

Crunch time in the NBA – The effectiveness of different play types in the endgame of close matches in professional basketball

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International Journal of Sports Science
& Coaching
0(0) 1–10
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sagepub.co.uk/journalsPermissions.nav
DOI: 10.1177/1747954118772485
journals.sagepub.com/home/spo



Abstract

In professional basketball, the final few possessions often determine the result of a game. The coach's decision on tactics may be critical to a team's win or loss. This study investigated offense play types in the endgame (final 120 s) of 115 close basketball matches (≤ 5 points score differential) in the National Basketball Association. We video-analysed 996 plays and assessed the frequencies and outcomes of six defined play types: 1 × 1 without isolation; 1 × 1 with isolation; pick-and-roll; complex team play; inbound play; and transition play. Analyses revealed that pick-and-roll was employed the most and inbound play the least frequently. The 1 × 1 with or without isolation were the least effective play types, averaging 0.9–1.0 pts/possession. They were rather 'static' and exhibited relatively long duration, low action frequency (passes, screens, handoffs, cuts, drives) and high defence pressure on the shooter. In contrast, transition, inbound and complex team plays were the most effective (means 1.3–1.5 pts/possession). They displayed greater spatial dynamics either through motion speed (transition) or high action frequency (complex and inbound plays), and either led to over-represented uncontested shots or over-represented offensive rebounds and their effective utilisation. Pick-and-roll play was intermediate in these regards. Overall, plays led to 0.8 pts/possession when being in the lead vs. 1.4 pts/possession when being down. Increased spatial dynamics through high motion speed and/or high frequency of concatenated cooperative manoeuvres enhance the success probability of endgame play types in professional basketball.

Keywords

Game sport, offense, play type, professional basketball, National Basketball Association, tactics

Introduction

In high-level basketball, the final few possessions often determine the result of a game. The present study addresses offense tactics during the endgame of close matches in men's professional basketball.

Basically, teams' offense tactics aim at creating a preferably uncontested shot within the permissible 24 s, oftentimes also attempting to control who exactly takes the shot and from which position and shot range (3-pts, mid-distance or paint shot). In this, the interplay of gaining separation from the defender(s) (e.g. to shoot or receive a pass) and gaining proximity (for a screen, handoff, cut or drive) is characteristic of the basketball game. Teams may essentially realise these spatial dynamics through individual 1-on-1 attack, single two-man actions (e.g. pass → shot, on-ball screen → shot), or by concatenating various actions (e.g. on-ball

screen → drive → outside pass → shot). In accomplished teams, actions do not occur randomly but players perform (inter) actions in purposefully organised, 'choreographed' patterns of simultaneous and successive actions that appear recurrently within a team.^{1,2} They are subsumed under characteristic 'play types' that are documented in playbooks³ and are often seen on a coach's clipboard during timeouts.

The coach's decision to elect a certain play type in an endgame may be critical to the team's win or loss.

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Understanding how teams generate successful scoring opportunities is practically and theoretically pivotal. This study explores how the most accomplished club teams worldwide – the National Basketball Association (NBA) – employ play types to create goal attempts. Our particular interest focused on endgames of close matches. The ‘crunch time’ is not only spectacular and thrilling; it is also particularly competitive and ensures – perhaps unlike some ‘blowout’ games – full effort of all players on the floor.

Extant research has addressed offense performance through varying approaches. Besides players’ physical and physiological characteristics⁴ or off-court examination of single skills,^{5,6} numerous studies examined offense tactics through varying approaches of game observation. For example, some research teams developed mathematic models to estimate indicators of between-players networks, skills complementarity, productivity spill-over, spatial team formation or typical patterns of players and ball motion sequences.^{2,7–12} While the utility of the approaches is apparent, applications to systematic comparison between more and less successful possessions have not been published to date.

The so-called ‘box score stats’ (frequencies of defined events and actions such as shots, rebounds, fouls, steals, turnovers, etc.) have become increasingly popular in applied analytics,^{13,14} not least since the NBA started to publish them routinely.¹⁵ Yet, the explanatory value has remained limited. They mostly describe aggregated outcomes rather than how they evolved. Furthermore, many of these statistics tell little about what exactly they are indicative of. For example, high shooting scores may reflect a player’s shooting skill or teammates preparing him great shot opportunities. Defensive rebound frequency may be a function of rebound skill or of the number of the opponent’s missed shots, etc.

