender el campo propio para evitar recibir canasta (Carling, Williams, y Reilly, 2007; Garganta de 2009). Con este propósito, los entrenadores y los jugadores desarrollan estrategias (que se define como las pautas generales del plan de acción establecidas antes de un partido) y tácticas (maniobras específicas ejecutadas por los jugadores durante un partido, adaptándose a los cambios constantes que se producen durante el enfrentamiento) para lograr la consecución de los objetivos colectivos necesarios para hacer frente a las demandas de la competición (Gréhaigne, Godbout, y Bouthier, 2001; Gréhaigne, Godbout, McGarry, O'Donoghue, y Sampaio, 2013).

Dado este marcado carácter colectivo del juego, nace la necesidad de conocer y estudiar aquellos comportamientos, relaciones e interacciones que resulten más ventajosos en función de las características de jugadores y equipo y la situación específica de partido, así como aquellos indicadores de rendimiento que potencien la

eficacia de éstas relaciones (Lames y McGarry, 2007; Lemmink y Frencken, 2013). Para ello, investigadores y entrenadores se han nutrido de un recurso ampliamente utilizado en baloncesto: el análisis de video (Hughes y Franks, 2004, 2007). A través de la observación de conductas es posible evaluar cualitativa y cuantitativamente el comportamiento de uno o varios jugadores y sus interacciones en un entorno natural (Anguera, Blanco, Hernández-Mendo, y Losada, 2011). Esta herramienta permite al jugador desenvolverse dentro de un contexto competitivo real, favoreciendo el registro de conductas y acciones espontáneas y creativas que enriquecen considerablemente la calidad y validez externa de los registros (Balagué, Torrentes, Hristovski, Davids, y Araujo, 2013; Memmert, 2013).

Gracias al desarrollo de nuevas tecnologías, la aparición de software de análisis específicos, y a la mejora de las técnicas metodológicas aplicadas, las investigaciones sobre el estudio del rendimiento de competición en baloncesto se han multiplicado en los últimos años (Drust, 2010; O'Donoghue, 2010). Sin embargo, existen ciertas limitaciones desde un punto de vista táctico (Lemmink y Frencken, 2013). En concreto, teniendo en cuenta el carácter complejo del baloncesto, en el que interactúan componentes técnicos, físicos, mentales, ambientales y tácticos, la evaluación de los aspectos tácticos del juego debería integrar la mayor cantidad posible de dichos componentes, con el fin de describir de manera precisa las razones y consecuencias del comportamiento de los jugadores (Glazier, 2010; Lamas, Santana, Heiner, Ugrinowitsch y Fellingham, 2015). Este nuevo enfoque permitiría obtener de información útil para el desarrollo de tareas de entrenamiento complejas que respondan a las necesidades reales de la competición, proporcionar un feedback más completo y de mayor calidad, definir de manera más precisa el estilo de juego del

equipo, y descubrir patrones e interacciones de juego que resulten más ventajosas (Maslovat & Franks, 2008; McGarry, 2009).

EL PASE INTERIOR: RECURSO TÁCTICO ESENCIAL EN BALONCESTO

En baloncesto, hacer llegar el balón a las proximidades del aro constituye un objetivo clave en el ataque ya que, entre otras razones: a) aumenta las posibilidades de canasta debido a los altos porcentajes de eficacia en el interior, b) genera desajustes defensivos al forzar al oponente a aglomerarse en las proximidades del aro para evitar el lanzamiento, permitiendo la creación de espacios libres en el exterior, y c) aumenta la probabilidad de rebote ofensivo y con ello de una segunda opción de ataque (Álvarez, Orega, Salado, y Gómez, 2009; Gupillotte, 2008; Mavridis, Laios, Taxildaris, y Tsiskaris, 2003; Mavridis, Tsamourtzis, Karipidis, y Laios, 2009). No obstante, este gran interés ofensivo por alcanzar el interior genera a su vez unos esfuerzos defensivos para evitar que esto ocurra. Como resultado, el sentido del juego y la dinámica del ataque en baloncesto se basan principalmente en el desarrollo de acciones en el exterior con el objetivo de generar espacios en el interior que, a su vez, generen nuevas opciones de juego (interior-exterior, interior-interior) que favorezcan la aparición de opciones de lanzamiento óptimas (Cárdenas et al., 1999; Sautu, Garay, y Hernández-Mendo, 2009).

Estudios previos han analizado el juego interior en baloncesto de élite (equipos masculinos del Top-16 de la Euroliga 2012), encontrado una mayor eficacia (63.3% vs. 49.8%) y una mayor tasa de anotación (0.84 vs. 0.68 puntos) en aquellas posesiones en las que se incluían pases al interior (20% del total de las posesiones de ataque) (Courel-Ibáñez, Suárez-Cadenas, Ortega, Piñar, y Cárdenas, 2013). De forma similar, Álvarez et

al. (2009) observaron que los equipos ganadores del partido permitían un menor número de pases interiores (26.7% vs. 35.2%), en selecciones nacionales masculinas de los Juegos Olímpicos de 2008. No obstante, se han encontrado diferencias en el uso del juego interior entre el baloncesto norteamericano (National Basketball Association, NBA) y el europeo (International Basketball Federation, FIBA).

La NBA se caracteriza por una prevalencia del juego individual, en donde los jugadores, físicamente muy superiores a los del resto de competiciones, están fuertemente definidos en función de unos pocos roles muy específicos: pasadores, anotadores, defensores, y todoterrenos (Sampaio, McGarry, Calleja-González, Sáiz, i del Alcázar, y Balciunas, 2015). Es por ello que su juego atacante se basa principalmente en acciones de 1vs1 y 2vs2, incluyendo un menor número de pases por fase de ataque (2.71 ± 1.84 vs. 2.95 ± 1.84) en comparación con el baloncesto europeo (Milanović, Selmanović, y Škegro, 2014). Pese a ello, se ha encontrado un predominio del juego interior en la NBA (20.0% vs. 30.0%), especialmente en el la zona de pivot alto (Mavridis et al., 2009), debido probablemente a la enorme altura, capacidad de salto y envergadura de sus jugadores, siendo capaces de recibir y anotar fácilmente desde el interior (Berri, Brook, Frick, Fenn, y Vicente-Mayoral, 2005; Erčulj, y Štrumbelj, 2015). En este sentido, se ha observado una evolución en los perfiles de juego de la NBA, encontrando jugadores exteriores extremadamente atléticos que les permiten ser más peligrosos a medida que se aproximan a canasta, mientras que los pívots son capaces de jugar y lanzar de manera efectiva en zonas alejadas de la canasta (Mateus, Gonçalves, Abade, Torres-Ronda, Leite, y Sampaio, 2015). Esta mayor versatilidad de los jugadores trae consigo una consecuente evolución hacia un estilo de juego más dinámico, enriqueciendo las posibilidades de cooperación y relación entre el juego exterior e

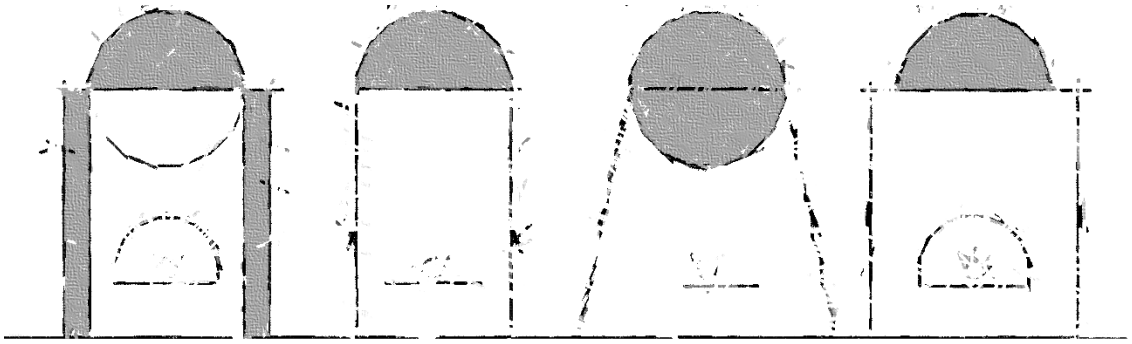
interior. Sin embargo, son escasas las investigaciones que hasta el momento han tratado de estudiar el juego interior en baloncesto NBA, especialmente desde un punto de vista táctico (Gómez, Gasperi, y Lupo, 2015).

Con este fin, investigaciones recientes han definido y clasificado con éxito acciones e interacciones de jugadores orientadas a la creación de espacios libres, así como la consecuente respuesta defensiva para proteger dichos espacios (Lamas, Junior, Santana, Rostaiser, Negretti, y Ugrinowitsch, 2011; Santana, Rostaiser, Sherzer, Ugrinowitsch, Barrera, y Lamas, 2015). Por un lado, definieron de siete acciones atacantes o dinámicas de creación de espacios (Space Creation Dynamics, SCD): creación de espacio driblando el balón (BD), creación de espacio sin driblar el balón (BND), aclarado en el poste (POSTI), aclarado en el perímetro (PERI), creación de espacios sin balón (WB), bloqueo directo (OBS), y bloqueo indirecto (OutBS). Posteriormente, estos autores estudiaron las consecuentes reacciones defensivas, diferenciando hasta 34 dinámicas de protección de espacios (Space Protection Dynamics, SPD). La detección y definición de estas acciones han hecho posible la representación de estructuras básicas de juego a través del estudio de las interacciones atacantes-defensivas durante la competición (Lamas, et al., 2015).

Existe por tanto un creciente interés en identificar tendencias y patrones de juego que permitan, por un lado, conocer con mayor exactitud qué está ocurriendo en la pista y, quizás más importante, evaluar la calidad y eficacia del comportamiento de los jugadores. A día de hoy, existen grandes limitaciones a la hora de cuantificar la contribución de las diferentes acciones de los jugadores al total de la posesión, y no sólo a la acción final de falta o canasta, siendo ésta un problema a la hora de

interpretar y valorar la calidad en la toma de decisiones de los jugadores (Cervone, D'Amour, Bornn, y Goldsberry, 2014). No obstante, acercamientos como los que se proponen en esta tesis contribuyen al conocimiento de la estructura colectiva en baloncesto, especialmente al de uno de los aspectos claves de este deporte: el juego interior. En concreto, el estudio y descripción de los comportamientos e interacciones de los pasadores y receptores, así como la detección y clasificación de indicadores que mejoren su rendimiento, permitiría a) diseñar tareas de entrenamiento específicas orientadas a la mejora de la toma de decisiones en el uso del pase interior; b) aplicar feedback de manera más precisa; c) seleccionar objetivos tácticos atacantes y defensivos específicos del juego interior; d) definir el estilo de juego del equipo de acuerdo a las características y a la situación de partido concretas.

JUSTIFICATION



TACTICAL BEHAVIOUR ASSESSMENT IN BASKETBALL

In essence, team sports such as basketball are defined by the collaborative and opposite relationship of two confronted teams, whose behaviors 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 interacting to perform collective actions focused on attacking the opponent's court, disturbing the defence to obtain an advantage, and defending their own court (Carling, Williams, & Reilly, 2007; Garganta, 2009). For this purpose, coaches and players develop strategies (defined as a general plan and action guidelines before a match) and tactics (specific manoeuvres executed by the players during a match adapted to the constant changes that occur during the confrontation) to accordingly achieve the collective aims required to deal with match demands (Gréhaigne, Godbout, & Bouthier, 2001; Gréhaigne, Godbout, McGarry, O'Donoghue, & Sampaio, 2013).

Given the collective nature of the game comes the need to know and study those behaviors, relationships, and interactions that are most advantageous in terms of the team's characteristics and specific game situation, as well as those performance indicators that enhance its effectiveness (Lames & McGarry, 2007; Lemmink & Frencken, 2013). To this purpose, basketball researches and coaches have accepted a widely used tool: the video analysis (Hughes &Franks, 2004, 2007). Through the observation of behaviours, it is possible to qualitatively and quantitatively evaluate

one or more players' conducts and their interactions within a natural environment (Anguera, Blanco, Hernández-Mendo, & Losada, 2011). These methods let the players act within a competitive context, allowing the observation of emerging, spontaneous and creative behaviours which enrich considerably the records quality and external validity (Balague, Torrents, Hristovski, Davids, & Araújo, 2013; Memmert, 2013).

Thanks to the new technologies development, the rise of specific analysis software, and the improvement of methodological techniques applied, research on performance analysis in basketball competition have grown considerably in recent years (Drust, 2010; O'Donoghue, 2009). However, there are some limitations from a tactical point of view (Lemmink & Frencken, 2013). In particular, considering the complex nature of basketball, in where technical, physical, mental, environmental, and tactical components interacts, there is a need to incorporate as many elements as posible in order to precisely describe the reasons and consequences of players' tactical behaviours (Glazier, 2010; Lamas, Santana, Heiner, Ugrinowitsch & Fellingham, 2015). This new approach would allow us: to obtain useful information in the design of multifactorial training tasks that meet competition requirements, to provide a better quality and more complete feedback, to give an accurate definition of teams' playing style, and to discover advantageous game patterns and interactions (Maslovat & Franks, 2008; McGarry, 2009).

THE INSIDE PASS: AN ESSENTIAL TACTICAL RESOURCE IN BASKETALL

In basketball, to get the ball near the rim represent a main offensive aim because, among other reasons: a) increases the scoring chances due to the high effectiveness rates from the inside, b) produces defensive mismatches as forces the opponent to

agglomerate nearby the ring to avoid shooting options from the inside, which generates free space at the outside, and c) increases the likelihood of offensive rebound and thereby second attacking options (Álvarez, Orega, Salado, & Gómez, 2009; Gupillotte, 2008; Mavridis, Laios, Taxildaris, & Tsiskaris, 2003; Mavridis, Tsamourtzis, Karipidis, & Laios, 2009). This great offensive interest in reaching the inside turns, subsequently, into defensive efforts to prevent this happen. As a result, basketball playing sense and attacking dynamics are mainly based on the development of actions in the outside to create spaces at the inside, which will generate new playing options (inside-outside, inside-inside) that favour the emergence of shooting options in optimal conditions (Cárdenas et al., 1999; Sautu, Garay, and Hernandez-Mendo, 2009).

Previous studies have analysed the inside game in European elite basketball (Top 16 men's teams from the Euroleague 2012), finding greater effectiveness (63.3% vs. 49.8%) and a higher scoring rate (0.84 vs. 0.68 points) in possessions including inside passes (20% of total ball possessions) (Courel-Ibáñez, Suárez-Cadenas, Ortega, Piñar, & Cárdenas, 2013). Similarly, Álvarez et al. (2009) observed that winning teams' defences allowed fewer inside passes (26.7% vs. 35.2%) in men's national teams from the 2008 Olympic Games. Nonetheless, important differences have been found in the use of inside game between American (National basketball Association, NBA) and European (International basketball Federation, FIBA) basketball.

The NBA is characterized by a prevalence of individual game, in where players physically far superior to other basketball competitions are strongly defined in terms of a few very specific roles: passers, scorers, defenders, and all-round (Sampaio, McGarry , Calleja-Gonzalez, Sáiz, i Alcazar, & Balciunas, 2015). Hence, their offensive

game is primarily based on 1v1 and 2v2 actions, including fewer passes per ball possession (2.71 ± 1.84 vs. 2.95 ± 1.84) compared to Europeans (Milanović, Selmanovic, & Škegro, 2014). Nevertheless, it is observed a predominance of the inside game in the NBA (20.0% vs. 30.0%) especially in the high post area (Mavridis et al., 2009), probably due to the big size, jump capacity, and wingspan of NBA players, being able to easily receive and score from this distance (Berri, Brook, Frick, Fenn, & Vicente-Mayoral, 2005; Erčulj, & Štrumbelj, 2015). In this sense, an evolution in NBA players' profiles has been detected, finding extremely athletic outside players, really dangerous as they approach to the basket, while big players are increasingly capable to play and shoot effectively away from the basket (Mateus Gonçalves, Abade, Torres-Ronda, Leite, & Sampaio, 2015). This players' versatility brings a development towards a more dynamic game style, enriching the cooperation and relationship possibilities between the outside-and-inside areas. However, there is limited research so far aimed at studying the inside game in NBA basketball, especially from a tactical point of view (Gómez, Gasperi, & Lupo, 2015).

To this purpose, recent researches have successfully defined and classified players' actions and interactions focused in creating open spaces, as well as the subsequent defensive response to protect them (Lamas, Junior, Santana, Rostaiser, Negretti, & Ugrinowitsch , 2011; Santana, Rostaiser, Sherzer, Ugrinowitsch, Barrera, & Lamas, 2015). On the one hand, they defined seven offensive actions or Space Creation Dynamics (SCD): with ball dribbled (BD), with ball not dribbled (BND), post isolation (POSTI), perimeter isolation (PERI), without the ball (WB), on ball screen (OBS), and out-of-ball screen (OutBS). Then, these authors studied the resultant defensive reactions, differentiating up to 34 Space Protection Dynamics (SPD). The detection and

definition of these actions have made possible to represent basic playing structures through analysing offensive-defensive interactions during the competition (Lamas, et al., 2015).

There is therefore a growth of interest in identifying game trends and patterns which allow a better understanding of what is happening on the court and, more importantly, to assess players' behaviours quality and effectiveness. Nowadays, we find major limitations to quantify how players' actions contribute to the whole possession and not just the events that end it like fouls or scores. This becomes a problem to make accurate evaluations and interpretation of players' decision-making (Cervone, D'Amour, Bornn, & Goldsberry, 2014). Current approaches proposed in this thesis may contribute to the knowledge of collective structures in basketball, particularly in one of the main aspects in this sport: the inside game. Specifically, the study and description of passers and receivers' behaviours and interactions, as well as the detection and classification of game performance indicators, would help in: a) designing specific training tasks aimed at improving players' decision-making in the use of interior pass; b) providing a more precisely feedback; c) selecting specific, offensive and defensive inside game tactical objectives; d) define the team playing style according to players' characteristics and match context.

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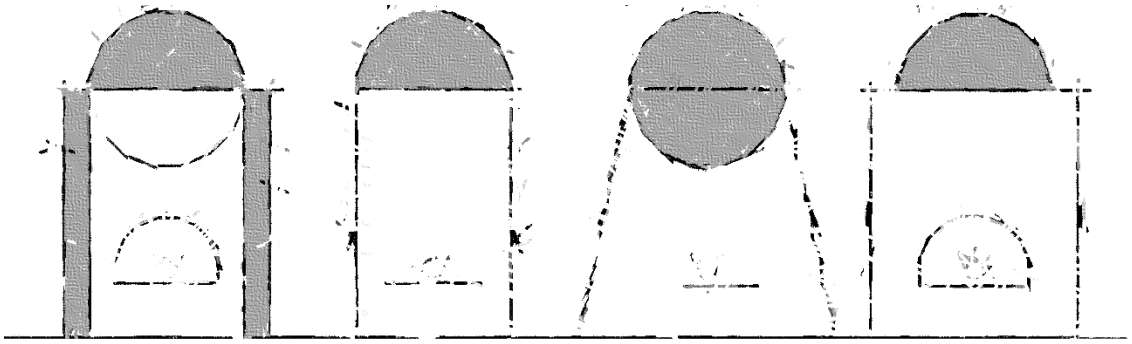

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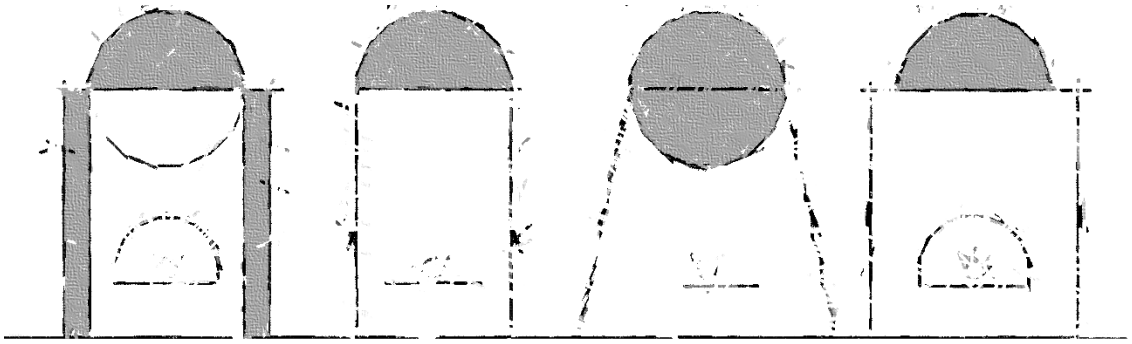
OBJETIVOS



Objetivo General

En la presente tesis doctoral se analizará el pase interior en baloncesto desde un punto de vista táctico a través de cuatro estudios. Más allá de los objetivos específicos de cada estudio, el objetivo general será identificar aquellas interacciones y relaciones entre jugadores que favorezcan la eficacia ofensiva del pase interior. Siendo la relación exterior-interior uno de los aspectos tácticos claves en baloncesto, este conjunto de trabajos pretende proporcionar información útil para la mejora del proceso de entrenamiento y competición, a través del diseño y planificación de tareas que respondan a las necesidades reales de la competición, así como contribuyendo en la definición del estilo de juego del equipo o en la selección de estrategias colectivas adecuadas a una situación de partido determinada. Además, la clasificación y revisión del estado del arte en la evaluación del comportamiento colectivo en baloncesto pretende impulsar la calidad de futuras investigaciones, contribuyendo a la mejora del establecimiento de objetivos, los métodos utilizados y la interpretación de los datos.

Artículo 1: Tactical analysis in basketball: a systematic review

Objetivo general:

- Revisar de forma sistemática los estudios que examinan comportamientos colectivos en baloncesto.