Other studies extracted units of two-man actions (passes, screens) and their outcomes, particularly within European basketball.^{1,16–19} Integrating their findings suggests that, consistently, cooperative actions were mostly more effective than a ball-handler’s individual action. Furthermore, concatenating multiple successive cooperative manoeuvres may be particularly successful. Accordingly, teams often employed cooperative actions – screens in particular – as preparatory measures for subsequent manoeuvres. Defence variants on offense actions (e.g. on screens: switch, slide through, etc.) display little effect on varying offense outcomes because accomplished teams rapidly adjust their subsequent offense actions to different defence variants.

Studies specifically involving endgame situations within tight games are scarce. As far as realised, they

focused on ‘box score stats’ during the final quarter²⁰ or on modelling decisions for a 2- or 3-pts attempt²¹ and for non-shot fouling when protecting an endgame 3-pts lead.²² To the best of our knowledge, no previous study has highlighted offense play types in the endgame of close games.

The present study draws on and extends earlier research by exploring play types that initiate the creation of shot opportunities. We suggest that characteristic patterns can be subsumed under six recognizable and distinguishable play types for meaningful analyses (defined in Table 1): ‘1-on-1 play without isolation’ (‘1 × 1’ hereafter), ‘1-on-1 play with isolation’ (‘1 × 1-isolation’), ‘pick and roll play’, ‘complex team play’, ‘inbound play’ and ‘transition play’.

Specifically, we explore the frequency distribution of the defined play types, describe them by their duration, number of involved actions, shot range and defence pressure on the shooter, and compare their outcomes. In this, we hold that play types may vary across situational variables. For example, we expect that decisions for play types are constrained by the types of possessions’ opening (e.g. inbound, rebound, steal). Furthermore, play types may vary depending on the momentary score-line and resultant varying time pressure on a team. Leading teams may tend to exhaust the available possession time during the endgame while trailing teams may attempt to come back through rather ‘quick’ plays.

We examined three questions:

1. Which play types do the NBA teams perform how frequently during the endgame of close matches? Do they vary across possessions starting with different types of opening?
2. Do the play types differ in their outcomes?
3. Do situations involving ‘usual time pressure’ (being in the lead) and particularly ‘high time pressure’ (trailing) differ in the performed play types and their outcomes?

Methods

The study combined standard quantitative assessment with qualitative observation and manual annotation of play types, involved actions, shot range and defence pressure on the shooter.

Sample

We downloaded (nba.com/leaguepass) all 2015 regular season post-Allstar games that ended in up to ± 5 final score differential ($n = 115$; final score spread -0.4 ± 3.3 points; mean \pm standard deviation, $M \pm SD$).

Table 1. Definition of play types, defence pressure and outcomes of play types.