Objetivos específicos:

- Proponer un enfoque de análisis táctico complejo en baloncesto, integrando el mayor número de factores posibles que permitan dar respuestas más precisas a

los problemas de la competición, explicando las consecuencias de los comportamientos de los jugadores.

- Organizar y clasificar la bibliografía en función de los aspectos tácticos estudiados con el fin de detectar carencias en los tópicos de estudio.

Artículo 2: Inside pass predicts ball possession effectiveness in NBA basketball

Objetivo general:

- Analizar los efectos del uso del pase interior en la eficacia de la fase de ataque.

Objetivos específicos:

- Identificar indicadores de rendimiento capaces de predecir el éxito del uso del pase interior.
- Clasificar la potencia predictiva de dichos indicadores de rendimiento con el fin de proporcionar claves a la hora de organizar y estructurar los objetivos de las tareas de entrenamiento del pase interior.

Artículo 3: Players' interactions during inside pass in NBA basketball

Objetivo general:

- Identificar en qué medida las interacciones de los jugadores pueden predecir el rendimiento atacante y defensivo cuando se usa el pase interior, considerando los efectos contextuales.

Objetivos específicos:

- Detectar el efecto de las acciones individuales del pasador y receptor sobre el rendimiento atacante durante el pase interior.
- Detectar el efecto combinado de las interacciones del pasador y receptor sobre el rendimiento atacante durante el pase interior.

Artículo 4: Inside game ball transitions according to players' specific positions in NBA

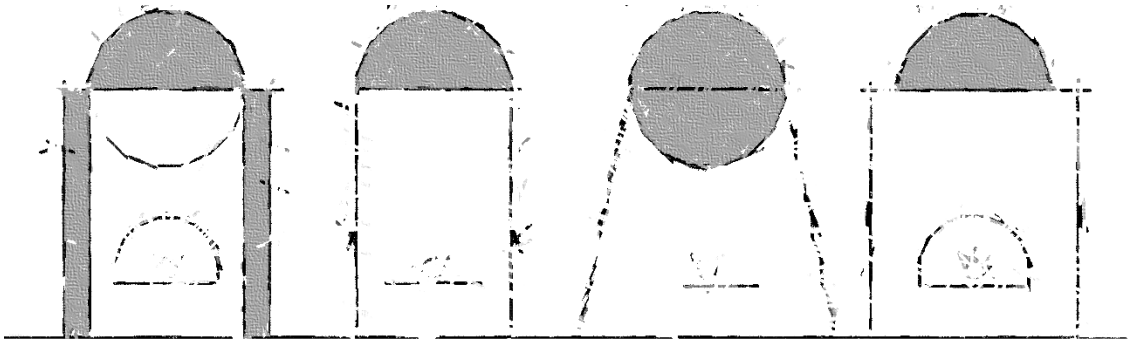
Objetivo general:

- Descubrir patrones de uso y eficacia en las transiciones de balón durante el uso el pase interior en función de la posición específica de los jugadores (pasador y receptor).

Objetivos específicos:

- Determinar diferencias en el uso y eficacia de indicadores de rendimiento en función de la posición específica del pasador y el receptor.
- Identificar las relaciones de entre los jugadores en función de su posición específica de juego y su rol (pasador y receptor).

AIMS



Main aim

In this thesis, we will analyse the inside pass in basketball from a tactical perspective through four different studies. Beyond the specific objectives of each study, the main aim of this research will be to identify those players' interactions and relationships that improve offensive performance when using the inside pass. Given that the balance between perimeter and post game constitute a main tactical key in basketball, this set of studies aims to provide useful information in supporting both the training and competition process, by designing tasks according to game constraints and demands, and helping in the match preparation and the selection of effective game plans and strategies. Besides, we classify and summarize the state of art of basketball collective behaviour in a try to boost the quality of future research by contributing in improving aims, methods and data interpretation.

Article 1: Tactical analysis in basketball: a systematic review

Main aim:

- To systematically review current literature examining basketball collective behaviour.

Specific aims:

- To propose a complex approach in basketball tactical analysis integrating the largest possible number of factors explored, providing more accurate answers to solve competition problems by explaining the consequences of players' behaviours.

- To organize and classify the bibliography according to the tactical aspects studied in order to detect gaps of knowledge.

Article 2: Inside pass predicts ball possession effectiveness in NBA basketball

Main aim:

- To analyse the effects of using inside pass on ball possession effectiveness.

Specific aims:

- To identify game performance indicators to predict inside pass success.
- To classify the predictive power of these performance indicators to provide useful keys supporting the structure, organization and aim defining when designing training tasks focused in improving the inside pass.

Article 3: Players' interactions during inside pass in NBA basketball

Main aim:

- To identify how players' interactions predicted offensive and defensive performance when using inside pass, considering contextual effects.

Specific aims:

- To detect the effect of individual actions from passer and receiver on offensive and defensive performance when using inside pass.
- To detect the effect of combined passer-receiver interactions on offensive and defensive performance when using inside pass.

Article 4: Inside game ball transitions according to players' specific positions in NBA

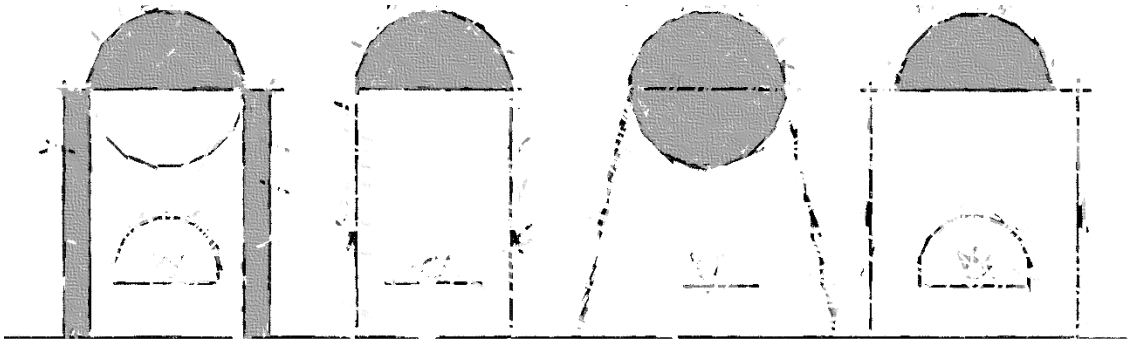
Main aim:

- To identify players' relationships (passer and receiver) and detecting ball transitions patterns according to their specific position when using inside pass

Specific aims:

- To determine differences in the use and effectiveness of performance indicators regarding passer and receiver specific position.
- To identify relationships between players regarding their specific position and role (passer and receiver).

ARTÍCULOS / ARTICLES



TACTICAL BEHAVIOR ASSESSMENT IN BASKETBALL: A SYSTEMATIC REVIEW.

Tactical Assessment In Basketball: A Review

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Abstract

We aimed to review and organize current literature in 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 employed 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). Findings exposed add relevant insights on basketball understanding, suggesting a change on current basketball research scope on tactical assessment to improve game knowledge. Plus, 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, summary and classification provided may serve as a useful guide to future research in basketball.

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

1. Introduction

In essence, team sports are defined as an "opposition relationship in which two teams must coordinate its actions in order to recover, conserve, and move the ball so as to bring it into the scoring zone and effectively score" (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 defence 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, McGarry, O'Donoghue, & Sampaio, 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 let the players 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). Team sports such as basketball are complex activities in which technical, physical, mental, environmental and tactical components are interrelated. Therefore, tactical basketball 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 (Figure 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, defence, 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 analysed 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, 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.

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

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

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 ("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 from English, Spanish, Portuguese and Greek languages were included.

2.3. 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 researches 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 researches 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.

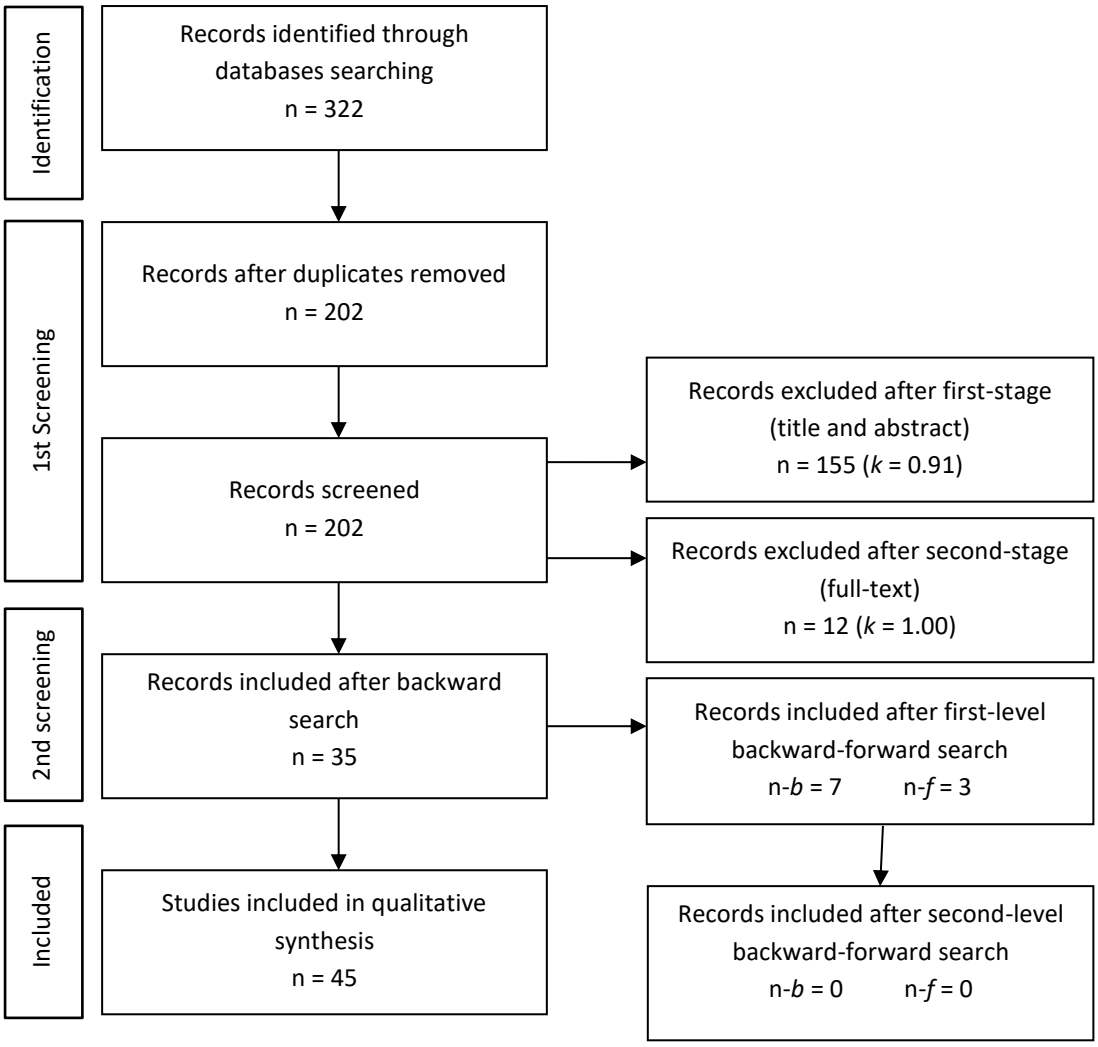

Figure 2. PRISMA flowchart illustrating the literature search at each stage. PRISMA Preferred Reporting Items for Systematic Reviews and Meta-Analyses.

3. Results

3.1. Descriptive Characteristics of Included Studies

A summary of included studies in the systematic review is provided in Table 1. 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 ± 4,893.8 in average; n=19), 7,892 shots (3,946.0 ± 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

Eligible articles classification is shown in Table 1. 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; Sarmento 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 defence (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, Cárdenas, De Baranda, & Palao, 2006; Ortega, Cárdenas, 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 (Gréhaigne, 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 defences. Regarding transition game, Refoyo et al. (2009) found that females initiated more fastbreaks 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 defences 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 defences. 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, & Hileno, 2015; Santana et al., 2015). Additionally, some authors have explored set defence, 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 fastbreaks, 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, fastbreak accounted for the 15% of total game attacks in elite teams, mostly lasted between 3 and 6 seconds 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 defence, 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 paper during fastbreaks 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 affect 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, Alsasua, Arana, Anguera, & Garzón, 2014; Lapresa, Anguera, Alsasua, 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 seconds in duration, and low results when using over 15 actions during possessions longer than 16 seconds. Furthermore, teamwork intensity increased through active player cooperation (e.g., performing screens off the ball) during limited ball possession time (between 9 and 16 seconds).

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, fastbreak 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 defence and generate spatial advantage in favor 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 defence (Remmert, 2003). Gómez 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, few researches have 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-defence 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 defence 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 researches 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).

Table 1. Summary of included studies

Nº	Study	Sample	Topic	Factors				Main results
				Game context	*Game phase and players' role*	*Game condition*	*Game outcome*	
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	Gómez 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	Fastbreak	Movement patterns Players' actions Numerical situations	Effectiveness	Females initiated fastbreak 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 Fastbreak	Space Movement patterns	Effectiveness Game result	Winning teams made more fastbreaks, 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 Fastbreak	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). Fastbreaks 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 Fastbreak	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 ate 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		Space–time movement patterns of playing dyads in basketball, while unique, nonetheless conform to a uniform description in keeping with universal principles of dynamical self-organizing systems as hypothesized.
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	Fastbreak 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 fastbreak 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	Fastbreak Transition defense Specific player position	Space Players' actions Numerical situation	Effectiveness	Emphasis should be given to completing transition from the 3˙ 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 Fastbreak	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)	24 games of the men's U16 finals of the Championship of Andalusia (Spain)	**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 seconds, attack phases with 2 and 5 players participating.

39	Ortega et al. (2006b)		**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**		Fastbreak	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.

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Inside pass predicts ball possession effectiveness in NBA basketball

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Abstract

The aims of this study were to analyse the effects of using inside pass on ball possession effectiveness and to identify game performance indicators to predict inside pass success in the National Basketball Association (NBA), considering situational variables. A total of 4207 closed ball possessions (± 10 points difference) where recorded from 25 matches of the 2010 NBA Playoffs series. Ball possessions were classified whether including inside pass (n=808) or not (n=3399). Predictive analysis of use and effectiveness was made through a series of binomial logistic regressions and Classification tree analysis (CHAID). Results indicate that ball possessions including inside pass were more effective and longer in duration, finding a greater use in top-4 NBA teams regardless the game period. Additionally, inside pass effectiveness was influenced by: the receiver attitude, reception distance, and defensive help. Particularly, the analysis of combined performance indicators disclosed relevant information on attack effectiveness, suggesting players to adopt a dynamic attitude in the weak side before getting the ball, while their teammates are developing individual and collective actions to create free space and enhance inside game options and effectiveness. Current findings shed some light on specific knowledge concerning tactical behaviours in NBA basketball, contributing in the design of specific programmes to increase inside game options and players' decision-making according to specific game constraints.

Key words: invasion games, match analysis, performance indicator, team sports.

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1. Introduction

The last decade has seen a growth in the analysis of performance indicators across team sports, since they can provide information that enhances the training and competition process (Drust, 2010; Hughes & Bartlett, 2008; O'Donoghue, 2009). Specifically, performance analysis aids our understanding on game evolution, offensive and defensive interactions, spatial and time structures, and team configurations (Garganta, 2009; Grehaigne & Godbuout, 2013). In team sports such as basketball, players are continuously interacting either cooperating with their teammates for disturbing and beating an adversary. Thus, one of the main challenges for coaches and researches is detecting and/or predicting effective collective behaviours to better perform against the opponent, enhancing winning chances. To this aim, tactical assessment through match analysis constitutes a powerful tool, making possible data collection of natural behaviours from the competition context; this information may subsequently be used to develop training programmes for improving players' decision-making during competition (Eccles, Ward, & Woodman, 2009).

A number of researches have examined players' interaction in European basketball, finding that space-time coordination across the longitudinal axis (i.e., interactions between outside and inside game) seems to be a crucial element in game performance (Bourbousson, Sève, & McGarry, 2010a; 2010b; Lapresa, Alsasua, Arana, Anguera, & Garzón, 2014). Results suggest that players' inside-outside coordination would increase shooting attempts near the basket, but also enhance unmarked long-distance shots opportunities by an open pass. Besides, evidence revealed greater offensive effectiveness when the ball reaches the inside through passing the ball (Courel, Suárez, Ortega, Piñar, & Cárdenas, 2013; Mexas, Tsitskaris,

Kyriakou, & Garefis, 2005). Specifically, Courel et al. (2013) observed in the Spanish Professional male League that attacks including inside pass (i.e., a pass received by a player located at the three-point restricted area) improved the offensive effectiveness from 49.8% to 63.3%, and increased the amount of points scored from 0.68 to 0.84. Moreover, important differences between European and National Basketball Association (NBA) teams have been reported (Mavridis, Tsamourtzis, Karipidis, & Laios, 2009; Mikołajec, Maszczyk, & Zając, 2013; Milanović, Selmanović, & Škegro, 2014). American basketball is characterized by a prevalence of individual offenses, including a lower number of passes per attack phase (2.71 ± 1.84 vs. 2.95 ± 1.84; $p<0.01$) than European one (Milanović et al., 2014). However, Mavridis et al. (2009) found a large use of inside pass (20% vs. 30%, $p<0.01$) in NBA teams compared to European, reflecting a greater importance of inside game.

Very recently, some researches have been conducted in the NBA league aimed at describing game characteristics by identifying players' profiles and teams' strategies (Fewell, Armbruster, Ingraham, Petersen, & Waters, 2012; Mateus, Gonçalves, Abade, Torres-Ronda, Leite, & Sampaio, 2015; Sampaio, McGarry, Calleja-González, Sáiz, i del Alcázar, & Balciunas, 2015). Sampaio et al. (2015) solidly defined a few specific playing profile related to the game roles of scoring, passing, defensive and all-round game behavior. In this line, Mateus et al., (2015) observed an evolution on specific inside and outside players' positions such as centers and guards, tending to find extremely athletic guards with optimal jump, speed and power skills that allow them to perform more blocks, whilst centers are able to effectively play in court zones away from the basket. However, from a collective point of view, Fewell et al., (2012) reported risks in moving the ball frequently to a specific player or position as allows the opposition to adjust their defence accordingly. For this reason, set up strategies

usually evolves into dynamic interactions such as inside-outside game coordination, particularly in the NBA in which players' roles are strongly defined and inside game takes a relevant importance. However, there is scarce information about inside-outside players' interactions in NBA basketball.

According to above-mentioned findings, it should be interesting to shed some light on specific knowledge concerning tactical behaviours to enhance inside game performance, particularly in NBA basketball. Therefore, the aims of this study were (i) to analyse the effects of using inside pass on ball possession effectiveness and (ii) to identify game performance indicators to predict inside pass success in NBA teams, considering situational variables. We were especially interested in investigating how game conditions (i.e., ball possession duration, reception attitude, pass zone, pass distance; reception zone, reception distance, player position, defensive pressure against the receiver and defensive help) and situational variables (i.e., team ranking, game period, game location and match status) impacted on ball possession effectiveness when using inside pass.

2. Methods

2.1. Sample

A total of 4207 ball possessions were recorded from 25 matches of the 2010 NBA (National Basketball Association) Playoffs series. Ball possessions were classified whether including inside pass (n=808) or not (n=3399). Inside pass was considered when the receiver player was stepping the zone or paint. Games were randomly selected including eight teams (four per conference) with a minimum of two matches and at least one victory and one defeated

per each, excluding overtime games. Ball possessions recorded had a score difference below 10 points (average = 1.64 ± 4.69 points). The choice of this specific sample was deliberate; first, NBA is the most important basketball club competition of the world; second, Playoffs confronted best season teams to become the champion, thus the maximum competitive level was expected until the end of the game; and third, possessions with short score differences ensure high players' activation and concentration levels (Erčulj & Štrumbelj, 2015).

2.2. Variables

Attack effectiveness: Following Gómez, Lorenzo, Ibáñez, and Sampaio, (2013), we analyse attack effectiveness as dichotomous variable considering: (a) successful ball possessions: when the offensive team scored a 2 or a 3-point field-goal, secured a rebound, or received a foul, including foul shot; (b) unsuccessful ball possession: when the offensive team missed a 2 or 3-point field -goal, received a block shot, committed a foul, made a turnover, or made any other rule violation.

Game condition: A series of categorical variables related to game condition were recorded (Figure 1) based on previously researches conducted in basketball match analysis (Csataljay, James, Hughes, & Dancs, 2013; Courel et al., 2013; Gómez et al., 2013; Faber & Schmidt, 2000; Remmert, 2003).

- Ball possession duration: the possession length was registered just before the possession clock restarted the count according to the game rules specifications.

Then, three categories were considered: 0 to 7 seconds, 8 to 15 seconds, and 16 to 24 seconds.

- Pass zone: Two areas were delimited regarding the passer location at the moment of releasing the ball, considering the imaginary diagonal line linking the rim with the midline sides and crossing the paint elbow: frontal and lateral (Figure 1A).
- Reception zone: Two areas were delimited regarding the receiver location at the moment of getting the ball, considering the imaginary line crossing the paint into two parts: low post and high post. Free-throw lines were used to visual reference (Figure 1A).
- Pass distance: Location of the passer at the moment of releasing the ball, considering if stepping inside or outside the 3-point area (Figure 1B).
- Reception distance: Two sides areas were delimited regarding the receiver location at the moment of the pass distinguishing between strong (side of the court where the ball is located) and weak (opposite the strong side, away from the ball) (Figure 1B).
- Receiver's attitude: from the moment the ball was released by the passer, to when the receiver gets the ball, we considered to possible attitudes: dynamic attitude (if the receiver have made a displacement to get the ball) and positional attitude (if the receiver do not move and keep the stance) (Figure 1C).
- Player position: Players' were classified according to their specific player position as: point guard - PG, shooting guard - SG, shooting forward - SF, power forward - PF, and center – C.
- Defensive opposition: receivers' the level of defensive pressure was determined and notated for the moment that the ball was received, considering low pressure

(absence or low presence of physical contact with the opponent) and high pressure (notable physical contact with the opponent).