| Variable | Definition |
|---|--|
| Offense play types | |
| 1-on-1 attack without isolation (1 × 1) | The ball handler attempts to vanquish his counterpart defender in a 1-on-1 attack; no particular movement of the teammates away from the ball handler. Variants: 1 × 1 → shot, 1 × 1 → pass → shot. |
| 1-on-1 with isolation (1 × 1-isolation) | The ball handler attempts to vanquish his counterpart defender in a 1-on-1 attack; teammates move away from the ball handler to draw their assigned defenders away and provide him maximum space for the 1-on-1 attack. Variants: 1 × 1-isolation → shot, 1 × 1-isolation → pass → shot; 1 × 1-isolation without / with entry play (preceding cooperative actions to isolate the ball handler). |
| Pick and roll | Screen set on the ball handler's assigned defender, screener rolls to the rim or rolls away (synonym: on ball screen). Variants: Screen → ball handler's shot, screen → ball handler's dribbling → shot, screen → pass (to screener / to other open player) → shot. |
| Complex team play | Various concatenated actions (passes, handoffs, drives, screens, cuts), including off side actions and involving 4–5 players, precede the creation of a shot opportunity. Variants: Up to 3 preparatory actions, 4+ preparatory actions. |
| Inbound play | Various cooperative actions (screens, cuts) creating a spatial advantage and open player(s) precede an inbound. Note: An inbound has to be executed within 5 s. |
| Transition | Opening in the backcourt, finish within 7 s and create a shot opportunity before opponent's half-court defence is set (synonym: fast break). Variants: Up to 5 s, 6–7 s. |
| Defence pressure on the shooter | |
| 0 | No defender in the shooter's area, no defensive action to disrupt the shot; wide open uncontested shot. |
| 1 | Shooter is open during shot preparation, defender closes out but with no chance to disrupt or block the shot; open shot. |
| 2 | Defender is closely guarding the shooter, pressuring him during shot preparation and execution, but has no hand close to the ball; moderately contested shot |
| 3 | Defender is closely guarding the shooter, pressuring him during shot preparation and execution, with his hand close to the ball; tightly contested shot. |
| 4 | Double-teaming, two defenders are closely guarding the shooter, pressuring him during shot preparation and execution, with their hands close to the ball; tightly contested shot. |
| Outcomes | |
| Score | 2-point, 3-point field goal (potentially plus free throw after a shot foul) and/or free throw made |
| Continued possession | Missed field goal attempt or missed free throw → offensive rebound; or stoppage with continued possession |
| No score | Missed field goal attempt or missed free throw → defensive rebound; turnover (bad pass, ball or player out of court, rules violation: ball handling, travelling, 3 / 5 / 8 / 24 s, offensive foul), game over |

The sample involved all NBA teams ($n = 30$; 7.7 ± 2.4 games per team). All possessions finishing within the last 120 s of a game were video-analysed ($n = 1182$; 39.4 ± 13.4 possessions per team). At the onset of a possession, the score-line was -0.8 ± 3.9 . These endgames included score-line changes ranging from 0 to 11 points (4.4 ± 2.0 points) and one or various changes in the lead in 61 games (53%).

The sample comprised 173 possessions stopped by defenders' intentional fouls or loose ball foul before initiation of a play type and 71 further possessions

with no identifiable play type (e.g. possessions protecting an endgame lead or ending by turnover or time expiration within 5 s), which were omitted from play type analyses. The remaining 938 possessions included 48 possessions involving two successive plays (reset within a continuation of a possession, see Table 1) and five possessions involving three successive plays. The total play type sample thus involved $n = 996$ plays.

Within the sample, we defined two contrast situations a priori, considered to involve 'usual' versus 'high time pressure': (i) being in the lead through the

final 70 s ($n = 123$) versus (ii) possessions trailing by 7–9 points through 70–46 s remaining game time or 4–9 points through 45–25 s or by any differential through the final 24 s ($n = 257$). The frequencies are unequal because within the initial, entire sample (with and without play types), 50.7% of ‘usual pressure’ versus 8.9% of ‘high pressure’ possessions were stopped by non-shot fouls ($\chi^2 = 139.06$; $p < 0.01$; $\phi = 0.46$).

Game observation

Video analyses involved traditional standard ‘score sheet data’ (home/away team, timeouts, game and shot clock, shots attempted/made/missed, scored points, score-line, rebounds, fouls and turnovers). In addition, we assessed the type of opening, play type, duration of plays (seconds from gaining ball possession until shot), numbers of involved actions (passes, handoffs, screens, cuts and drives), shot range (paint, mid-range, 3-point range), defence pressure on a shooter and outcomes by manual annotation (Table 1).

Since play types may not only vary in their direct scoring but also in the probability of passing into a continued possession (primarily through offensive rebound; Table 1) we considered not only the points scored directly through a play (pts/play) but also those scored in a potential continuation of a possession following a play type (pts/possession).

A play type is typically not static but may pass into varying subsequent actions (see for example variants of ‘1 × 1’, ‘1 × 1-isolation’ and ‘pick and roll play’ in Table 1), depending on defenders’ reactions (e.g. close out, help defence, switch, etc.). Importantly, we identified exactly the play type that was *initial to creating* a shot opportunity within each possession.