- Defensive help: the presence/absence of a briefly leaving of the direct pair in order to defend the unmarked receiver's action (Figure 1D).

Situational variables: based on Gómez, Lago and Pollard (2013) we measured: (i) Team ranking (teams standing according to the end-of-season classification), (ii), Game period (first to forth quarter); (iii); Game location (local and away team) and (iv) Match status (whether the team was winning, drawing or losing at the moment of the pass). Match status was obtained using the accumulative differences between points scored and allowed in each ball possession and then converted into a categorical variable using a two-step cluster analysis (Sampaio, Drinkwater, & Leite, 2010; Sampaio, Lago, & Drinkwater, 2010). Three clusters were identified and categorised as "moderate disadvantage" (differences between -10 and -4 points), "balanced" (differences between -3 and 3 points), "moderate advantage" (differences between 4 and 10 points).

1A. Pass/reception zone. 1B. Reception distance. 1C. Receiver's attitude. 1D. Defensive help.

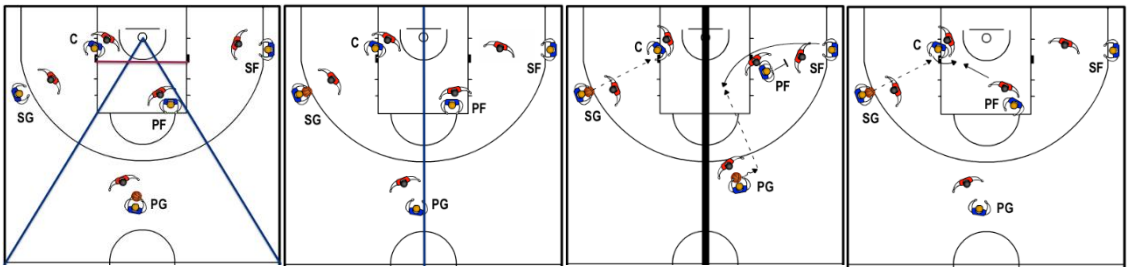

Figure 1. Game conditioning variables. Diagram 1A shows pass (blue lines) and reception (red line) zones: (PG) is frontally located, while (SF) and (SG) are lateral; (C) is in the low post and (PF) in the high post. Diagram 1B shows reception distance: As (SG) has the ball, (C) and (PG) are located in the strong side (blue line, ball side), while (PF) and (SF) in the weak side. Diagram 1C shows receiver's attitude: (C) gets the ball standing positional (left side), while (SF) is moving at the moment (PG) drops the ball to make the pass (right side). Diagram 1D shows defensive help: (C) gets the ball in the inside and face the basket overpassing his direct opponent; then, (PF) defender leaves his direct pair in order to defend the unmarked opponent's action. Continuous arrows indicate player movement without the ball, dotted arrows indicate a pass, and a T indicates a screen.

2.3. Procedures

Four pairs of observers specialising in basketball analysed all games after a 3-week training period. The observers' objectivity (inter-observer reliability) and reliability (intra-observer reliability) were assessed using the multi-rater k free index (Randolph, 2008) and Cohen's Kappa respectively. Scores obtained were over 0.87 in all cases, therefore objectivity and reliability were classified as 'almost perfect agreement' (Altman, 1991). Ball possessions were recorded using the LINCE software (Gabin, Camerino, Anguera, & Castañer, 2012), flexible digital recording software that allows data exportation for its treatment on statistical packages.

2.4. Statistical Analysis

Descriptive analysis included frequencies, means with standard deviations and percentages with standard errors. Odds Ratio (OR) and 95% Confidence Intervals (CI) were calculated by multiple binary logistic regression to predict ball possession effectiveness whereas using or not inside pass. The likelihood ratio Chi-Square test was used to identify main effects of variables studied. Then, adjusted regression models were conducted. Significations of predictors were assessed by means of Wald's test (p<0.05). Secondly, a classification tree analysis was used to determine inside pass effectiveness according to performance indicators predicted (Gómez et al., 2015). The exhaustive CHAID (Chi Squared automatic interactions detection) algorithm was used to identify relationships between independent categorical variables through completing three steps on each node of the root, finding the predictor that exert the most influence on the dependent variable. Significant level was set

at $p<0.05$, considering a maximum of 100 iterations and a minimum change in expected cell frequencies of 0.001. Strength of associations was studied recurring Adjusted Standardised Residuals (ASRs), considering values from 1.96 to 2.58 as little, 2.58 to 3.29 as weak and over 3.29 as strong associations (Field, 2009). Effect size and goodness of fit were calculated through Cox & Snell and the Nagelkerke pseudo-R2 for regression analyses, and Phi (φ) for Chi-Square tests, considering 0.10 = small effect, 0.30 = medium effect, and 0.50 = large effect (Fritz, Morris, & Richler, 2012). In order to avoid reporting too optimistic predictive models, a leave-one-out-cross-validation process was performed by splitting data into a training sample to estimate and compare the total and the partial models (Norusis, 2004). Independence of observations was assumed, as interactions between players during ball possessions constitute an unpredictable task and environment-related functional information (Duarte et al. 2012). Statistical analyses were conducted in IBM SPSS v. 20.0 for Macintosh (Armonk, NY: IBM Corp.).

3. Results

Distribution of frequencies from studied variables in ball possessions using or not inside pass are shown in Table 1.

Table 1. Distribution of frequencies from studied variables in ball possessions using or not inside pass.

Performance Indicators	No Inside pass (n=3399)	Inside pass (n=808)	Performance Indicators	Inside pass (n=808)
	%	%		%
Effectiveness			**Pass zone**	
Successful	51.8	63.9	Frontal	40.6
Unsuccessful	48.2	36.1	Lateral	59.4
Possession duration (s)			**Pass distance**	
0-7	33.9	26.4	Outside	83.7
8-15	39.6	43.5	Inside	16.3
16-24	26.5	30.0	**Passer position**	
Game period			PG	40.6
1st quarter	29.7	31.8	SG	23.0
2nd quarter	25.5	24.6	SF	21.7
3rd quarter	22.7	24.3	PF	10.7
4th quarter	22.1	19.4	C	4.1
Game location			**Receiver position**	
Home	50.8	51.0	PG	6.5
Away	49.2	49.0	SG	6.2
Match status			SF	18.2
Moderate advantage	44.0	42.7	PF	38.7
Balanced	63.4	38.0	C	30.4
Moderate disadvantage	19.6	19.3	**Reception zone**	
			High post	57.8
			Low post	42.2
			Reception distance	
			Strong side	69.1
			Weak side	30.9
			Reception attitude	
			Positional	39.3
			Dynamic	60.7
			Defensive opposition	
			High pressure	39.2
			Low pressure	60.8
			Defensive help	
			Help	54.1
			No help	45.9

Table 2 displays Likelihood ratio Chi-Square values for general and adjusted models predicting use and effectiveness of inside pass. When predicting the use, both general (X2(10)=75.62; p<0.01; R2=.02-.03) and adjusted (X2(4)=70.15; p<0.01; R2=.02-.03) models revealed significant associations of effectiveness and possession duration, considering team ranking influences. Regarding the inside pass effectiveness, general model (X2(24)=82.79; p<0.01; R2=.10-.14) detected influences of variables pertaining to task (possession duration and receiver attitude), space (pass zone and reception distance), players' position (receiver position) and defence (defensive help). However, adjusted model (X2(10)=59.88; p<0.01; R2=.07-.10) excluded pass zone and receiver position as effectiveness predictors.

Table 2. Likelihood ratio Chi-Square values for general and adjusted models predicting use and effectiveness of inside pass.

Performance Indicators	Use				Effectiveness			
	General		Adjusted		General		Adjusted	
	X2	p	X2	p	X2	p	X2	p
Outcome								
Effectiveness	42.88*	<0.01*	42.55*	<0.01*				
Task								
Possession duration	20.12*	<0.01*	19.48*	<0.01*	9.49*	<0.01*	10.16*	<0.01*
Receiver attitude					20.60*	<0.01*	16.10*	<0.01*
Space								
Pass zone					4.10*	0.04*	3.39	0.08
Pass distance					1.31	0.25		
Reception zone					2.28	0.13		
Reception distance					5.79*	0.02*	8.73*	<0.01*
Players' position								
Passer position					9.66*	0.04*		
Receiver position					4.72	0.32		
Defence								
Defensive opposition					2.83	0.09		
Defensive help					6.55*	0.01*	8.41*	<0.01*
Situational Variables								
Team ranking	8.86*	<0.01*	9.53*	0.02*	1.69	0.19		
Game period	4.77	0.19			3.84	0.28		
Game location	0.80	0.77			0.02	0.90		
Match status	0.13	0.19			4.34	0.11		
Global	72.43*	<0.01*	70.15*	<0.01*	82.79*	<0.01*	59.88*	<0.01*

* Significant differences (p<0.05)

Table 3 shows results from adjusted multiple logistic regression analysis. Regarding the use of inside pass, attack effectiveness increased from 44 to 98% and ball possession duration was likely to last over 17 seconds when include it. Besides, the high-ranked the team was, the more this action was included. Concerning effectiveness, receiver attitude (dynamic) was the most powerful predictor, followed by possession duration (over 16 seconds), reception distance (weak side) and defensive help (no help).

Table 3. Odds Ratio and their 95% Interval Confidence for adjusted models to predict use and effectiveness of inside pass**.**

Performance Indicators	Use		Effectiveness	
	OR	**95%-CI**	**OR**	**95%-CI**
Effectiveness				
Successful	1.69*	1.44-1.98*		
Unsuccessful (ref)				
Possession duration (s)				
0-7 (ref)				
8-15	1.08	0.90-1.30	0.59*	0.40-0.89*
16-24	1.53*	1.24-1.87*	0.59*	0.41-0.84*
Team ranking	1.06*	1.02-1.09*		
Reception distance				
Strong side (ref)				
Weak side			1.67*	1.18-2.34*
Receiver attitude				
Positional (ref)				
Dynamic			1.87*	1.38-2.55*
Defensive help				
Help (ref)				
No help			1.58*	1.16-2.15*

* Significant differences ($p<0.05$). Ref: Reference category.

Figure 2 displays results from the classification tree analysis, disclosing important increments on attack effectiveness. Regarding the first level (effectiveness and reception attitude) revealed that dynamic attitude was the most powerful predictor compared to positional standing (Node 2; ASRs=3.4; φ=0.16). Second level (includes reception distance) showed increments on attack effectiveness when the receiver was located at the weak side rather than keeping in the strong side (Node 4; ASRs=3.0; φ=0.14). Finally, third level (includes defensive help) added no help as a success predictor (Node 6; ASRs=3.4; φ=0.23). This classification tree model enabled explaining 64.6% of total variance.

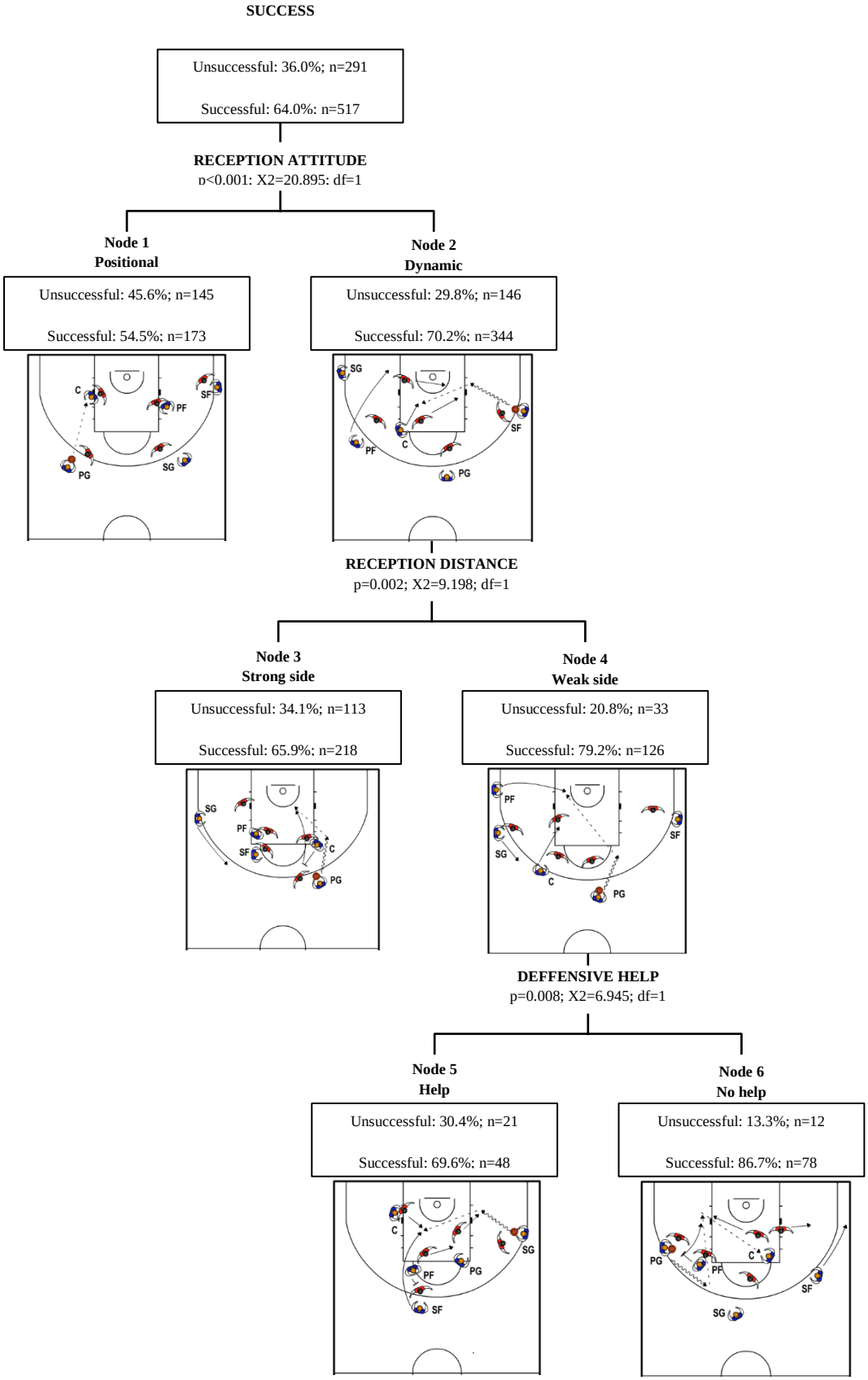

Figure 2. Classification tree analysis of inside pass effectiveness. Continuous arrows indicate player movement without the ball, zigzag arrows indicate player movement with the ball, dotted arrows indicate a pass, and a T indicates a screen.

4. Discussion

Current study aimed to analyse the effects of using inside pass on ball possession effectiveness and to identify game performance indicators to predict inside pass success in NBA basketball, considering situational variables. Obtained results strengthen the importance of using inside pass to increase ball possession effectiveness. More importantly, it has been detected a variety of game performance indicators that may predict inside pass success. Concretely, adjusted predictive models included reception distance, receiver attitude, receiver action, and defensive help as main performance indicators.

Nearby 20% of ball possessions included inside passes, being 1.4 to 2.0 times more likely to be effective compared to those that did not include this action. This is in line with Courel et al. (2013) who reported higher effectiveness (63.3% vs. 49.8%) and more points scored (0.84 vs. 0.68) when using inside pass in the Spanish Professional male League. Conforming to out expectation, playing near the rim enlarge offensive efficiency providing close shooting options and increasing scoring-rates (Gómez et al., 2013; Gómez, Gasperi, & Lupo, 2016). Chiefly, our findings point out the importance of the post game in NBA basketball emphasizing in pass and reception interactions to improve inside game effectiveness. Furthermore, best-ranked NBA teams included this action slightly more during the offences in the Playoffs stage regardless the game period. As previously stated, All-star NBA players consistently outperformed non-all star players particularly in locations close to the basket (Sampaio et al., 2015). Thus better skills and physical condition expected in best-ranked teams might explain these differences, being however necessary to further explore teams' configuration when performing inside game.

Ball possessions including inside pass likely lasted over 17 seconds in duration, however success options increased if finishing earlier than 7 seconds. These results concur with those reported by Courel et al. (2013), who found longer possessions (14.46 ± 4.4s. vs. 13.28 ± 5.92s.) when using inside. In basketball, making a pass involves the risk of losing the possession of the ball and benefiting the opponent to score through a fastbreak (Gómez et al., 2013; Trninić, Dizdar, & Lukšić, 2002). Thus, teams should invest enough time during the offence in completing collective actions to create space near the basket, and then explore the options to take the best decision (Cárdenas et al., 1999; Ortega, Cárdenas, Sainz de Baranda, & Palao, 2006; Mavridis et al., 2003). In particular, we found a prevalence of inside passes in the longer ball possession. This could be a direct consequence of defensive distractions and poorer decision-making during the last seconds of the possession (Gómez et al., 2015; Mesagno et al., 2015). On the other hand, an expected higher inside pass effectiveness was observed in short-duration possessions (0-7 seconds) which indicates that teamwork intensity may account for inside game success, avoiding defensive anticipation through performing fewer actions across a shorter time duration (Bazanov, 2005).

According to our findings, inside pass effectiveness was mainly influenced by: receiver's attitude, possession duration, reception distance, and defensive help. Concretely, players should include a previous movement (dynamic) before receiving and taking advantage of defensive imbalance in order to avoid defensive helps. These results are in line with previous studies, establishing that a player who receives the ball close to the basket generates opponents' imbalance, facilitating the offence play, so defense is less effective when an inside pass is performed (Álvarez, Ortega, Gómez, & Salado, 2009; Ortega et al., 2006).

A main contribution of this study is the exploration of combined performance indicators through a classification tree analysis. This analysis allowed us to obtained accurate information on players' behaviours and interactions to enhance inside game use and effectiveness. In this sense, it is worth noting that dynamic receiver's attitude resulted in greater effectiveness compared with positional standings (70.2% vs. 54.3%). This data suggest overlapping collective interactions to create free space in favour of the receiver (Lamas, Junior, Santana, Rostaiser, Negretti, & Ugrinowitsch, 2011; Remmert, 2003). More importantly, we observed that success rate increased up to 79.2% when the receiver was on the weak side at the moment of the pass. These findings add relevant insights on tactical behaviour during inside game interactions from a spatial point of view, strengthens the notion that individual and collective actions away from the ball would benefit those in the strong side. Indeed, cooperative actions would facilitate the offence against a misplaced defence, avoiding the use of helps and increasing the success rate up to 86.7% (Figure 3).

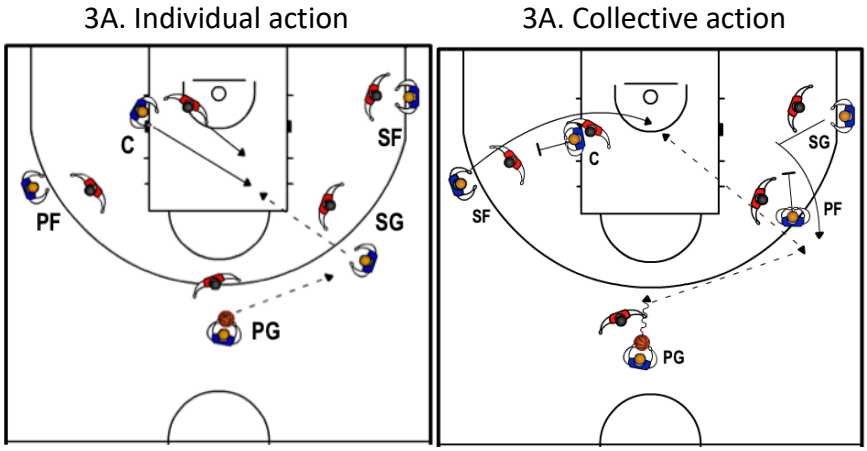

Figure 3. Individual and collective actions before an inside pass. Diagram 3NBA AA shows inside player (C) movement from the weak to the strong side previous to the reception from (SF). Diagram 3B shows overlapping of actions before the inside pass. (PG) dribbles to the basket, while (C) screens to free (PF) and (SF) screens to free (SG). Continuous arrows indicate player movement without the ball, dotted arrows indicate a pass, and a T indicates a screen.

Surprisingly, we did not identify significant effects between players' specific position and inside pass effectiveness. This intriguing result was previously reported in similar studies exploring collective behaviours in elite basketball such as ball screens (Gómez, et al., 2015). As the authors stated, this kind of actions are likely to be quite pre-determined by the coaches during elite basketball close games. Additionally, elite basketball players are characterized according to their specific position. In this sense, inside players need to be physically powerful to dominate receiving and shooting skills near the basket against high defensive pressure, as well as being good rebounders, screeners and blockers (Cárdenas, Ortega, Llorca, Courel, Sánchez-Delgado, & Piñar, 2015; Gómez, et al., 2015; Ortega, et al., 2006).

In sum, our results strongly suggest making efforts to include an inside pass during the set offence and controlled game possessions. Particularly, players should adopt a dynamic attitude in the weak side before getting the ball, while their teammates are developing individual and collective actions to create free space and enhance inside game options and effectiveness. These findings may have implications in basketball training process, contributing in the design of specific programmes to increase inside game options and players' decision-making according to specific game constraints. Further research is needed to examine, group-tactical behaviours when using inside pass in order to obtained accurate information about players interactions to improve performance.