The play types were determined by a high-profile basketball coach. He has a master degree in sport science, had 12-year experience as a coach, and holds high-level basketball coaching licences. He was trained specifically for this assessment in six sessions. Furthermore, evaluations relied on a written glossary defining the variables and categories.

Objectivity and reliability measures were fairly high. Intra-rater test–retest reliability was examined by assessing 24 randomly selected possessions twice, two weeks apart. The agreement of determined play types was 94.1%; Cohen’s Kappa was $\kappa = 0.93$. Test–retest reliability was $r_{(s)tt} = 0.96$ for defence pressure rating and $r_{(s)tt} = 0.99$ for the number of identified singular actions within a play. To test inter-rater reliability, two other licenced coaches rated 30 randomly extracted possessions. The play type identification exhibited an overall agreement of 93.2%; Fleiss’ Kappa was $\kappa = 0.93$. Intra-class-correlations were $ICC_{(3,30)} = 0.94$

for defence pressure and $ICC_{(3,30)} = 0.91$ for the number of actions within a play.

The 30 teams did not differ significantly in the frequencies of the play types they performed when controlled for the type of opening and the momentary score-line (being ahead, trailing or deuce). Furthermore, a preliminary study had investigated the robustness of play types across and within different types of teams.²³ Across all NBA teams, it identified three different clusters regarding their offense behaviour (defined by their shot range distribution and free throws) and four clusters with regard to their defence behaviour (defined by defensive rebounds, blocks, steals and opponents’ transitions, field goal percentage and free throws). The distribution of play types was fairly stable, in that no significant effect of the offense cluster or its interaction with opponents’ defence clusters on the frequency distribution of the play types was revealed (all $p > 0.05$).

Statistical analysis

Preliminary comparison between the variants within each play type (Table 1) as well as home vs. away team or a preceding timeout revealed no significant outcome differences, respectively. Play type analyses therefore drew on the six play type categories defined in Table 1 and on the entire sample, without further subdivision, respectively. Regarding defence pressure, preliminary ANOVA indicated that only the difference between levels 0–2 (no or moderate pressure) vs. 3–4 (tightly contested shot; Table 1) discriminated the attained score significantly. We thus dichotomised defence pressure for analyses.

Analyses were performed using SPSS 24.0. Descriptive data include frequencies, mean value and standard deviation. Group comparisons involved χ^2 -test for categorical variables (play type, type of opening, shot range, defence pressure and outcome categories) and ANOVA or unpaired *t*-test or, for non-uniform (skewed) data distribution, *U*-test, for parametric variables (duration, number of actions, scored points). Effect sizes²⁴ are expressed as ϕ , Cohen’s *d* using pooled variance, or η^2_p . All statistical testing was two-tailed. A value of $p < 0.05$ was considered statistically significant.

Results

Table 2 highlights the frequency distribution of play types, together with the types of opening (question 1). The teams performed each of the six play types with mentionable frequency, whereas ‘pick and roll play’ was particularly frequent (29.1%), ‘inbound play’ particularly infrequent (9.5%) and the remaining play types were quasi evenly distributed. Some 40.0% of

Table 2. Frequency distribution of play types and types of opening.