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PLAYERS' INTERACTIONS DURING INSIDE PASS IN NBA BASKETBALL.

Interactions during inside pass in basketball

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Abstract

The inside game constitutes an essential aspect of modern basketball, particularly in the NBA in where the best players of the world compete. The purpose of this study was to identify how players' interaction predicted offensive and defensive performance when using inside pass in the NBA, considering game contextual effects. The sample was composed of 808 inside passes from 25 randomly selected matches of the 2010 NBA Playoffs series. A series of logistic regression analyses were used to analysed passers and receivers' actions and its effectiveness during inside passes, both individually and combined. Main results revealed that interactions combining passer's previous actions (dribbling or faking) with receiver's cuts toward the basket achieved the highest offensive effectiveness. Besides, performing screens in favour to the receiver was an effective alternative to increase inside passing options since it reduces the defensive pressure. Furthermore, player's actions previously passing the ball were further successful if combined and synchronized with the receivers' displacements, especially when cutting to the basket. In sum, it is supported the greater benefits of overlapping and concatenation of disruptive actions for progressively creating sufficient space and enhance scoring odds in basketball. Current research provides novel insights on specific players' configurations that contribute on inside game performance. This information allows a better understanding of basketball collective strategies, contributing in the design of precise practice tasks and so improving the training process.

Keywords: performance analysis, predictive analysis, team configurations, collective behaviour**.**

1. Introduction

In team sports such as basketball, understanding tactical elements through collective behaviours assessment is of vital importance to improve performance, supporting the training process and preparation for the match (Grehaigne & Godbout, 2013; Lemmink & Frencken, 2013). Previous researches have very recently explored players' interactions in basketball, providing detailed and quantitative evidence of game process, exploring team's dynamics, game patterns, and players' configurations to better predict and estimate how decisions contribute to the whole possession effectiveness and not only at the final states like points, rebounds, and turnovers (Gómez, Battaglia, Lorenzo, Lorenzo, Jiménez, and Sampaio, 2015; Lamas, Santana, Heiner, Ugrinowitsch, & Fellingham, 2015). This information assists in the coaching process to assess the quality of players' decision-making and interpret the causes of the achieved outcome, for example, the pass that led to the open shot, or the preceding drive that collapsed the defence (Cervone, D'Amour, Bornn, & Goldsberry, 2014). Additionally, players' behaviour may be altered by the contextual situation of the game (game period, game location, match status, quality of opposition), and so must be considered when assessment teams' tactics (Gómez, Lago, & Pollard, 2013; McGarry, 2009).

In modern basketball, offensive efficiency depends on the balance between the outside game and the post game (Gupillotte, 2008). To this purpose, players' interactions have been successfully categorized and recorded through match analysis in basketball (Lamas, Junior, Santana, Rostaiser, Negretti, & Ugrinowitsch, 2011; Santana, Rostaiser, Sherzer, Ugrinowitsch, Barrera, & Lamas, 2015). These authors

have detected and classified possible actions used to create and protect space, defined as Space Creation Dynamics (SCD) and Space Protection Dynamics (SPD). These tools have been implemented in the analysis and modelling of offensive and defensive interactions in elite teams (Lamas et al., 2015). Moreover, Gómez et al. (2015) identified the predictors of success in ball screens related to time, space, players and tasks performed. There is therefore interest in identifying trends and game patterns to better prepare training sessions aimed at improving players' tactical performance and decision-making according to specific game situations and constraints (Eccles, Ward & Woodman, 2009). Unfortunately, current information of game dynamics came mostly from European basketball teams, finding limited studies exploring National Basketball Association (NBA), the most popular and important basketball league in the world (Gómez, Gasperi, & Lupo, 2015).

One of the most important actions in basketball are passing and receiving the ball. Evidence reveals that teams with better passing skills enhance their match and season winning options (Melnick, 2001; Ibáñez, Sampaio, Feu, Lorenzo, Gómez, & Ortega, 2008). More specifically, inside pass has been shown to be a performance indicator in basketball, creating defensive imbalance, generating open spaces for shooting, 1 on 1 situations close the basket, and increasing scoring options (Courel, Suárez, Ortega, Piñar, & Cárdenas, 2013; Mavridis, Laios, Taxildaris, & Tsiskaris, 2003; Milanović, Selmanović, & Škegro, 2014). Particularly in the NBA, there is a larger use of inside pass compared to European teams (Mavridis, Tsamourtzis, Karipidis, & Laios, 2009). In basketball, the majority of possessions are solved in the inside, chiefly in the NBA due to the athletic complexion of center players, making them specialist in shooting near the basket and dunking with a higher rate of effectiveness (Erčulj & Štrumbelj, 2015).

Furthermore, a very recent researched exploring NBA playoffs series reported greater effectiveness in ball possessions when using inside pass, specially if including previous movements before receiving and cooperative actions to facilitate the offence against a misplaced defence (Courel-Ibáñez, McRobert, Ortega, & Cárdenas, 2016). This leads to the suggestions that specific passer-receiver interactions would result in benefit for playing inside pass.

In sum, predicting and estimating how players' interactions contribute to the possession success is an on-going challenge for analytics in team sports. In basketball, achieving to play inside the paint constitute an essential offensive aim, as most of points scored and fouls received come from near the basket; however there is scarce information on how players should behave to enhance inside game performance. The purpose of this study was therefore to identify how players' interaction predicted offensive and defensive performance when using inside pass in the NBA, considering game contextual effects.

2. Methods

2.1. Sample and variables

A total of 808 inside passes where recorded from 25 matches of the 2010 NBA Playoffs series. Games were randomly selected including eight teams (four per conference) with a minimum of two matches and at least one victory and one defeated per each, excluding overtime games. Ball possessions recorded had a score difference below 10 points (average = 1.58 ± 4.56 points). The choice of this specific sample was deliberate;

first, NBA is the most important basketball club competition of the world; second, Playoffs confronted best season teams for becoming the champion, thus the maximum competitive degree was expected until the end of the game; and third, possessions with short score differences ensure high players' activation and concentration levels (Erčulj & Štrumbelj, 2015).

Inside pass was considered when the receiver player was stepping the zone or paint. Variables pertaining to players' interaction, offensive and defensive performance and game context were included in the analyses. Players' interaction was analysed by classifying passer and receiver action, based on Lamas et al.'s proposal (2011). Passer action included: (i) Ball Dribbled (BD): individual actions by dribbling the ball, (ii) Ball not Dribbled (BND): similar to BD but without a dribble, using only body displacements techniques (i.e., ball fakes, jab step), (iii) On ball screen (OBS): one or more players try to free a teammate with the ball by interposing their body to the path of the defender, (iv) Positional (P): player states without making BD or BND. Receiver action included: (i) OBS and roll (OBS&roll): the screener moves towards the basket after blocking and receives the ball, (ii) Out-of-ball screen (OoBS): similar to OBS but freeing a teammate without the ball, (iii) OoBS and roll (OoBS&roll): Similar than OBS&roll when performing OoBS, (iv) Space Creation Without Ball (WB): previous movement without the ball to create space and receive it properly, (v) Dive cut (DC): displacement from the outside toward the basket, (vi) Positional (P): player states with no previous actions.

Offensive and defensive performance was explored through dichotomous categorical variables (Courel-Ibáñez, et al, 2016). Offensive performance assessment comprised (i)

effectiveness (successful ball possessions: when the offensive team scored a 2 or a 3-point field-goal, secured a rebound, or received a foul, including foul shot; unsuccessful ball possession: when the offensive team missed a 2 or 3-point field -goal, received a block shot, committed a foul, made a turnover, or made any other rule violation, and (ii) shooting options (shot: when the receiver shot right after receiving the ball; not shot: when the receiver made a pass, dribbled the ball or stayed positional). Defensive performance involved (i) defensive pressure (following Csataljay et al's (2013), maximal pressure was considered when the receiver got the ball contacting or very close to an opponent) and (ii) defensive helps (help: a teammate briefly leaved his direct pair in order to stop the receiver action; not help: no other opponents rather than the direct pair tried to stop the receiver action).

Finally, contextual variables were considered as covariates, by measuring: (i) team ranking (top-4 and low-4 teams according to the end-of-season classification), (ii), game period (first to forth quarter); (iii); game location (local and away team) and (iv) match status (whether the team was winning, drawing or losing at the moment of the pass). Match status was obtained using the accumulative differences between points scored and allowed in each ball possession and then converted into a categorical variable using a two-step cluster analysis (Sampaio, Drinkwater, & Leite, 2010; Sampaio, Lago, & Drinkwater, 2010). Three clusters were identified and categorised as "moderate disadvantage" (differences between -10 and -4 points), "balanced" (differences between -3 and 3 points), "moderate advantage" (differences between 4 and 10 points).

2.2. Procedure

Four pairs of observers specialising in basketball analysed all games after a 3-week training period. The observers' objectivity (inter-observer reliability) and reliability (intra-observer reliability) were assessed using the multi-rater k free index (Randolph, 2008) and Cohen's Kappa respectively. Scores obtained were over 0.87 in all cases, therefore objectivity and reliability were classified as 'almost perfect agreement' (Altman, 1991). Ball possessions were recorded using the LINCE software (Gabin, Camerino, Anguera, & Castañer, 2012), flexible digital recording software that allows data exportation for its treatment on statistical packages.

2.3. Statistical Analysis

Descriptive analysis included frequencies and percentages of studied variables. Odds Ratio (OR) and 95% Confidence Intervals (CI) were calculated by multiple binomial logistic regression to predict offensive and defensive performance (dependent variables) regarding players interaction (predictor) and game context (covariate). The Cox & Snell and the *Nagelkerke* R2 were used to assess the effect size as the final amount of variance explained by regression models. Significations of predictors were assessed by means of Wald's test ($p<0.05$). Independence of observations was assumed, as interactions between players during ball possessions constitute an unpredictable task and environment-related functional information (Duarte, Araujo, Correia, & Davids, 2012). Statistical analyses were conducted in IBM SPSS v. 20.0 for Macintosh (Armonk, NY: IBM Corp.).

3. Results

Table 1 displays distribution of factors, covariates and game performance variables. Individually, P and BD passers' actions accounted for the 71.2% of the total, whilst P, DC and OBS&roll receivers' actions were the most prevalent with 83.8%. Besides, we detected 17 passer-receiver interactions, being the most common BD-DC, P-P, OBS-OBS&roll, BD - P and BD - WB (75.7%).

Table 1. Distribution of variables studied.

Players' actions	n	%	Game context	n	%
Passer Action			**Team ranking**		
Ball Dribbled (BD)	286	35.4	Top-4	466	57.7
Ball Not Dribbled (BND)	103	12.8	Low-4	342	42.3
On Ball Screen (OBS)	129	16.0	**Game Period**		
Positional (P)	289	35.8	1st quarter	257	31.8
Receiver Action			2nd quarter	199	24.6
OBS and roll (OBS&roll)	121	15.0	3rd quarter	196	24.3
Out-of-ball screen (OoBS)	33	4.1	4th quarter	157	19.4
OoBS and roll (OoBS&roll)	43	5.3	**Game Location**		
Space Creation Without Ball (WB)	55	6.8	Local	412	51.0
Dive cut (DC)	241	29.8	Away	396	49.0
Positional (P)	315	39.0	**Match Status**		
Passer & Receiver Interaction			Moderate advantage	345	42.7
BD - OoBS&roll	8	1.0	Balanced	307	38.0
BD – OoBS	11	1.3	Moderate disadvantage	156	19.3
BD – WB	105	13.0			
BD – P	109	13.5	**Game performance**	**n**	**%**
BD – DC	149	18.5	**Effectiveness**		
BND - OoBS&roll	13	1.6	Successful	516	63.9
BND – OoBS	10	1.2	Unsuccessful	292	36.1
BND – WB	11	1.4	**Shooting**		
BND – P	30	3.7	Shoot	545	67.4
BND – DC	32	3.9	Not shoot	263	32.6
OBS - OBS&Roll	121	15.0	**Defensive pressure**		
OBS – P	8	1.0	Maximal pressure	317	39.2
P - OoBS&roll	12	1.5	Not maximal pressure	491	60.8
P – OoBS	23	2.9	**Defensive help**		
P – WB	33	4.1	Help	437	54.1
P – DC	94	11.6	No help	371	45.9
P – P	127	15.7			

Table 2 shows results from predictive analysis of offensive and defensive performance when using inside pass regarding individual passer and receiver actions. It was reported influence of previous passer actions on receivers' shooting options (X2(15)=33,371; p=0.004; R2=.04-.06), defensive pressure (X2(15)=33,840; p=0.004; R2=.04-.06) and helps (X2(15)=47,756; p<0.004; R2=.06-.08), not finding differences in attack effectiveness (X2(15)=22,260; p=0.101; R2=.03-.04). Including BD before passing increased receivers' shooting options from 1.3 to 2.8 times, as well as reduced the appearance of maximal defensive pressure situations by 1.7 to 3.5 times and defensive helps by 1.08 to 2.15 times. Similarly, BND passer's actions also provided advantage by decreasing maximal defensive pressure situations (1.21 to 3.36 times). Conversely, receiver actions did not show any significant effect when treated individually. Regarding covariates influence, receiver players from high-ranked teams were capable to make more shots right after getting the ball in the inside (from 1.07 to 2.01 times). Further, interactive effects revealed greater shooting likelihood for high-ranked teams when performing BD before passing (OR=1.99, CI: 1.25-3.15) in comparison with the low-ranked (X2(7)=14,688; p=0.004; R2=.02-.03). Moreover, defensive pressure increased during the first and third quarter compared to the last period. In particular, receiver's positional standing during the first quarter raised maximal opposition situations (OR=0.12, CI: 0.01-0.99; X2(37)=84,455; p<0.001; R2=.09-.13) and enlarged the appearance of defensive helps (OR=0.45, CI: 0.24-0.94; X2(37)=64,252; p=0.004; R2=.07-.10), while BND augmented defensive pressure in the first quarter (OR=0.23, CI: 0.07-0.80; X2(37)=64,252; p=0.004; R2=.07-.10).

Table 2. Odds Ratio and their 95% Interval Confidence for factors and covariates predicting offensive and defensive performance when using inside pass regarding individual passer and receiver actions.

Parameter	Offensive performance		Defensive performance	
	Shooting(a)	Effectiveness(b)	Defensive pressure(c)	Help(d)
Passer Action (1)				
Ball Dribbled (BD)	**1.91 (1.32-2.76)***	1.87 (1.30-2.70)	**2.44 (1.72-3.48)***	**1.53 (1.08-2.15)***
Ball Not Dribbled (BND)	0.88 (0.53-1.44)	1.20 (0.72-1.99)	**2.02 (1.21-3.36)***	1.26 (0.77-2.06)
On Ball Screen (OBS)	2.60 (0.51-13.20)	0.84 (0.21-3.33)	1.29 (0.32-5.16)	1.18 (0.29-4.71)
Receiver Action (1)				
OBN and roll (OBN&roll)	0.36 (0.06-1.91)	1.04 (0.24-4.36)	2.24 (0.53-9.52)	1.86 (0.44-7.83)
Out-of-ball screen (OoBS)	0.94 (0.44-2.03)	0.81 (0.37-1.74)	2.30 (1.00-5.26)	0.96 (0.46-2.01)
OoBS and roll (OoBS&roll)	0.94 (0.48-1.84)	0.70 (0.36-1.36)	1.43 (0.73-2.80)	0.59 (0.30-1.16)
Space Creation Without Ball (WB)	0.70 (0.33-1.47)	0.96 (0.44-2.08)	0.79 (0.43-1.47)	1.51 (0.83-2.78)
Dive cut (DC)	0.91 (0.33-2.46)	1.07 (0.39-2.97)	1.15 (0.80-1.66)	1.08 (0.76-1.54)
Covariates				
Team ranking (2)	**1.44 (1.07-2.01)***	0.84 (0.62-1.14)	0.94 (0.69-1.27)	0.84 (0.62-1.13)
Game Period (3)				
1st quarter	0.89 (0.66-1.20)	1.00 (0.62-1.59)	**0.62 (0.36-0.98)***	**0.57 (0.37-0.88)***
2nd quarter	0.74 (0.46-1.17)	0.74 (0.46-1.17)	0.71 (0.44-1.13)	0.93 (0.60-1.45)
3rd quarter	1.03 (0.64-1.66)	1.03 (0.64-1.66)	**0.60 (0.38-0.96)***	1.08 (0.69-1.69)
Game Location (4)	0.81 (0.59-1.11)	0.83 (0.61-1.13)	1.02 (0.76-1.38)	1.07 (0.80-1.43)
Match Status (5)				
Moderate advantage	1.33 (0.97-1.83)	1.01 (0.88-1.65)	0.94 (0.61-1.47)	1.31 (0.85-2.02)
Balanced	1.03 (0.70-1.49)	1.02 (0.70-1.50)	0.96 (0.66-1.39)	1.22 (0.85-1.75)

*Wald's test $p < 0.05$. Dependent Variables references: (a) not shooting; (b) unsuccessful; (c) maximal pressure; (d) help. [Note that positive defensive OR indicate higher pressure and more helps]. Predictors references: (1): positional; (2) low-4 teams; (3) fourth quarter; (4) away team; (5) moderate disadvantage.

Finally, results from players' interactions are presented in Table 3. In contrast with individual results, we found greater influence of combined actions on attack effectiveness ($X^2(20)=53,439$; $p<0.001$; $R^2=.07-.09$), and also on shooting options ($X^2(20)=56,860$; $p<0.001$; $R^2=.07-.10$), defensive pressure ($X^2(20)=58,029$; $p<0.001$; $R^2=.07-.10$), and helps ($X^2(20)=61,469$; $p<0.001$; $R^2=.08-.10$). Specifically, we observed that BD-DC and BND-DC combinations increased attack effectiveness up to 8.7 times. Moreover, we found many benefits when analysing passer-receiver's interactions: larger shooting options (BD-P, BD-DC, and P-DC), lower defensive pressure (BD - OoBS&roll, BD – OoBS, BD – P, BD – DC, BND - OoBS&roll, OBS - OBS&Roll, OBS - OBS&Roll, and P – DC) and lower defensive helps (BD – P, BND - OoBS&roll, BND – WB, and OBS - OBS&Roll). In overall, receivers' dive cut through the basket increased shooting options, being the most effective way to score, whilst the use of screens considerably decreased defensive pressure. Regarding covariates, although best-positioned team in the ranking were able to make more shots right after receiving the ball, interactive effects were not conclusive to make interpretations ($X^2(13)=17,920$; $p=0.161$; $R^2=.02-.03$).

Table 3. Odds Ratio and their 95% Interval Confidence for factors and covariates predicting offensive outcome and defensive reaction when using inside pass regarding passer-receiver interactions.

Parameter	Offensive performance		Defensive performance	
	Shooting(a)	Effectiveness(b)	Defensive pressure(c)	Help(d)
Passer-receiver Interaction (1)				
BD - OoBS&roll	0.81 (0.19-3.48)	2.50 (0.46-13.63)	**11.91 (1.40-100.99)***	0.85 (0.19-3.80)
BD - OoBS	0.90 (0.25-3.18)	2.55 (0.63-10.24)	**15.13 (1.86-122.87)***	0.88 (0.25-3.11)
BD – WB	1.77 (0.42-7.37)	1.51 (0.39-5.83)	3.34 (0.80-13.90)	4.70 (0.93-23.65)
BD – P	**2.04 (1.17-3.57)***	1.55 (0.90-2.67)	**2.78 (1.61-4.81)**	**1.90 (1.10-3.26)***
BD – DC	**4.40 (2.51-7.72)***	**4.99 (2.84-8.75)***	**3.35 (2.03-5.55)***	1.22 (0.72-1.9)
BND - OoBS&roll	2.20 (0.64-7.65)	0.61 (0.17-2.00)	**5.29 (1.37-20.34)***	**5.74 (1.21-27.24)***
BND - OoBS	2.60 (0.62-10.75)	1.52 (0.40-5.80)	1.58 (0.43-5.86)	0.69 (0.18-2.64)
BND - WB	0.96 (0.22-4.08)	2.88 (0.55-14.95)	2.71 (0.61-11.92)	**3.13 (0.60-16.31)***
BND – P	0.70 (0.30-1.6)	1.47 (0.62-3.46)	1.92 (0.82-4.49)	0.29 (0.11-0.78)
BND - DC	1.50 (0.65-3.38)	**3.47 (1.38-8.74)***	**5.18 (2.06-13.04)***	1.91 (0.83-4.37)
OBS - OBS&Roll	1.37 (0.87-2.29)	1.47 (0.88-2.46)	**3.70 (2.17-6.29)***	**2.03 (1.21-3.41)***
OBS – P	3.18 (0.65-16.7)	1.12 (0.21-4.48)	1.83 (0.45-7.35)	1.19 (0.29-4.80)
P - OoBS&roll	1.21 (0.37-3.98)	3.55 (0.92-13.75)	2.67 (0.81-8.77)	0.22 (0.04-1.00)
P – OoBS	1.73 (0.68-4.38)	1.12 (0.45-2.75)	1.88 (0.77-4.57)	0.54 (0.21-1.38)
P – WB	1.13 (0.53-2.44)	1.82 (0.82-4.04)	0.87 (0.39-1.90)	1.05 (0.49-2.24)
P – DC	**2.29 (1.27-4.13)***	2.58 (1.42-4.69)	**2.14 (1.22-3.75)***	1.17 (0.67-2.04)
Covariates				
Team ranking (2)	**1.38 (1.00-1.90)***	0.79 (0.57-1.09)	0.90 (0.66-1.23)	0.87 (0.64-1.18)
Game Period (3)				
1st quarter	1.04 (0.65-1.69)	0.70 (0.43-1.14)	0.63 (0.39-1.00)	0.58 (0.37-0.91)
2nd quarter	0.70 (0.44-1.13)	0.74 (0.45-1.21)	0.69 (0.43-1.11)	0.92 (0.58-1.45)
3rd quarter	1.02 (0.63-1.65)	0.86 (0.54-1.40)	0.60 (0.37-0.96)	1.09 (0.69-1.72)
Game Location (4)	0.89 (0.65-1.22)	1.00 (0.73-1.36)	1.01 (0.74-1.36)	1.10 (0.82-1.47)
Match Status (5)				
Moderate advantage	0.93 (0.59-1.47)	0.91 (0.58-1.43)	0.91 (0.58-1.43)	1.31 (0.84-2.02)
Balanced	0.99 (0.67-1.46)	1.32 (0.90-1.94)	0.93 (0.64-1.35)	1.21 (0.84-1.74)

*Wald's test $p < 0.05$. Dependent Variables references: (a) not shooting; (b) unsuccessful; (c) maximal pressure; (d) help. [Note that positive defensive OR indicate higher pressure and more helps]. Predictors references: (1): positional; (2) low-4 teams; (3) fourth quarter; (4) away team; (5) moderate disadvantage.

4. Discussion

The current study investigated how players' interaction predicted offensive and defensive performance when using inside pass, considering game context effects. Regression analyses identified important influences of passer and receiver actions and interactions on attack effectiveness, shooting options, defensive pressure and helps occurrence. Overall results recommended developing dynamics interactions between passer (e.g., dribbling the ball or fake), and receiver (e.g., dive to the basket or screen and rolling) to enhance scoring options when using inside pass, pointing out that collaboration between the perimeter and post players is an essential key for successful offense in NBA basketball. Although the notion of developing game dynamics to increase inside pass effectiveness has been reported earlier (Courel et al., 2016), current research provides novel insights on specific players' configurations that contribute on inside game performance. This information allows a better understanding of basketball collective strategies, contributing in the design of precise practice tasks and so improving the training process.

Interactions combining passer's previous actions with receiver's cuts toward the basket achieved the highest offensive effectiveness (Figure 1). On the one hand, when the passer dribbles towards the basket creates a mismatch and a defensive unbalance providing an offensive advantage for both passer and receiver (Gómez et al., 2015; Guppillote, 2008). Particularly in the NBA, outside players have a great 1 on 1 ability and are extremely athletic, with optimal jump, speed and power skills, making them really dangerous when approaching to the basket (Mateus, Gonçalves, Abade Torres-Ronda, Leite & Sampaio, 2015; Sampaio, McGarry, Calleja-González, Sáiz, i del Alcázar,

& Balciunas, 2015). Similarly, faking actions and movements when having the ball are aimed at catching the opponent's attention, reducing the interpersonal space and avoiding his possible help to other defenders and making easy for the teammates to receive a pass. On the other hand, our results indicate that these actions previously passing the ball are further successful if combined and synchronized with the receivers' displacements, especially when cutting to the basket. Hence, it is supported the greater benefits of overlapping and concatenation of disruptive actions for progressively creating sufficient space and enhance scoring odds in basketball (Remmert, 2003; Lamas et al., 2015). Certainly, NBA players are characterized by a superior strength, jump conditions (González et al., 2013; Sampaio, Drinkwater, & Leite, 2010) and a strongly specialization (Sampaio et al., 2015). Then, it seems logical to promote predefined outside-inside coordinated behaviours in the NBA (e.g., cutting towards the basket for an alley-oop), since players' physical condition allows them to easily score through dunking (Erčulj & Štrumbelj, 2015). More importantly, our findings point out the importance of specific inside players' displacement without the ball (e.g., back-door cut, blind pig) to increase odds of receiving the ball in optimal conditions as close to the basket as possible, enhancing scoring options. To this purpose, it is suggested developing the inside players agility to quickly fake, move, and act to provide the passer a clear target where passing the ball, and solid enough once get the ball to keep the stance against pushes and fights at the paint (Guppillote, 2008). Likewise, it is reinforced the increasing need in modern basketball of a spatiotemporal coordination (timing) between the ball handler, the future receiver, and rest of teammates to succeed in passing and receiving the ball, chiefly in overprotected locations such as the inside (Lamas et al., 2014; 2015).

1A. BD-DC. 1B. BND-DC.

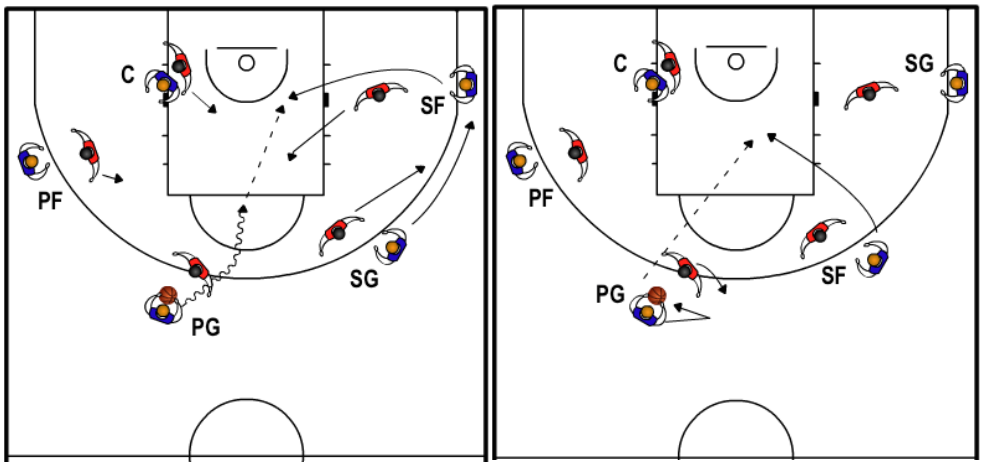

Figure 1. Interactions with greater effectiveness. Diagram 1A shows BD-DC interaction: (PG) dribbles through the middle unbalancing the defense and (SF) takes advantages to back cut to the basket. Diagram 1B shows BND-DC interaction: (PG) makes a jab step to the right and (SG) back cuts to the basket. Continuous arrows indicate player movement without the ball, dotted arrows indicate a pass, and a T indicates a screen.

Interactions including on-ball and out-of-ball screens reduced receivers' defensive pressure and helps, however they did not produce the highest effectiveness or enlarge shooting options (Figure 2). These results concur with those of Lamas et al. (2015) who observed that pick actions were the most prevalence space creation dynamic, being used both to attempt scoring and to initiate offenses. Ball screen effectiveness relies on how the dribbler perceives defender actions and how well the screener sets the screen to free the player with the ball (Gómez et al., 2015; Hollins, 2003). On the contrary, out-of-ball screens involve at least three players (the passer, the receiver, and the screener), multiplying offensive options and creating serious difficulties to the defence, particularly if the screener rolls. Considering the fact that the post area is naturally well protected for its proximity to the basket, it is proposed performing screens in favour to the receiver as an effective alternative to increase inside passing options since it reduces the defensive pressure. This aligns with Lamas et al.'s (2015)

study, who reported that making the ball to reach the post generates a concentration of defensive players inside the zone to protect the basket, which often leads to the concatenation of a new offensive action. It is also worth noting that the linkage of teamwork actions should be performed under a relative intensity, which requires an active player cooperation (i.e., performing a sequence of screens and rolls during a limited ball possession time) to avoid defensive anticipation (Bazanov, Vohandu & Haljand, 2008; Cárdenas, Ortega, Llorca, Courel, Sánchez-Delgado, & Piñar, 2015).

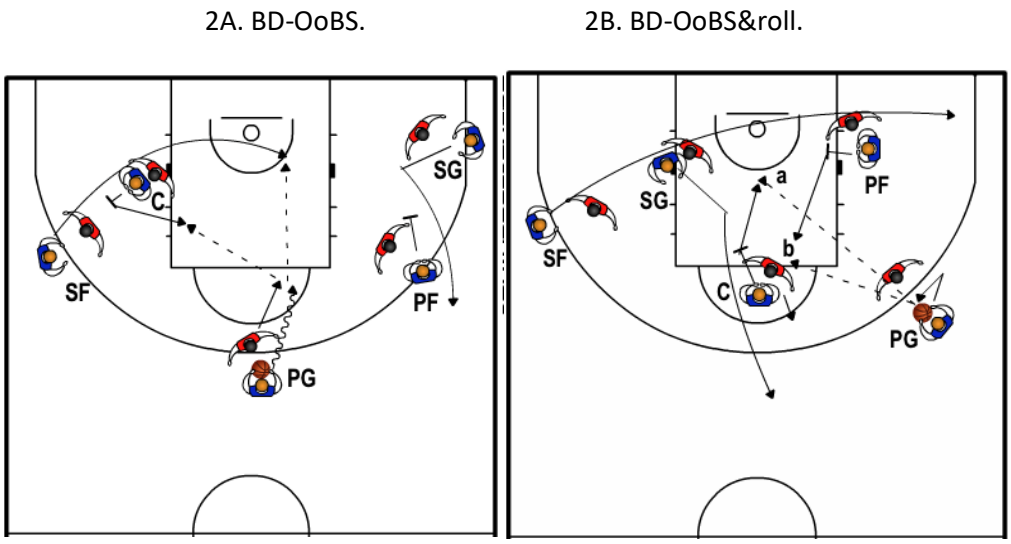

Figure 2. Interactions to lower the defensive pressure. Diagram 2A shows BD-OoBS: (PG) dribbles to the basket and passes the ball to (SF) who has received a screen from (C). Diagram 2B shows BND-OoBS&roll: (PG) fakes while (SF) makes a deep cut from the outside position, receiving a screen from (SG) and (PF) sequentially; simultaneously, after blocking, (SG) makes a zipper cut receiving a screen from (C), then, it emerges two inside pass situations for (PF) and (C) rolls. Continuous arrows indicate player movement without the ball, dotted arrows indicate a pass, and a T indicates a screen.

An important aspect of the present study was the analysis of contextual variables during specific basketball actions. According to our findings, high-ranked teams get more shooting options when using inside pass, specially if dribbling the ball before passing, which may suggest that better ball handling ability of best teams allow them

to increase shooting rates in optimal conditions during inside pass situations. This was quite unexpected since similar offensive ability can be hypothetically assumed within NBA Playoffs Finals teams, particularly when performing such a common actions like dribbling or passing in the inside. Unfortunately, we were not able to provide solid reasons explaining this finding since interactive effects obtained were not strongly conclusive, probably due to a limited sample size as a result of data splitting (Gómez et al., 2013). Additionally, there is a lack of variables pertaining to shooting in current study. In this line, recently interesting approaches made in elite basketball (Cervonet, et al. 2014; Suárez, et al., 2017) evaluated how tactical decisions quality such as consider rebound players' disposal or passing to an open mate may contribute in the team success. However, there is still an open challenge in basketball performance analysis to understand how players should behave and cooperate to support the ball handler (in shooting or passing) or another teammate (in receiving the ball in optimal conditions) to increase offensive effectiveness.

A possible limitation of the present study is the absence of taking into consideration specific defensive actions. As recently reported, (Lamas et al., 2015; Santana et al., 2015), every offensive action is influenced by the defensive reaction, thus future studies should be improved by including a complete tactical modelling design including offensive-defensive interactions. Furthermore, we only explored passer and receiver behaviour during the offence; so we are not able to know how the other teammates collaborations may affect on inside pass effectiveness. Hence, according with Cervonet et al. (2014), what is now required is to better understanding how players' actions contribute to the whole possession success and not just the events that end it, for instance, by applying network metrics (Fewell, Armbruster, Ingraham, Petersen &

Waters, 2012). Plus, considering that the NBA gather the best inside players of the world, receiving most of them the highest salaries in their teams (Berri, Brook, Frick, Fenn, & Vicente-Mayoral, 2014), it would be interesting to identify and describe specific inside players' profiles in order to optimize practice planning and game performance according to individual and collective characteristic.

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INSIDE GAME BALL TRANSITIONS ACCORDING TO PLAYERS' SPECIFIC POSITIONS IN NBA BASKETBALL

Inside game ball transitions in NBA basketball

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Abstract

The purposes of this study were to identify players' relationships and detecting ball transitions patterns according to their specific position when using inside pass, in the National Basketball Association (NBA) competition. In total, 808 inside passes (ball possession score differences below 10 points) from 25 matches (NBA Playoffs, 2011) were analysed through systematic observation. A decision tree analysis (Chi-Squared Automatic Interaction Detection) was used to identify ball transitions patterns regarding specific players' position (roots) and passer-receiver interactions (predictors). We detected strong pass and reception sequences of movements according to players' specific position, especially when including interactions between perimeter and post players. Game conditions such as reception zone, pass distance, reception attitude, and defensive helps were also influenced by players' position. Current results point out the outside-inside coordination as an essential key to success in the NBA. It is recommended developing game dynamics focused in taking advantage of the high- and low-post positions, as well as performing supporting actions in the weak side to enhance inside pass options. These findings may have implications in basketball training and competition process, contributing in a better understanding of collective strategies which leads to an accurate designing of practices task focused on increasing inside game options and players' decision-making according to specific competition constraints.

Keywords: team sports, sequential analysis, performance, tactics.

1. Introduction

Investigations on tactical behaviours in team sports such as basketball has gained importance in the last years, searching for a better understanding of players' adaptive response to the emergent cooperation and opposition situations which describes game performance during the match contest (Glazier, 2010; Grehaigne & Godbout, 2013). Information of this nature contributes in explaining "how" and "why" players should interact one way or the other to succeed, supporting both the training and competition process in defining the team's game style and developing playing tasks according to the competition demands (Maslovat & Franks, 2008; McGarry, 2009). To this purpose, observational analysis has been shown to be a consisten method to objective recording spontaneous behavioral events of one or more players within a natural environment, allowing the assessment of emerging spontaneous and creative comportments which enrich the quality and external validity of records obtained (Anguera, Blanco, Hernández-Mendo, & Losada, 2011; Cárdenas, Conde, & Courel-Ibáñez, 2013).

In modern basketball, playing effectively in the inside constitutes an essential offensive aim since increases scoring-rates providing close shooting chances, enlarge rebounding opportunities and force opponents' defensive misplacement contributing in better shooting options (Gómez, Lorenzo, Ibáñez, & Sampaio, 2013; Mavridis, Tsamourtzis, Karipidis, & Laios, 2009). For this reason, recent studies have been focused on detecting, describing and understanding game factors to better explain inside pass (i.e., pass received by a player stepping the paint) performance in elite basketball (Courel-Ibáñez, McRobert, Ortega, & Cárdenas, 2016; Courel-Ibáñez, Suárez-Cadenas,

Ortega, Piñar, & Cárdenas, 2013). These reports describe greater ball possession effectiveness when using inside pass - nearby 20% of total match possessions - both in top-16 Euroleague teams (63.3% vs. 49.8%) and top-8 NBA teams (63.9% vs. 51.8%). More importantly, a variety of game performance indicators have been shown to increase inside game successfulness, suggesting players to adopt a dynamic attitude in the weak side before getting the ball, while their teammates are developing individual and collective actions to create free space and enhance effective passing and shooting options (Courel-Ibáñez et al., 2016). Thus, it seems that dynamic interactions with and without the ball like pick and roll, or dive cut for an alley-oop may account for these differences, emphasizing the importance of tactical analysis exploring outside-inside players' coordination (Gupillotte, 2008; Lamas, Junior, Santana, Rostaiser, Negretti, & Ugrinowitsch, 2011).

An interesting approach made in NBA basketball (Fewell, Armbruster, Ingraham, Petersen, & Waters, 2012) studied teams as a strategic network, defining players as nodes and ball movements as links. As a result, they were allowed to predict ball transitions patterns using network metrics, which can usefully quantify team decisions about how to most effectively coordinate players. Particularly in the NBA, players are strongly characterised according to their specific role in the court, mainly identifying shooters, passers, defenders, and all-around players (Sampaio, McGarry, Calleja-González, Sáiz, i del Alcázar, & Balciunas, 2015). This lead to the suggestion that collective tactics are defined considering players' individual skills, chiefly if considering simple interactions like 2vs.2 or 3vs.3 situations. The purpose of this study was therefore to identify ball transitions and players' relationships according to their specific position when using inside pass in NBA playoffs teams.

2. Methods

2.1. Sample

A total of 808 inside passes where recorded from 25 matches of the 2010 NBA Playoffs series. Games were randomly selected including eight teams (four per conference) with a minimum of two matches and at least one victory and one defeated per each, excluding overtime games. Ball possessions recorded had a score difference below 10 points (average = 1.58 ± 4.56 points). The choice of this specific sample was deliberate; first, NBA is the most important basketball club competition of the world; second, Playoffs confronted best season teams for become the champion, thus the maximum competitive degree was expected until the end of the game; and third, possessions with short score differences ensure high players' activation and concentration levels (Erčulj & Štrumbelj, 2015).

2.2. Variables

Inside pass was considered when the receiver player was stepping the zone or paint (Courel-Ibáñez, et al., 2013; 2015). Variables pertaining to players' specific position, players' actions, game condition and ball possession effectiveness were included in the analyses. Players' specific position was classified as Point Guard (PG), Shooting Guard (SG), Shooting Forward (SF), Power Forward (PF), and Center (C). Players' action before passing and receiving the ball was analysed based on Lamas et al.'s proposal (2011). Passer action included: (i) Ball Dribbled (BD): individual actions by dribbling the ball, (ii) Ball not Dribbled: Ball not Dribbled (BND): similar to BD but without a dribble,

using only body displacements techniques (i.e., ball fakes, jab step), (iii) On ball screen (OBS): one or more players try to free a teammate with the ball by interposing their body to the path of the defender, (iv) Positional (P): player states without making BD or BND. Receiver action included: (i) OBS and roll (OBS&roll): the screener moves towards the basket after blocking and received the ball, (ii) Out-of-ball screen (OoBS): similar to OBS but freeing a teammate without the ball, (iii) OoBS and roll (OoBS&roll): Similar than OBS&roll when performing OoBS, (iv) Space Creation Without Ball (WB): previous movement without the ball to create space and received properly, (v) Dive cut (DC): displacement from the outside toward the basket, (vi) Positional (P): player states with no previous actions. Besides, a series of categorical variables previously defined and used elsewhere in NBA inside pass ball possession analysis (Courel-Ibáñez, et al., 2016) related to game condition (pass/reception zone, pass/reception distance, receiver's attitude, and defensive help) and ball possession effectiveness (successful and unsuccessful) were also recorded.

2.3. Procedures

Four pairs of observers specialising in basketball analysed all games after a 3-week training period. The observers' objectivity (inter-observer reliability) and reliability (intra-observer reliability) were assessed using the multi-rater k free index (Randolph, 2008) and Cohen's Kappa respectively. Scores obtained were over 0.87 in all cases, therefore objectivity and reliability were classified as 'almost perfect agreement' (Altman, 1991). Ball possessions were recorded using the LINCE software (Gabin,

Camerino, Anguera, & Castañer, 2012), flexible digital recording software that allows data exportation for its treatment on statistical packages.

2.4. Statistical Analysis

Descriptive analysis included frequencies, means with standard deviations and percentages with standard errors. Chi-Square was used to analyse relationships between players' specific position (both passer and receiver), players' actions (both passer and receiver), and conditional variables studied. Source of differences detected were further interpreted by studying the adjusted standardised residuals (ASRs) (Agresti, 2002). Strength of associations was measure considering values from 1.96 to 2.58 as little (p< .05), 2.58 to 3.29 as weak (p< .005) and over 3.29 as strong (p< .001) (Field, 2009). Effect size was calculated through Cramer's *V* considering .10 = small effect, .30 = medium effect, and .50 = large effect (Fritz, Morris, & Richler, 2012). Then, decision tree analysis was used to determine inside pass effectiveness according to performance indicators predicted (Gómez, Battaglia, Lorenzo, Lorenzo, Jiménez, & Sampaio, 2015). The exhaustive CHAID (Chi-Squared Automatic Interaction Detection) algorithm was used to classify relationships between independent categorical variables through completing three steps on each root of the root, finding the predictor that exert the most influence on the dependent variable. Significant level was set at p< .050, considering a maximum of 100 iterations and a minimum change in expected cell frequencies of .001. Two models were conducted: one considering the passer position and the other the receiver position as dependent variable. Strength of associations was studied recurring In order to avoid reporting too optimistic predictive models, a

leave-one-out-cross-validation process was performed by splitting data into a training sample to estimate and compare the total and the partial models (Norusis, 2004). Independence of observations was assumed, as interactions between players during ball possessions constitute an unpredictable task and environment-related functional information (Duarte, Araújo, Correia, & Davids 2012). Statistical analyses were conducted in IBM SPSS v. 20.0 for Macintosh (Armonk, NY: IBM Corp.).

3. Results

3.1. Players' specific position

Outside players were likely to pass the ball (PG: 40.7%, SG: 22.8%, SF: 21.7%, PF: 10.7%, C: 4.0%) and inside players commonly received it (PG: 6.6%, SG: 6.2%, SF: 18.2%, PF: 38.8%, C: 30.2%). Associations between passer and receiver specific positions were detected when performing inside pass (X2(16)=107.921; p<.001; V= .18). In particular, seven pairs of players were positively associated: PG pass with PF reception (ASR=2.9; n=146), SG pass with SF reception (ASRs=3.4; n=49), SF pass with PF reception (ASRs=2.5; n=82), PF pass with SF (ASRs=3.3; n=27) and SG (ASRs=2.2; n=10) and PG (ASRs=2.0; n=10) reception, and C pass with PG reception (ASRs=2.9; n=6). Besides, combinations between same specific positions were negatively likely (ASRs>-1.96).