| Opening | Play types 1 × 1 | 1 × 1-Iso | Pick & roll | Complex | Inbound | Transition | Total |
|-------------------|---------------------|------------------|-------------------|------------------|---------|------------|--------|
| Inbound | | | | | | | |
| Backcourt | | | | | | | |
| <i>n</i> | 62 ^{NS} | 66 ^{NS} | 139 ^{NS} | 79 ^{NS} | 1** | 51** | 398 |
| % | 39.2% | 41.8% | 47.9% | 50.6% | 1.1% | 36.7% | 40.0% |
| Frontcourt | | | | | | | |
| <i>n</i> | 59** | 39 ^{NS} | 56** | 47 ^{NS} | 94** | 0** | 295 |
| % | 37.3% | 24.7% | 19.3% | 30.1% | 98.9% | 0.0% | 29.6% |
| Rebound | | | | | | | |
| Defensive | | | | | | | |
| <i>n</i> | 29 ^{NS} | 41 ^{NS} | 80* | 24* | 0** | 67** | 241 |
| % | 18.4% | 25.9% | 27.6% | 15.4% | 0.0% | 48.2% | 24.2% |
| Offensive | | | | | | | |
| <i>n</i> | 7 ^{NS} | 7 ^{NS} | 6 ^{NS} | 3 ^{NS} | 0 | 0 | 23 |
| % | 4.4% | 4.4% | 2.1% | 1.9% | 0.0% | 0.0% | 2.3% |
| Steal | | | | | | | |
| <i>n</i> | 1 ^{NS} | 5 ^{NS} | 9 ^{NS} | 3 ^{NS} | 0** | 21** | 39 |
| % | 0.6% | 3.2% | 3.1% | 1.9% | 0.0% | 15.1% | 3.9% |
| Total | | | | | | | |
| <i>n</i> | 158 | 158 | 290 | 156 | 95 | 139 | 996 |
| % | 15.9% | 15.9% | 29.1% | 15.7% | 9.5% | 14.0% | 100.0% |

Definitions of play types: see Table 1. 'Inbound play': Unlike other leagues, NBA teams can call up to three timeouts within the last 120 s when they are in ball possession. The game is then resumed by a frontcourt inbound. 'Transition play' after backcourt inbound exclusively after opponent's made goals, i.e. with no game interruption before the inbound. Bottom row (total) percentages are row wise: distribution of play types. Right column (total) percentages are column wise: distribution of openings. Percentages within cells are column wise: distribution within a play type. Total play type × opening: $\chi^2 = 387.28$; $df = 20$; $p < 0.01$; $\varphi = 0.62$. χ^2 test for single cells (2×2 , $df = 1$ comparison with remaining play types in each case). NS: not significant ($p > 0.05$); * $p < 0.05$; ** $p < 0.01$.

all possessions started from backcourt inbounds, 29.6% from frontcourt inbounds and 24.2% from defensive rebounds, while offensive rebounds and steals were relatively infrequent openings. Decisions for the different play types were constrained by the type of opening. For example, teams played transitions exclusively after a defensive rebound, backcourt inbound or steal and inbound play was performed (quasi) exclusively after a frontcourt inbound. Among the remaining play types, 'pick and roll play' was significantly over-represented relative to the other play types and 'complex team play' under-represented after defensive rebounds while '1 × 1 play' was over-represented and 'pick and roll play' under-represented after frontcourt inbounds (Table 2).

Table 3 compares the different play types in more detail, specifically regarding their duration, number of involved actions, shot range, defence pressure on the shooter and their outcomes (question 2). The data highlight a clear distinction between 'quick' ('inbound play', 'transition play'; mean duration < 6 s) and 'long' plays ('1 × 1 play', '1 × 1-isolation play', 'pick and roll play', 'complex team play'; mean > 12 s). The quick play types were particularly effective and arrived at 1.5 average

pts/possession, respectively. Both, 'transition play' and 'inbound play' were characterized by a clearly polarized shot area profile 'polarized away' from mid-range toward paint or 3-pts shots. 'Transition play' involved comparatively few cooperative actions but a quick creation of shot attempts (before the opponent defence was set in their half-court). It led to a significantly increased rate of moderately or uncontested shots (72.4%), augmented total field goal percentage (FG%: 50.4%) – an extraordinary 3-pts percentage (3P%) of 53.9% in particular – and significantly enhanced total scoring percentage and absolute points scored. 'Inbound play' was characterised by frequent cooperative actions within a short time. It went along with roughly average defence pressure on shooters and FG%, but continued possessions were significantly over-represented after 'inbound play' (22.1%). The continued possessions led to 80.0% moderately or uncontested shots and scoring in 76.2% of the continuations (1.6 ± 1.0 pts/continuation), leading to significantly enhanced total pts/possession (Table 3).