Table 1. Frequency distribution (in percentages) and relationships of variables studied regarding players' specific position.

	Passer position					Receiver position				
	PG	***SG***	***SF***	***PF***	***C***	***PG***	***SG***	***SF***	***PF***	***C***
Passer action										
Ball Dribbled (BD)	42.9	42.1	39.1	**23.3^{n}**	34.4	37.7	34.0	41.1	37.0	43.4
Ball Not Dribbled (BND)	**6.4^{n}**	12.6	12.6	**18.6^{p}**	**21.9^{p}**	18.9	12.0	11.0	**8.4^{n}**	12.8
On Ball Screen (OBS)	**16.6^{p}**	16.4	14.4	**<0.1^{n}**	**<0.1^{n}**	**1.9^{n}**	**0.0^{n}**	**5.5^{n}**	**19.9^{p}**	15.7
Positional (P)	34.0	**29.0^{n}**	33.9	**58.1^{p}**	43.8	41.5	**54.0^{p}**	42.5	34.7	**28.1^{n}**
Receiver action										
OBS and roll (OBS&roll)	**19.0^{p}**	19.1	14.4	**<0.1^{n}**	**3.1^{n}**	**1.9^{n}**	**<0.1^{n}**	**7.5^{n}**	**20.6^{p}**	**19.4^{p}**
Out-of-ball screen (OoBS)	**2.5^{n}**	**6.6^{p}**	5.2	4.7	**0.0^{n}**	3.8	<0.1	2.7	3.2	**7.0^{p}**
OoBS and roll (OoBS&roll)	**3.7^{n}**	8.2	6.3	7.0	3.1	9.4	**18.0^{p}**	**13.7^{p}**	**3.2^{n}**	**0.4^{n}**
Space Creation Without Ball (WB)	**9.5^{p}**	**3.3^{n}**	4.6	8.1	6.2	1.9	**0.0^{n}**	6.8	**9.0^{p}**	6.2
Dive Cut (DC)	**31.0^{n}**	30.6	40.2	**44.2^{p}**	46.9	**64.2^{p}**	**72.0^{p}**	**46.6^{p}**	**28.0^{n}**	**23.1^{n}**
Positional (P)	34.4	32.2	29.3	36.0	40.6	**18.9^{n}**	**10.0^{n}**	**22.6^{n}**	36.0	**43.8^{p}**
Pass distance										
Exterior	85.6	82.0	81.6	84.9	84.4	88.7	82.0	84.2	**88.1^{p}**	**77.3^{n}**
Interior	14.4	18.0	18.4	15.1	15.6	11.3	18.0	15.8	**11.9^{n}**	**22.7^{p}**
Pass zone										
Frontal	40.8	39.3	37.9	45.3	40.6	43.4	38.0	41.1	37.0	43.8
Lateral	59.2	60.7	62.1	54.7	59.4	56.6	62.0	58.9	63.0	56.2
Reception zone										
High post	**63.7^{p}**	53.6	59.2	**46.5^{n}**	**46.9^{n}**	47.2	**42.0^{n}**	54.8	**69.8^{p}**	**49.8^{n}**
Low post	**36.3^{n}**	46.4	40.8	**53.5^{p}**	**53.1^{p}**	52.8	**58.0^{p}**	45.2	**30.2^{n}**	**50.2^{p}**
Reception distance										
Strong side	69.2	69.4	64.4	80.2	59.4	67.9	76.0	61.6	71.4	68.9
Weak side	30.8	30.6	35.6	19.8	40.6	32.1	24.0	38.4	28.6	31.1
Reception attitude										
Positional	39.9	37.7	36.8	44.2	46.9	**18.9^{n}**	**14.0^{n}**	**28.8^{n}**	**44.1^{p}**	**49.6^{p}**
Dynamic	60.1	62.3	63.2	55.8	53.1	**81.1^{p}**	**86.0^{p}**	**71.2^{p}**	**55.9^{n}**	**50.4^{n}**
Defensive help										
Help	51.1	56.8	54.0	58.1	50.0	47.2	62.0	**41.8^{n}**	57.6	55.6
No Help	48.9	43.2	46.0	41.9	50.0	52.8	38.0	**58.2^{p}**	42.4	44.4
Effectiveness										
Successful	62.3	64.5	61.5	68.6	78.1	73.6	74.0	64.4	58.8	66.1
Unsuccessful	37.7	35.5	38.5	31.4	21.9	26.4	26.0	35.6	41.2	33.9

Bolt numbers indicate positive (p) or negative (n) significant associations between specific players positions (Chi-Square p <.05; ASRs > ±1.96).

Table 1 shows distribution and relationships between variables studied. Passer action, receiver action, pass distance, and reception zone were significantly associated according to players specific position, as follows: passer position was related to passer action (X2(12)=56.711; *p*<.001; *V*=.16), receiver action (X2(20)=50.158; p<.001; V=.13), reception zone (X2(2)=12.182; *p*=.016; *V*=.12). On the other hand, receiver position was related to passer action (X2(12)=47.852; *p*<.001; *V*=.14), receiver action (X2(20)=168.219; *p*<.001; *V*=.23), pass distance (X2(4)=12.900; *p*=.012; *V*=.13), reception zone (X2(4)=32.733; *p*<.001; *V*=.20), reception attitude (X2(4)=43.117; *p*<.001; *V*=.23) and defensive help (X2(4)=12.847; *p*=.012; *V*=.13).

Adjusted residual analysis revealing the level of associations between players' specific positions and players' actions is depicted in figure 1. Regarding passing actions, BD was unlikely performed by PF (ASRs=-3.3; n=20), BND was seldom seen in PG (ASRs=-3.5; n=21) but mostly in PF (ASRs=2.3; n=16) and C (ASRs=2.0; n=7), OBS was typically in PG (ASRs=2.3; n=54) and very rarely in PF and C (n=0), and P was quite frequent in PF (ASRs=4.6; n=50) but not in SG (ASRs=-2.2; n=53). Regarding receiver actions, OBS&roll was regularly performed by PF (ASRs=3.3; n=64) and C (ASRs=2.1; n=47) but rarely by outside players (n<10), OoBS was frequent in C (ASRs=2.1; n=47) whilst OoBS&roll in SG (ASRs=3.9; n=9) and SF (ASRs=4.9; n=20), WB was prevalent in PF (ASRs=2.0, n=28), DC was more likely in PG (ASRs= 4.6; n=34), SG (ASRs= 5.7; n=36), and SF (ASRs=3.2; n=68) than PF (ASRs=-3.3; n=87) and C (ASRs=-4.6; n=56), and P was common in C (ASRs= 4.2; n=106).

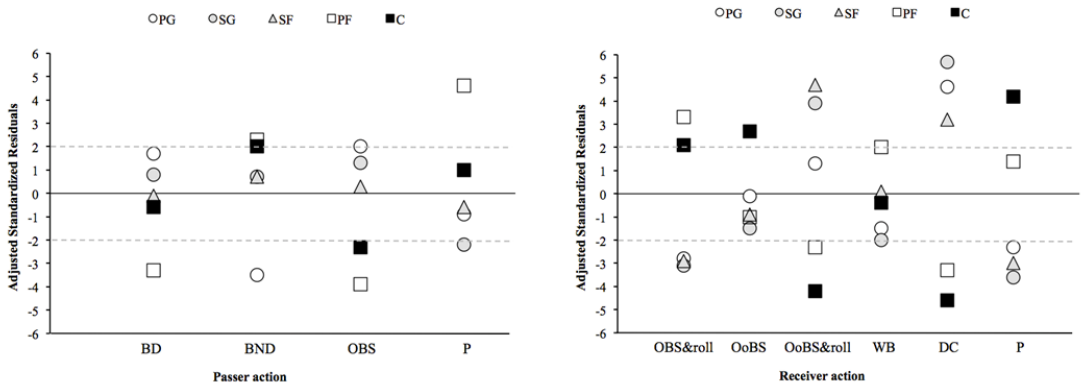

Figure 1. Adjusted residual analysis of passer (left panel) and receiver (right panel) actions regarding players' specific position. The dotted lines represent observed frequencies greater than or less than chance, respectively (ASRs<±1.96; *p*<.05).

3.2. Decision tree analysis

CHAID Model 1 describing passing transitions revealed in first term receiver position as main predictor (X2(12)=97.003; p<0.001), classifying four main roots: PG passes, SF/C passes, SG passes, and PF passes. Then, receiver action was set as a second predictor in root 1 (X2(4)=50.001; p<0.001), root 2 (X2(4)=39.180; p<0.001) and root 3 (X2(4)=50.001; p<0.001). Finally, reception zone was detected as a last predictor in root 1 (X2(4)=12.882; p<0.05). Figure 1 displays weighted edges of passing transitions regarding main roots and predictors detected. As depicted, root 1 (PG) classified three main paths: a) PG pass + PF reception + receiver action (OBS&roll, OoBS, WB, P) + reception zone (High post); b) PG pass + C reception + receiver action (OBS&roll, OoBS, WB, P) + reception zone (Low post); c) PG pass + SF reception + receiver action (OoBS&roll, DC). Root 2 (SG) classified two main paths: a) SG pass + SF reception + receiver action (OBS&roll, DC, WB); b) SG pass + C reception + receiver action (OBS&roll, DC, WB). Root 3 (SG) classified four main paths: a) SF/C pass + PF reception + receiver action (OBS&roll, P); b) SF/C pass + C reception + receiver action (OBS&roll,

P); c) SF/C pass + SG reception + receiver action (OoBS, OoBS&roll, WB, DC); d) SF/C pass + PG reception + receiver action (OoBS, OoBS&roll, WB, DC). Root 4 (PF) was not able to discriminate beyond receiver's position.

CHAID Model 2 describing receiving transitions revealed in first term receiver position as main predictor ($X^2(12)=101.095$; $p<0.001$), classifying four roots: C receptions (root 1), SF receptions (root 2), PF receptions (root 3), and PG/SG receptions (root 4). Then, following variables were set as second predictors: receiver action in root 1 ($X^2(4)=21.368$; $p<.01$), passer action in root 2 ($X^2(4)=15.042$; $p<.05$), and passing zone in root 3 ($X^2(4)=14.371$; $p<.05$). Finally, defensive help in root 1 ($X^2(4)=16.405$; $p<.05$) and effectiveness in root 3 ($X^2(4)=10.635$; $p<.05$) were detected as last predictors. Figure 2 displays weighted edges of passing transitions regarding main roots and predictors detected. As depicted, root 1 (C) classified one main path: a) receiver action (OBS&roll, OoBS) + SG pass + C reception. Root 2 (SF) classified two main paths: a) PG pass + passer action (OBS, BD) + SF reception; b) PF pass + passer action (BND, P) + SF reception. Root 3 (PF) classified one main path: PG pass + receiver action (OBS&roll, WB) + PF reception.

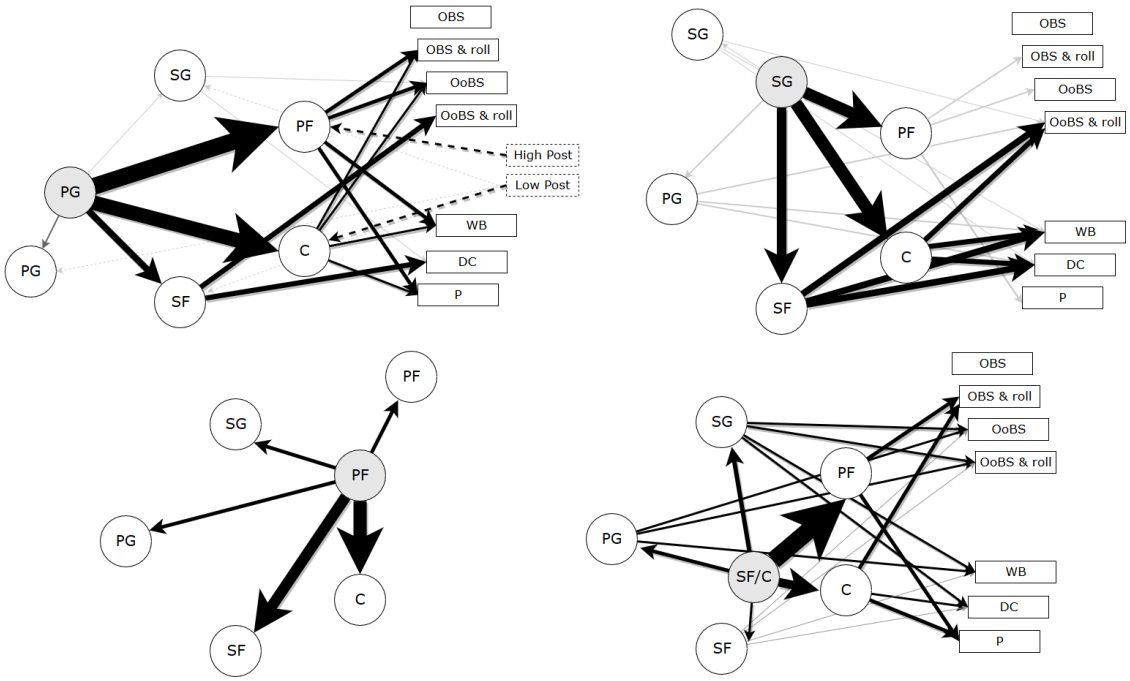

Figure 1. Weighted graph of ball pass transitions according to specific players' position: PG passes (root 1), SF/C passes (root 2), SG passes (root 3), and PF passes (root 4). Predictors are displayed in circles (specific players' position) and rectangles (players' action). Edges width is proportional to probability of transition between roots. Dotted lines indicate a third root division. Second-path edges colours represent increments over 10% (black) and below 10% (grey).

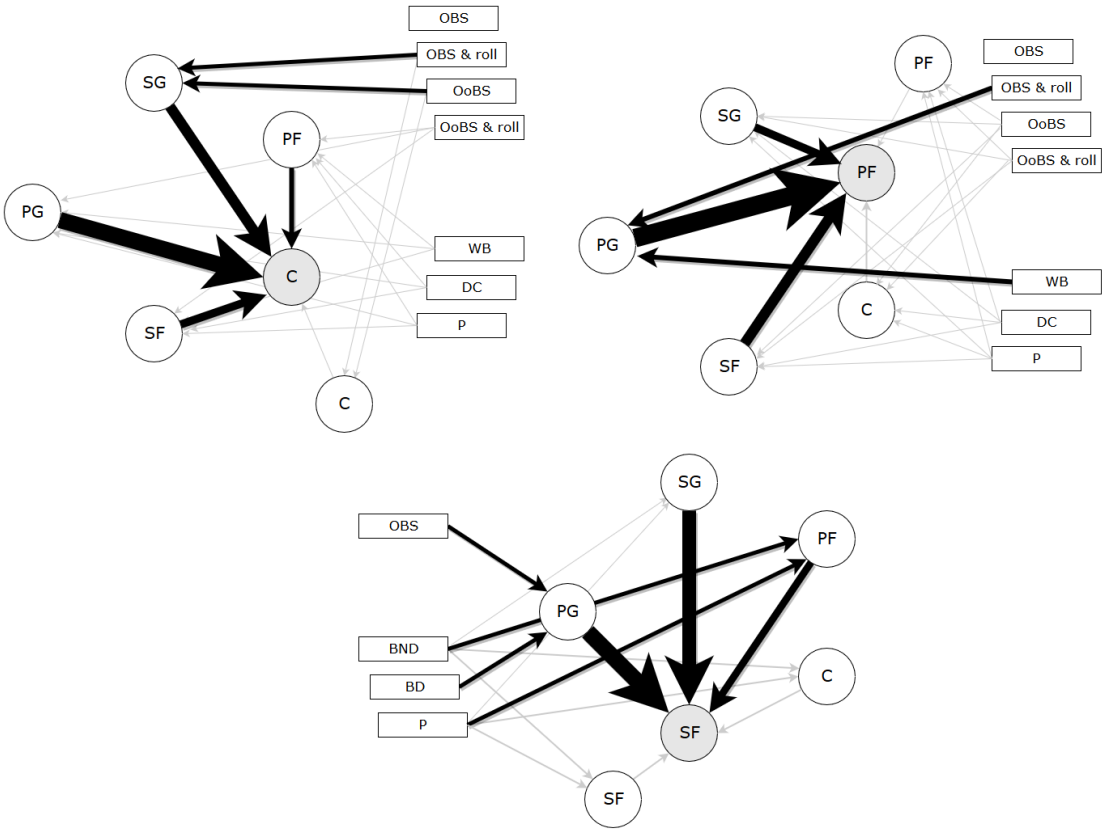

Figure 2. Weighted graph of ball reception transitions according to specific players' position: C receptions (root 1), SF receptions (root 2), PF receptions (root 3), and PG/SG receptions (root 4). Predictors are displayed in circles (specific players' position) and rectangles (players' action). Edges width is proportional to probability of transition between roots. Second-path edges colours represent increments over 10% (black) and below 10% (grey).

4. Discussion

Current study sought to identify players' relationships according to their specific position when using inside pass in NBA playoffs teams. As expected, outside players were likely to pass the ball while inside players received it. However, we detected well-defined pass and reception transition patterns especially when including interactions between outside-inside players. Concretely, seven pairs of players were positively associated: PG-PF, SG-SF, SF-PF, PF-SF, PF-SG, PF-PG, and C-PG. This concurs with

Fewell et al. (2012), who found risks on moving the ball frequently to a specific player position as it allows the opposition to adjust their defence accordingly. Indeed, players' actions around the outside are required to force defensive displacement and generate optimal passing conditions near the basket, enhancing scoring options by reducing opposition degree and helps occurrence (Courel-Ibáñez, et al., 2016; Sautu, Garay, & Hernández-Mendo, 2009). Our findings support this premise, as the lack of previous passer's actions (i.e., ball not dribbled and positional standing) was negative associated with specialist passing positions like PG and SG. Furthermore, we observed that particular actions previous the reception have been used differently according to the players' specific position. On the one hand, on-ball screen and roll is the commonest way for PF and C to get the ball in the inside, whilst dive cuts are proper to outside players like PG, SG and SF. This seems logical given that ball screen effectiveness relies on how the ball hander perceives defender actions - requiring a dribbling and passing skills - and how well the screener sets the screen to free the player with the ball – requiring enough strength and body size to stand against the physical contact (Gómez, et al., 2015; Hollins, 2003). Besides, NBA outside players are lately becoming more athletic, increasing jump, speed and power skills that allow them to grab the ball in higher heights (enhancing alley-oops options) and also dunking the ball from farther distances from the basket (Mateus, Gonçalves, Abade, Liu, Torres-Ronda, Leite, & Sampaio, 2015). On the other hand, out-of-ball screens and roll are practically only made by SG and SF. This is quite interesting since this specific movement involves two supporting players without the ball, which indicate the importance of overlapping collective interactions away from the ball (weak side) to create free space in favour of the receiver (Courel-Ibáñez, et al., 2016; Lamas, Santana, Heiner, & Ugrinowitsch,

2015). For instance, as depicted in Figure 3, first inside pass option comes from a pick and roll between PG and C in the strong side. Meanwhile in the weak side, an out-of-ball screen between SF and PF is trying to avoid defensive helps against C, as well as providing a second inside pass option from the PF roll. As a last chance, SG cuts toward the basket to receive as approaching to the rim (both from PG or C), but also helps on SF potential open pass by moving his opponent at the inside. These sequences of movements have been widely used in the Utah Jazz team headed by John Stockton (NBA's all-time leader in assist) and Karl Malone (NBA's 2nd all-time leading scorer) (Howell, 2011).

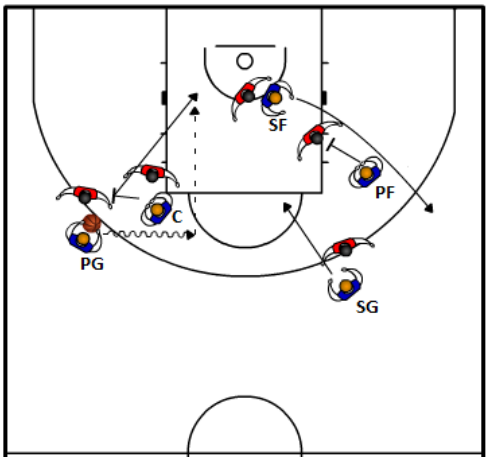

Figure 3. A common outside-inside players' interaction during an inside pass. Strong side (left): On ball screen and rolling between PG and C. Weak side (right): At the same time, out-of-ball screen of PF in favor SF while SG cuts toward the basket**.** Continuous arrows indicate player movement without the ball, dotted arrows indicate a pass, and a T indicates a screen.

We were especially interested in discovering ball transition patterns to describe how players collectively behave during inside pass situations. This approach is spreading widely in basketball research since allow to represent basic structure of players' interactions in the match, which help in better understanding of game dynamics during

the competition (Fewell et al., 2012; Lamas et al., 2015). In the current study, we were able to detect and describe a series of common game strategies used to make the ball reach the inside according to passer and receiver specific positions and the action perform. As mentioned above, the highest used connections involved PG and SG passes with PF, SF, and C receptions. These data corroborate those reported by Fewell et al., (2012), who observed that NBA teams' ball movement is controlled mainly by the PG and secondary by the SG, while PF functioned as the primary shot-taker and C usually had the highest success/failure ratio. Besides, the superior physical condition of NBA players, linked with their extraordinary skills chiefly in post-game positions, promote the use of the inside game as an efficient tactic to easily score even against the latent high defensive pressures (Erčulj & Štrumbelj, 2015; Mavridis, et al., 2009). Nevertheless, we detected differences in the way these players interact when aimed at getting the ball reaches the paint. For instance, PF receiving odds increased when PG had the ball and mainly after screening and rolling to the high post. Conversely, C receiving options came mostly from the SG and after rolling to the low post.

It is worth noting at this point the role of inside players as passers and not only as receivers. We noticed important increments on PF reception chances when C or SF had the ball but also the vast majority of PF passes were received by C or SF. Certainly, inside players' role require passing skills to initiate the offence after a defensive rebound, to stimulate fastbreak options by an outlet pass, or to redistribute the ball to the outside after an offensive rebound (Cárdenas, Ortega, Llorca, Courel, Sánchez-Delgado, & Piñar, 2015; Fewell, at al., 2012). However, during the offense, inside players should be also involved in the development of collective dynamics focused in taking advantage of the high- and low-post positions (Figure 4), such as the triangle

offence (Jackson & Winter, 2009), or the best-known John Wooden's UCLA offence (Wooden & Nater, 2006). These kind of strategies and their multiples variations results in great benefits serving as an alternative to avoid defensive adjustment and force defensive imbalances, emerging a large variety of optimal shooting conditions. Nonetheless, inside players should be technically and tactically trained accordingly to their new role - far beyond just rebounding, screening and blocking -, in which tactical intelligence, creativity, pattern detection, passing-receiving skills and decision making abilities play a crucial role (Alarcón, Cárdenas, Miranda, Ureña, & Piñar, 2010; Perales, Cárdenas, Piñar, Sánchez, & Courel, 2011; Memmert, 2013). Indeed, it is becoming easier to find inside players passing specialist in the NBA, called by the press as "point centers"; for instance in the latest season (2015-2016), centers like Pau Gasol (4.1 assists per game) or Marc Gasol (3.8 assists per game), and point forwards Draymond Green (7.8 assists per game) or Blake Griffin (4.9 assists per game) reached numbers close to guard positions.

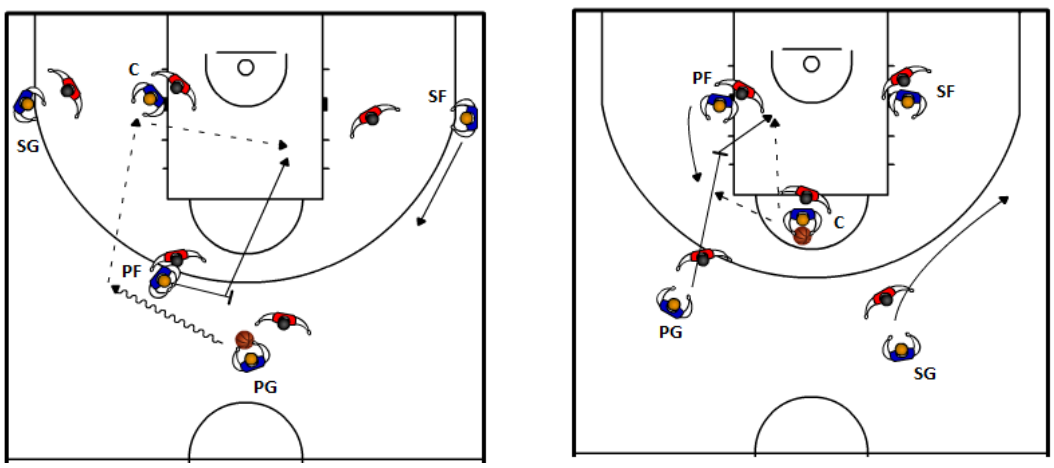

Figure 4. Post players passing combinations during an inside pass**.** Left graph: pick and roll between PG and PF and triangle with C assisting. Right graph: C in the high-post handling the ball, PG set a down screen for PF while SG cuts to the wing. Continuous arrows indicate player movement without the ball, dotted arrows indicate a pass, and a T indicates a screen.

Finally, the lack of detecting ball transitions that result in more effectiveness (i.e., larger points scored or fouls received) might be explained given the greater benefits that inside pass situations provided per se to the offence (Courel-Ibáñez, et al., 2013; 2016). Hence, current players' combinations should be considered as useful ways to enhance inside pass options, consequently increasing team's odd of succeeding. There is however an open challenge for performance analysis researches of assessing the quality of actions to the whole possession (Cervone, D'Amour, Bornn, & Goldsberry, 2014), raising the spectre of methods conduced, offensive and defensive behaviours measured and, more importantly, feed the debate on defining what would be considered as a good or a not-so-good decision according to each specific game situation. Current investigation could be limited however by the lack of defensive factors assessment, so we were unable to express how the offensive action is influenced by the defensive reaction (Lamas et al., 2015). Another potential limitation could be the study of short-time period events like just before or right after the pass, missing important information on how these situations have emerged (Suárez-Cadenas, Courel-Ibañez, Cárdenas, & Perales, *in press*).

The fact that nearby 20% of total match ball possessions from this sample (score difference below 10 points) included an inside pass represents a large potential scoring options with a greater effective rate, even in tight competition situations. Players' configurations described may serve as a useful guide for coaches and staffs when training the inside game. It is recommended developing dynamics interactions in the strong side (pick and roll, pass and cut) linked with simultaneous supporting actions from players in the weak side (out-of-ball screen, dive cut) to increase scoring options when using inside pass. Furthermore, our findings point out that collaboration

between the perimeter and post players is an essential key to success in NBA basketball, highlighting the concept of "point centers" as inside players with greater on ball skills (dribbling and passing), but also capable to score from far distances. These findings may have implications in basketball training and competition process, contributing in a better understanding of collective strategies which leads to an accurate designing of practices task focused on increasing inside game options and players' decision-making according to specific competition constraints.

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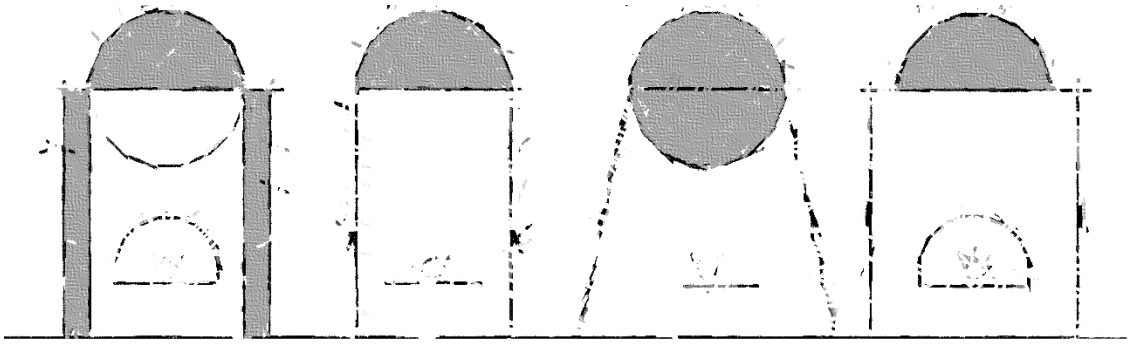
DISCUSIÓN Y CONCLUSIONES



En esta tesis doctoral hemos analizado el juego interior en baloncesto desde un punto de vista táctico, tratando de aportar novedades metodológicas y conceptuales que den respuesta a cuestiones no abordadas hasta el momento en este tópico de investigación (detectadas en el **Artículo 1**). Para ello se ha analizado el uso y eficacia del pase interior, identificando posibles indicadores que mejoren su rendimiento (**Artículo 2**); posteriormente se han estudiado de manera pormenorizada las acciones previas al pase y a la recepción, definiendo aquellas combinaciones pasador-receptor que resultan en una mayor ventaja atacante (**Artículo 3**); y finalmente se han clasificado dichas interacciones en función de la posición específica de los jugadores, describiendo las transiciones de balón más comunes (**Artículo 4**). Estas aportaciones podrían ser de utilidad a la hora de diseñar futuros trabajos de investigación en relación con el análisis táctico en baloncesto, especialmente en el juego interior. Además, los resultados descritos pretenden contribuir al desarrollo del proceso de entrenamiento y competición, proporcionando información útil para entrenadores y técnicos a la hora de planificar y diseñar tareas de entrenamiento que favorezcan la mejora de la toma de decisión y el aumentar las relaciones exterior-interior e interior-interior de los jugadores, siendo ambos aspectos claves de éxito en el baloncesto moderno (Eccles, Ward, y Woodman, 2009; Guppillotte, 2008).

En primer lugar, se realizó una revisión sistemática sobre el análisis táctico en baloncesto **(Artículo 1)**. Se resumieron y clasificaron un total de 45 estudios en función de los parámetros tácticos analizados, diferenciando entre: contexto de juego, fase de juego y rol del jugador, y condiciones de juego. Se detectaron importantes carencias

en el análisis del comportamiento de los jugadores desde una perspectiva dinámica, es decir, teniendo en cuenta la complejidad de los elementos estratégicos y tácticos que intervienen en el rendimiento de un equipo. Esta falta de información no obstante limita la interpretación y validez externa de los datos obtenidos, pues en la mayoría de los casos no se contemplan aspectos claves en el rendimiento táctico, como son: el contexto de partido, el tipo y grado de oposición frente a cierta acción atacante, las acciones de cooperación entre los componentes del equipo, las características y habilidades de los jugadores o la relación espacio-temporal de las acciones (Garganta, 2009; Gréhaigne, Godbout, McGarry, O'Donoghue, y Sampaio, 2015; Lemmink y Frencken, 2009). Además, es difícil encontrar literatura que evalúe, en mayor o menor medida, la calidad o consecuencias de los comportamientos de los jugadores, siendo en su mayoría cuantificada la eficacia final del ataque (canasta, fallo, falta y pérdida de balón). Esto supone un grave problema ya que los jugadores están continuamente interactuando y tomando decisiones con el objetivo de superar al adversario, siendo el conjunto de éstas acciones (con y sin balón, en el interior y en el exterior, individuales y colectivas, simultáneas o alternativas), en un contexto determinado, la causa principal de la eficacia final del ataque, y sin embargo pocas veces son tenidas en cuenta (Cervone, D'Amour, Bornn, y Goldsberry, 2014; Glazier, 2010; Lamas, Barrera, Otranto, y Ugrinowitsch, 2014).

Un enfoque interesante es el propuesto recientemente por investigadores brasileños, quienes han identificado y clasificado siete acciones utilizadas para crear espacios libres (botando el balón, fintas sin botar el balón, aclarado al poste, aclarado en el perímetro, desplazamientos sin el balón, bloqueo directo y bloqueo indirecto), así como las consecuentes 34 reacciones defensivas para protegerlos (Lamas, De Rose

Junior, Santana, Rostaiser, Negretti, y Ugrinowitsch, 2011; Santana, Rostaiser, Sherzer, Ugrinowitsch, Barrera, y Lamas, 2015). Igualmente, encontramos trabajos que tratan de describir la eficacia y detectar posibles indicadores de rendimiento de acciones colectivas concretas, como por ejemplo el bloqueo directo (Gómez, Battaglia, Lorenzo, Lorenzo, Jiménez, & Sampaio, 2015). Estos autores encontraron que factores temporales como el tiempo de posesión, y en especial aspectos espaciales como la orientación del bloqueo, suponen aspectos fundamentales en su eficacia. Más interesante, exploraron las diferencias en función de variables propias del juego, observando que el tipo de bloqueo, la acción posterior del bloqueador o el tipo de defensa contra el jugador con balón tuvieron una influencia importante en la eficacia del bloqueo directo. Finalmente, otro método utilizado en el estudio del comportamiento táctico es el análisis de redes de estrategia (Fewell, Armbruster, Ingraham, Petersen, y Waters, 2012). Con este tipo de análisis es posible detectar patrones de comportamiento, representando un mapa completo de las transiciones de balón; en este caso, se analizaron el inicio del ataque, jugadores que intervienen, acciones realizadas, y resultado final del ataque. Es conclusión, teniendo en cuenta la necesidad de investigaciones que analicen en profundidad el comportamiento táctico de los jugadores de baloncesto, se consideró relevante el estudio del pase interior dada la escasa información disponible pese a ser una de las relaciones colectivas básicas en baloncesto (Guppillotte, 2008; Mavridis, Tsamourtzis, Karipidis, y Laios, 2009).

Con este propósito, exploramos en un primer paso el uso y la eficacia del pase interior en las posesiones de ataque, identificando y clasificando posibles indicadores de rendimiento relevantes **(Artículo 2)**. En este estudio se demostró el elevado uso del pase interior como recurso ofensivo, estando presente en 2 de cada 10 ataques. Además, se observó una mayor eficacia en aquellas posesiones en las que se realizaba al menos un pase interior. Ciertamente, estudios previos ya habían indicado elevados porcentajes de acierto en lanzamientos cercanos al aro, especialmente en la NBA en donde la capacidad física de los jugadores les permite realizar un mayor número de mates, aumentando su capacidad anotadora (Erčulj y Štrumbelj Gómez, Lago, y Pollard, 2013; Gómez, Gasperi, y Lupo, 2016). Sin embargo, hasta ahora no se habían detectado indicadores de rendimiento que favorecieran tanto las opciones de juego interior como el aumento de las opciones de éxito. En este sentido, nuestros resultados destacan como principal predictor de rendimiento la actitud dinámica del receptor, resultando mucho más eficaz (70,2% vs. 54,3%) aquellas recepciones que incluían desplazamientos previos, en comparación con las clásicas actitudes posicionales. Estos datos sugieren el desarrollo de interacciones colectivas para crear espacio libre en favor del receptor (Lamas, Junior, Santana, Rostaiser, Negretti, y Ugrinowitsch de 2011; Remmert, 2003). Asimismo, se observó que la tasa de éxito se incrementó hasta un 79,2% cuando estos desplazamientos previos al pase se realizaban desde el lado débil. Por último, se registró una tasa de éxito de hasta el 86,7% cuando, además, se evitó la aparición de ayudas defensivas. En definitiva, estos resultados aportan información relevante sobre el comportamiento táctico de los jugadores durante el juego interior, reforzando la idea de que las acciones individuales y colectivas sin balón realizadas en el lado débil (bloqueos, cortes, fintas) benefician en

gran medida al ataque, generando desequilibrios defensivos, evitando la aparición de ayudas defensivas y favoreciendo la recepción del balón en situaciones de lanzamiento óptimas.

Una vez conocida la importancia de las acciones previas en el pase interior, pasamos a estudiar con detenimiento las interacciones entre pasador y receptor **(Artículo 3)** utilizando la clasificación de acciones de Lamas et al. (2011). En este sentido, se diferenciaron cuatro acciones previas del pasador (botando el balón, fintas sin botar el balón, bloqueo directo, y posicional) y seis acciones previas del receptor (desplazamientos sin el balón, bloqueo directo sin continuación, bloqueo directo con continuación, bloqueo indirecto sin continuación, bloqueo indirecto con continuación, corte a canasta y posicional). Las interacciones que incluían acciones previas del pasador (driblando el balón o realizando fintas sin bote) seguido de un corte a canasta del receptor, resultaron ser las más eficaces, aumentando además las opciones de lanzamiento directo tras la recepción. Por un lado, el ataque del jugador con balón botando hacia canasta genera un desajuste y desequilibrio defensivo al forzar su detención mediante una ayuda, favoreciendo con ello la recepción (Gómez et al, 2015; Guppillote, 2008). Especialmente en la NBA, los jugadores exteriores poseen una enorme capacidad de 1 vs 1, siendo además extremadamente atléticos, con gran salto, velocidad y potencia, lo que los convierte en un auténtico peligro a medida que se aproximan a la canasta (Mateus, Gonçalves, Abade Torres-Ronda, Leite y Sampaio , 2015; Sampaio, McGarry, Calleja-González, Sáiz, i del Alcázar, y Balciunas, 2015). Del mismo modo, acciones de engaño y fintas sin botar el balón atraen la atención del

oponente, reduciendo el espacio interpersonal y evitando su posible ayuda a otros defensores, haciendo más fácil la recepción del pase a los compañeros de equipo. Por otro lado, de acuerdo a nuestros resultados, estas acciones previas serán mucho más ventajosas si se combinan de manera sincronizada con desplazamientos del receptor, especialmente si son hacia el aro. Esto parece resultar lógico teniendo en cuenta la capacidad de salto de los jugadores en la NBA (González et al., 2013), siendo muy común encontrar este tipo de relaciones 2vs2 en el que el base, tras un 1vs1 agresivo sobre su rival, realiza un pase alto hacia el aro para que un jugador exterior realice un mate, o un pase con bote al compañero que corta para que penetre hacia canasta (Erčulj & Štrumbelj, 2015).

Lo que resulta más interesante es la importancia de los desplazamientos específicos del jugador sin balón (puerta atrás, bloqueo ciego) para recibir el balón cerca de canasta y en las mejores condiciones posibles. Estas acciones no obstante requieren de un desarrollo completo del jugador desde el punto de vista motor, físico, técnico y táctico. El jugador sin balón necesita ser lo suficientemente ágil para realizar cambios de ritmo y acciones a gran velocidad, con fuerza para aguantar la lucha por la posición interior, capacidad de recibir y lanzar en desplazamiento y en desequilibrio, y de leer el juego para decidir adecuadamente cómo y cuándo actuar (Alarcón, Cárdenas, Miranda, Ureña, & Piñar, 2010; Guppillote, 2008). Cabe también destacar el uso de bloqueos directos e indirectos para disminuir el grado de oposición y la aparición de ayudas defensivas en el pase interior. La eficacia de los bloqueos ha sido previamente descrita, siendo uno de los recursos más utilizados debido al enorme y variado despliegue de opciones de ataque que surgen de esta acción, gracias a los desequilibrios defensivos que causa (Lamas et al., 2015). Dentro de los aspectos que definen la efectividad del

bloqueo, destacan la habilidad del jugador beneficiario para percibir las acciones defensivas y actuar en consecuencia – sacando ventaja del bloqueo para superar al rival y lanzar o pasar -, unido a los esfuerzos del bloqueador para liberar a su compañero y a su capacidad de decidir la orientación del bloqueo y el tipo de continuación (Gómez et al., 2015; Hollins, 2003). En definitiva, esta concepción dinámica del juego sugiere mayores beneficios cuando existe una coordinación y una concatenación de acciones colectivas, lo cual perturbará progresivamente a la defensa, aumentando las posibilidades de que el oponente cometa un error y surja una opción de lanzamiento óptimo, especialmente en zonas sobreprotegidas como el interior de la zona (Remmert, 2003; Lamas et al, 2015).

Finalmente, en el último estudio que conforma esta tesis **(Artículo 4)** estudiamos las relaciones pasador-receptor de los jugadores en función de su posición específica (PG: Base, SG: Escolta, SF: Alero, PF: Ala-pívot; C: Pívot), con especial interés en representar aquellas transiciones de balón más comunes y eficaces. Se encontraron siete relaciones principales entre pasador-receptor: PG-PF, SF-SG, SF-PF, PF-SF, SG-PF, PF-PG, y C-PG. Igualmente, de acuerdo con Fewell et al. (2012), se observaron relaciones negativas entre jugadores del mismo puesto específico, debido posiblemente a la mayor facilidad defensiva y entre jugadores de similares características, permitiendo al oponente realizar ajustes rápidamente. Por el contrario, la mayoría de las interacciones involucraban combinaciones de juego exterior-interior, remarcando la necesidad descrita anteriormente de realizar acciones colaborativas en el exterior para generar espacios en el interior y facilitar las opciones de lanzamiento ante una baja

presión defensivas (Cárdenas, Piñar, Sánchez, y Pintor, 1999; Sautu, Garay, y Hernández-Mendo, 2009). Del mismo modo, la falta de acciones previas del pasador se asoció negativamente con las posiciones de especialistas como base y escolta. Además, encontramos diferencias en el uso de acciones previas a la recepción en función de la posición específica de los jugadores. El bloqueo directo con continuación fue la forma más común de recibir el balón para los jugadores interiores (ala-pívot y pívot). Ciertamente, estas posiciones se caracterizan por su función reboteadora y anotadoras cerca del aro, así como por su capacidad para realizar bloqueos que liberen al jugador con balón de su oponente, de menor tamaño y peso, resultando altamente efectivos (Gómez et al., 2015). Por otro lado, también se observó que los bloqueos indirectos y los cortes hacia el aro fueron prácticamente solo usados por los jugadores escoltas y aleros. Este hallazgo resulta interesante dado que este tipo de movimientos sin balón son característicos de jugadores de apoyo y se realizan en el lado débil, recalcando nuevamente la importancia de desarrollar, de manera simultánea y coordinada, movimientos que desajusten la defensa en lado débil y acciones orientados al ataque en profundidad en el lado fuerte, que aumenten las opciones de éxito (Lamas et al., 2015). Por ejemplo, combinar un bloqueo directo con continuación en lado de balón, con un bloqueo indirecto diagonal y un corte hacia el aro en el lado débil. Esta secuencia dinámica de juego fue ampliamente utilizada por los Utah Jazz liderados por John Stockton (base, máximo asistente de la historia de la NBA) y Karl Malone (ala-pívot, segundo máximo anotador de la historia de la NBA) (Howell, 2011). En línea con este dato, observamos que una de las transiciones de balón más comunes de pase y recepción fue la formada por el base y el ala-pívot (18.2% del total de la muestra), especialmente tras bloqueo directo y continuación en la zona de pivot alto.

Igualmente, es recalcable el elevado número de transiciones en las que el ala-pívot cumplía la función de pasador (10.7% del total de la muestra), siendo en su mayoría el pívot el jugador que recibía el balón (34.9% del total de pases del ala-pívot). La capacidad de pase de los jugadores interiores ha sido anteriormente descrita, destacando su labor para iniciar el ataque tras rebote defensivo, potenciando las opciones de contraataque con un primer pase hacia el campo contrario, o en la redistribución del juego al base tras rebote atacante (Cárdenas, Ortega, Llorca, Courel, Sánchez-Delgado, & Piñar, 2015; Fewell, et al., 2012). Sin embargo, durante el ataque posicional, los jugadores interiores deben además involucrarse en el desarrollo de dinámicas colectivas aprovechando las posibilidades que ofrece la zona de pivot alto, como son el juego en triángulo (Jackson y Winter, 2009) o el ampliamente conocido corte de UCLA de John Wooden (Wooden y Nater, 2006). Este tipo de estrategias y sus múltiples variaciones sirven como alternativa ofensiva forzando ajustes defensivos ante situaciones menos comunes pero altamente efectivas. Recientemente se ha observado una evolución en los jugadores de la NBA, encontrando jugadores interiores con una mayor agilidad y habilidad con el balón, lo que les permite crear peligro en posiciones más alejadas de la canasta (Mateus et al., 2015). No es de extrañar, por tanto, encontrar cada vez más jugadores interiores especialistas en pasar, como por ejemplo, en la última temporada (2015-2016), a Pau Gasol (4.1 asistencias por partido), Marc Gasol (3,8 asistencias por partido), Draymond Green (7,8 asistencias por partido) o Blake Griffin (4,9 asistencias por juego), logrando números propios de bases y escoltas. No obstante, este nuevo papel de distribuidor de juego requiere un entrenamiento técnico-táctico de los jugadores interiores, más allá del juego puramente físico, en el que la inteligencia táctica, la creatividad, la detección de

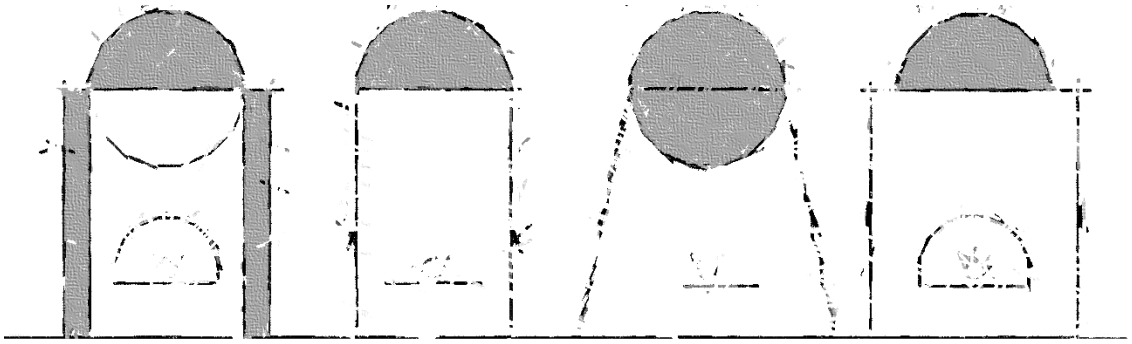
patrones, la capacidad de pase y recepción y la toma de decisiones juegan un papel fundamental (Alarcón, Cárdenas, Miranda, Ureña, y Piñar, 2010; Perales, Cárdenas, Piñar, Sánchez, y Courel, 2011; Memmert, 2013).

Las implicaciones de los estudios desarrollados en esta tesis doctoral son múltiples. Por un lado, la organización y clasificación del conocimiento científico en análisis táctico en baloncesto potencia el desarrollo y calidad de futuros trabajos de investigación en este tópico, contribuyendo a la selección de objetivos, definición de variables, la aplicación de métodos y la interpretación de los resultados. Además, la información obtenida sobre el uso y eficacia de las interacciones pasador-receptor resultan de gran utilidad para técnicos y entrenadores a la hora de diseñar tareas de entrenamiento que respondan a las necesidades y problemas de la competición. Como resultado, se pretende contribuir en el proceso de enseñanza-aprendizaje de baloncesto, potenciando la inteligencia táctica y la capacidad de toma de decisiones de los jugadores para resolver los problemas que se les plantean durante la competición.

ESTUDIOS FUTUROS

Los estudios desarrollados en esta tesis nos permitirán abordar problemas concretos que, hasta la fecha, no nos había sido posible resolver. Nuestro próximo objetivo será comprobar si estas dinámicas de pase y recepción se repiten o contradicen en diferentes competiciones de baloncesto, tanto masculinas como femeninas y en distintas edades. De esta manera, obtendremos un mapa más completo de qué dinámicas de juego son las que potencialmente deberían ser entrenadas. Una vez conocidas, nos proponemos evaluar el efecto de diferentes tareas y métodos de aprendizaje sobre el uso y eficacia del pase interior. Así, completaríamos el ciclo observación – identificación – aplicación, en el cual, tras la detección de indicadores de rendimiento, se desarrollan planes de entrenamiento para su desarrollo en la pista. En este paso, sería deseable contemplar el análisis de la calidad de la toma de decisiones en el pase interior, atendiendo a claves decisionales tanto para el pasador (momento y tipo de pase, jugador al que se pasa, acción posterior al pase) como para el receptor (orientación, localización, aprovechamiento de la ventaja, acción posterior a la recepción). De forma paralela, nos proponemos aumentar la potencia de interpretación de los datos mediante el registro de acciones defensivas realizadas para evitar el pase y recepción cerca del aro, así como las acciones posteriores, posibilitando identificar los comportamientos adaptativos resultan más eficaces para evitar un pase en condiciones óptimas o permitirlo ante la mayor oposición posible.

DISCUSSION AND CONCLUSIONS



In this work we have analysed the inside game in basketball from a tactical view, providing methodological novelties that help to solve the main limitations on the topic (detected in **Article 1**). We have analysed the use and effectiveness of the inside pass, identifying possible indicators that will improve its performance (**Article 2**); subsequently we studied in detail actions prior to the pass and the reception, defining those passer-and-receiver combinations that result in greater advantage (**Article 3**); finally, we classified these interactions depending on the players' specific position, describing the most common ball transitions (**Article 4**). These findings could be valuable when designing future research in relation to basketball tactical analysis. In addition, the results described may contribute in the basketball training and competition process, providing useful information for coaches and technicians in planning and designing drills and tasks aimed at improving players' decision making and enhance inside-outside and inside-inside relationships, being both key points to success in modern basketball (Eccles, Ward, & Woodman, 2009; Guppillotte, 2008).

First, we systematically reviewed the literature pertaining to tactical analysis in basketball **(Article 1).** We summarized and classified a total of 45 studies according to the tactical factors explored, distinguishing between: a) game context, b) game phase and players' role, and c) game condition. There were detected important gaps in the analysis of players' behaviours from a dynamic perspective, i.e. taking into account the complexity of the strategic and tactical elements involved in the game performance. This lack of information limits the data interpretation and external validity, since major tactical key aspects are not often considered, such as: the match context, the type and degree of defensive opposition against the attacker, teams' cooperative action, players' skills and characteristics, or the spatiotemporal relationship between actions

(Garganta, 2009; Gréhaigne, Godbout, McGarry, O'Donoghue, & Sampaio, 2015; Lemmink & Frencken, 2009). Moreover, it was difficult to find literature that evaluate, greater or lesser extent, the quality and consequences of players' behaviours, being mostly reduced to the assessment of ultimate effective events (score, failure, foul and turnover). This becomes a serious problem because players are constantly interacting and making decisions aimed at overcoming the opponent, being the integration of all of these actions (with and without the ball, inside and outside, individual and collective, simultaneous or alternative), within a particular competition context, the main cause of attack effectiveness, yet are rarely taken into account (Cervone, D'Amour, Bornn, & Goldsberry, 2014; Glazier, 2010; Lamas, Barrera, Otranto, & Ugrinowitsch, 2014).

An interesting approach was recently proposed by Brazilian researchers, who have identified and classified seven actions or dynamics used to create free spaces (with ball dribbled, with ball not dribbled, post isolation, perimeter isolation, without the ball, on-ball screen, and out-of-ball screen) and the consequent 34 defensive reactions to protect them (Lamas, De Rose Junior, Santana, Rostaiser, Negretti, & Ugrinowitsch, 2011; Santana, Rostaiser, Sherzer, Ugrinowitsch, Barrera, & Lamas, 2015). Similarly, we found researches that attempt to detect and describe the use and efficacy of potential performance indicators for particular collective actions, such as screens on the ball (Gómez, Battaglia, Lorenzo, Lorenzo, Jimenez, & Sampaio, 2015). These authors found that time-based factors like possession length, and especially spatial aspects like the screen orientation, would mainly describe it effectiveness. More interesting, they explored differences depending on game conditions, noting that the type of screen, the subsequent screener action or the type of defence against the dribbler had a

crucial influence on screens success. Finally, strategic network analysis stands out as a novel and useful method for the study of tactical relationships in basketball (Fewell, Armbruster, Ingraham, Petersen, & Waters, 2012). This kind of analysis allows detecting behavioural patterns to represent a complete map of ball transitions; in this case, their model included the attack setting, players involved, actions performed, and the final attack effectiveness. In conclusion, taking into account the need for research on players' tactical behaviour in basketball, we considered the inside pass as relevant to study, given the limited information available despite being one of the basic collective relations in basketball (Guppillotte, 2008; Mavridis, Tsamourtzis, Karipidis, & Laios, 2009).

For this purpose, we firstly explored the use and effectiveness of the inside pass during the attacking ball possession, identifying and classifying relevant performance indicators (**Article 2**). This study showed a large use of inside pass during the offence, accounted for 2 out of 10 attacks. Furthermore, we observed greater effectiveness in those possessions in which at least one inside pass was included. Certainly, previous studies have already indicated high successful rates when shooting close to the basket, especially in the NBA, where players' physical ability allows them to easily dunk, increasing scoring capability (Erčulj & Štrumbelj Gómez, Lake, & Pollard, 2013; Gómez Gasperi, & Lupo, 2016). However, to date, there is a lack of knowledge about performance indicators that increased inside game options and success. In this sense, our findings point out the receiver's dynamic attitude as the main predictor of the inside pass performance, being much more effective (70.2% vs. 54.3%) those receptions including previous displacements compared to the classical positional standings. These data suggest developing collective interactions to create free space in

favor to the receiver (Lamas, Junior, Santana, Rostaiser, Negretti, & Ugrinowitsch 2011; Remmert, 2003). It was also noted an increment on the effectiveness up to 79.2% when these previous displacements were performed away from the ball (the weak side). Lastly, success rate rose up to 86.7% when no defensive help appeared. In short, these findings provide relevant information about players' tactical behavior during the inside game, reinforcing the idea that individual and collective actions without ball occurring in the weak side (screens, cuts, fakes) will greatly benefit the attack, forcing defensive imbalances, avoiding the appearance of defensive helps, and favoring the ball reception in optimal shooting situations.

Once known the importance of actions pervious to the inside pass, we moved to study in detail the interactions between passer and receiver **(Article 3)** using the Lamas et al.'s (2011) classification. In this regard, four passer's previous actions (with ball dribbled, with ball not dribbled, screen on the ball, and positional) and six receiver's previous actions (with ball not dribbled, on-ball screen, on-ball screen and rolling, out-of-ball screen, out-of-ball screen and rolling, dive cut, and positional) were recorded. Interactions including passer's previous actions (with ball dribbled and with ball not dribbled) followed by a receiver's cuts towards the basket were the most effective, increasing shooting options right after receiving the ball. On the one hand, dribbling to the basket creates a mismatch and defensive imbalance by forcing the appearance of helps to stop the player with the ball, thereby making easier the reception (Gómez et al., 2015; Guppillote, 2008). Especially in the NBA, outside players have an excellent 1v1 abilities, being also extremely athletic, with great jump, speed and power skills, which makes them really dangerous as approaching to the basket (Mateus, Gonçalves, Abade Torres-Ronda, Leite, & Sampaio , 2015; Sampaio, McGarry, Calleja-González,

Sáiz, i del Alcázar, & Balciunas, 2015). Similarly, fake actions and movements without dribbling the ball attract the opponent's attention, reducing the interpersonal space and avoiding defensive helps, which facilitates the reception. On the other hand, according to our results, these previous actions will be much more advantageous if combined synchronously with receiver's displacement, especially when moving towards the basket. This seems to be logical considering NBA players' jumping ability (Gonzalez et al., 2013), being common to find these kind of 2v2 relationships in which the point guard, after an aggressive 1v1 on his defender, throws the ball near the basket to a teammate who dunks, or make a bounce pass to a teammate who cuts and penetrate to the basket (Erčulj & Štrumbelj, 2015).

What is most interesting is the relevance of players' movements without the ball (back door cut, blind screen) to receive near the basket in the best possible conditions. These actions however require a complete player motor, physical, technical and tactical development. The player without the ball needs to be agile enough to make changes of pace and act at high speed, to be strong enough to endure the struggle in the inside area, to receive and shoot in imbalance, and to read the game to decide how and when acting accordingly (Alarcón, Cárdenas Miranda, Ureña, & Piñar, 2010; Guppillote, 2008). It is noteworthy the use of screens to reduce the opposition degree and avoid the appearance of defensive help during the inside pass. Screens effectiveness has been previously reported, being one of the most common resources given the large and varied display of attacking options arising from this action, thanks to defensive mismatch caused (Lamas et al., 2015). Among the definition of screens effectiveness, authors highlight the player's skills to perceive defensive actions and acting accordingly – getting advantage of the screen to overcome the opponent and shoot or pass -

linked with the screener's efforts to free a teammate and their ability to decide the screen orientation and type of rolling (Gómez et al, 2015; Hollins, 2003). In short, this dynamic conception of the game suggests greater benefits when collective actions are coordinated and concatenated, progressively disturbing the defence, increasing the opponents' chance for mistake and emerging optimum shooting situations, especially in overprotected areas as inside the area (Remmert, 2003; Lamas, et al, 2015).

Finally, in the last study from this thesis (**Article 4**) we analysed players' relationships regarding their specific position (PG: Point Guard, SG: Shooting Guard, SF: Shooting Forward, PF: Power Forward; C: Center), with special interest in describing the most common and effective pass and reception sequences. We detected seven main pass-and-reception relationships: PG-PF, SF-SG, SF-PF, PF-SF, SG-PF, PF-PG, and C-PG. Agreeing with Fewell et al. (2012), negative relationships between players from the same specific position were observed, possibly due to the defence between similar players' represents an easier task, allowing an opponent quickly adjustment. Conversely, interactions involving combinations between outside and inside players accounted for the most, emphasizing the abovementioned need to perform collaborative actions in the perimeter to generate open spaces in the inside and enhance shooting options against a lower opposition (Cárdenas, Piñar, Sánchez & Pintos, 1999; Sautu, Garay, & Hernandez-Mendo, 2009). Similarly, the absence of passer's previous actions was negatively associated with specialized positions such as point guard and shooting guard. In addition, we found differences in the use of actions previous to the reception depending on the players' specific position. Screen on the ball and roll was the most common way to get the ball for inside players (power forward and center). Certainly, these positions are characterized by their functions as

rebounders and scorers near the basket, as well as their ability to perform screens and release the dribbler to his opponent, smaller in size and weight, which result highly effective (Gómez et al., 2015). On the other hand, it was also noted that out-of-ball screens and cuts towards the basket were practically only used by shooting guards and shooting forwards. This is interesting because this kind of movements without the ball are distinctive of supporting players and performed on the weak side, underlining the importance of developing, simultaneously and coordinatly, movements aims at misplaced the defence away from the ball linked with vertical offensive actions (towards the rim) in the strong side to increase the chances of success (Lamas et al., 2015). For example, combining on-ball screen and roll in the strong side, with a diagonal out-of-ball screen and a dive cut in the weak side. This dynamic sequence was widely used by the Utah Jazz led by John Stockton (base, top assistant in the history of the NBA) and Karl Malone (power forward, second top scorer in NBA history) (Howell, 2011). In line with this fact, we found that one of the most common pass-and-reception ball transition involved the point guard and the power forward (18.2% of total sample), especially after on-ball screen and from the high post area. It is worth stressing on the high number of transitions in which the power forward served the function of passer (10.7% of the total sample), being mostly received by the center (34.9% of all power forward passes). The inside players' passing abilities have been previously described, remarking their task in starting the attack after a defensive rebound, boosting counterattack options by giving the first pass, or redistributing the game to the point guard after offensive rebound (Cárdenas, Ortega, Llorca, Courel, Sánchez-Delgado, & Piñar, 2015; Fewell, et al., 2012). However, during the set offence, the inside players should be also involved in the development of collective dynamics

taking advantage of the high post area, such as the triangle offence (Jackson & Winter, 2009) and the best-known John Wooden's UCLA offence (Wooden & Nater, 2006). These kind of strategies and their multiples variations results in great benefits serving as an alternative to avoid defensive adjustment and force defensive imbalances, emerging a large variety of optimal shooting conditions. Recently there has been an evolution in the NBA players, finding inside players with greater agility and skills with the ball, being really dangerous in positions away from the basket (Mateus et al., 2015). It is therefore becoming easier to find inside players passing specialist in the NBA, called by the press as "point centers"; for instance in the latest season (2015-2016), centers like Pau Gasol (4.1 assists per game) or Marc Gasol (3.8 assists per game), and point forwards like Draymond Green (7.8 assists per game) or Blake Griffin (4.9 assists per game) reached numbers close to guard positions. Nonetheless, inside players should be technically and tactically trained accordingly to their new role - far beyond just rebounding, screening and blocking -, in which tactical intelligence, creativity, pattern detection, passing-receiving skills and decision making abilities play a crucial role (Alarcón, Cárdenas, Miranda, Ureña, & Piñar, 2010; Perales, Cárdenas, Piñar, Sánchez, & Courel, 2011; Memmert, 2013).

The studies developed in this thesis have multiple implications. On the one hand, to classify and summarize the state of art in basketball collective behaviours enhance the quality of future research by contributing in improving aims selection, variables definition, methods design, and data interpretation. In addition, the information obtained on the use and effectiveness of pass-and-receiver interactions may support

coaches and staffs in designing training tasks that respond to the needs and problems of the competition.

FUTURE STUDIES

The studies developed in this thesis allow us to address specific problems that, so far, we had not been able to resolve. Our next aim will be to check if current pass-and-reception dynamics are repeated or contradicted in different basketball competitions depending on gender and group of age. Thereby, we would get a more complete map including those dynamics that should be trained. Once known, we intend to assess the effect of different tasks and learning methods on the use and effectiveness of the inside pass. Hence, we will complete the observation - identification – application cycle, in which, following the detection of performance indicators comes the design of training plans to its development in the court. At this point, it would be desirable contemplate the analysis of the quality of decision-making keys when using the inside pass, attending to decisional keys for both the passer (timing and type of pass, selecting the target player who will received the ball, action after the pass) and the receiver (orientation, location, use of the advantage, action after the reception). In parallel, we propose to improve the power of data interpretation by recording defensive actions taken to stop the pass and reception near the basket, as well as subsequent actions, making possible to identify adaptive behaviors which are more effective in avoiding the inside pass in optimal conditions or allow it against the greatest opposition the possible.

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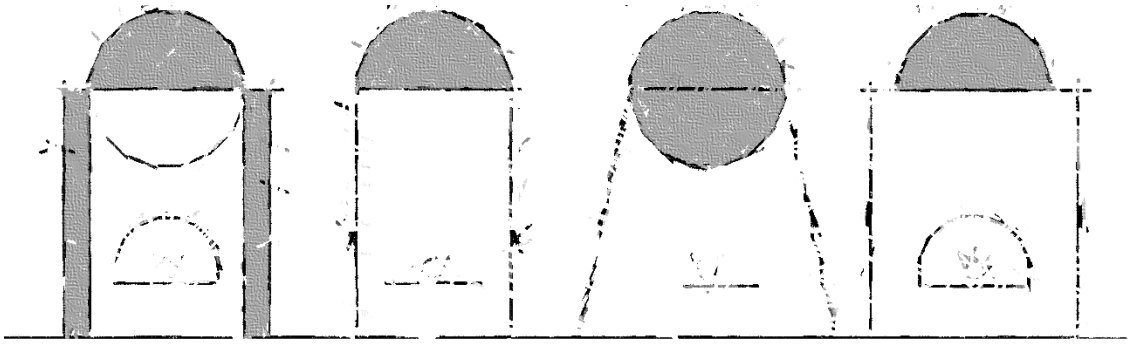

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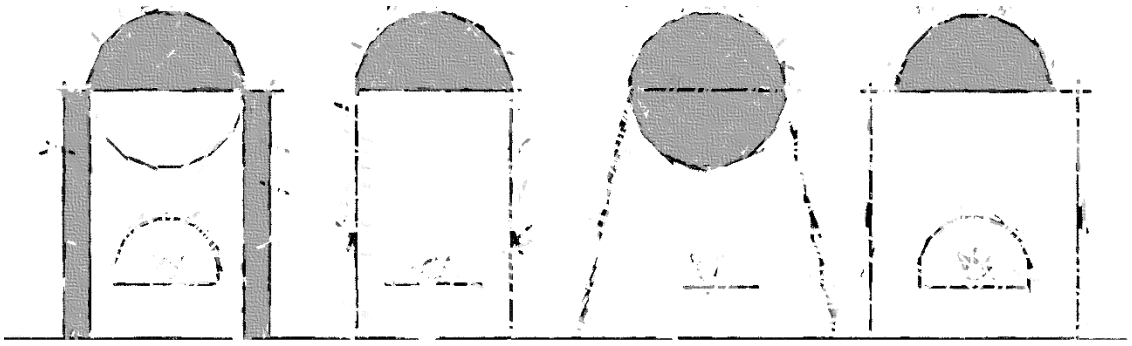

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