Across the remaining, 'long' play types, there is a recognizable trend, in that play types involving more cooperative actions mostly brought about more scored

Table 3. Description of the play types regarding their duration, number of actions, shot area, defence pressure on the shooter and outcomes.

| | 1 × 1 | | 1 × 1-iso | | Pick & roll | | Complex | | Inbound | | Transition | | Total | |
|-----------------------------|---------------------|-----|---------------------|-----|---------------------|-----|---------------------|-----|---------------------|-----|---------------------|-----|-------|-----|
| | M | SD | M | SD | M | SD | M | SD | M | SD | M | SD | M | SD |
| Duration (s) | 12.6 | 6.6 | 16.1 | 5.5 | 14.1 | 4.8 | 13.2 | 5.2 | 2.2 | 1.2 | 5.0 | 1.5 | 11.6 | 6.6 |
| Number actions | 2.6 | 1.8 | 2.1 | 1.6 | 3.4 | 1.6 | 5.5 | 2.1 | 4.8 | 1.6 | 1.4 | 1.0 | 3.2 | 2.1 |
| Shot range | | | | | | | | | | | | | | |
| Within paint | 54.7%** | | 37.7% ^{NS} | | 47.5% ^{NS} | | 42.6% ^{NS} | | 22.2%** | | 50.0% ^{NS} | | 44.1% | |
| Mid-range | 18.7% ^{NS} | | 42.5%** | | 25.3% ^{NS} | | 18.4% ^{NS} | | 11.1%** | | 4.3%** | | 21.9% | |
| 3-point range | 26.6%* | | 19.9%** | | 27.2%** | | 39.0% ^{NS} | | 66.7%** | | 45.7%** | | 34.1% | |
| Defence pressure on shooter | | | | | | | | | | | | | | |
| None/moderate | 42.4%** | | 37.7%** | | 65.7% ^{NS} | | 80.9%** | | 66.7% ^{NS} | | 72.4%** | | 60.8% | |
| Tight | 57.6%** | | 62.3%** | | 34.3% ^{NS} | | 19.1%** | | 33.3% ^{NS} | | 27.6%** | | 39.2% | |
| Outcome of the play | | | | | | | | | | | | | | |
| Total FG% | 30.9%* | | 30.8%** | | 40.2% ^{NS} | | 51.5%** | | 43.2% ^{NS} | | 50.4%* | | 38.5% | |
| 2P% | 36.3% ^{NS} | | 32.5%** | | 42.2% ^{NS} | | 57.8%** | | 63.3%* | | 47.6% ^{NS} | | 43.0% | |
| 3P% | 16.2%** | | 24.1% ^{NS} | | 34.7% ^{NS} | | 41.5% ^{NS} | | 32.8% ^{NS} | | 53.9%** | | 35.2% | |
| Direct score | 40.5% ^{NS} | | 33.5%** | | 44.5% ^{NS} | | 52.6%* | | 42.1% ^{NS} | | 57.6%** | | 45.0% | |
| Continued poss. | 14.6% ^{NS} | | 19.6%* | | 12.4% ^{NS} | | 12.2% ^{NS} | | 22.1%* | | 10.1% ^{NS} | | 14.5% | |
| No score | 44.9% ^{NS} | | 46.8% ^{NS} | | 43.1% ^{NS} | | 35.3% ^{NS} | | 35.8% ^{NS} | | 32.4%* | | 40.6% | |
| Of these: TOV | 7.6% ^{NS} | | 5.1% ^{NS} | | 6.2% ^{NS} | | 8.3% ^{NS} | | 5.3% ^{NS} | | 10.8% ^{NS} | | 7.1% | |
| Pts/play | 0.8 | 1.1 | 0.7 | 1.1 | 1.0 | 1.1 | 1.2 | 1.2 | 1.1 | 1.3 | 1.3 | 1.2 | 1.0 | 1.2 |
| Outcome of the possession | | | | | | | | | | | | | | |
| Score | 47.5% ^{NS} | | 42.4%** | | 52.8% ^{NS} | | 59.0% ^{NS} | | 59.0% ^{NS} | | 65.5%** | | 53.6% | |
| No score | 52.5% ^{NS} | | 57.6%** | | 47.2% ^{NS} | | 41.0% ^{NS} | | 41.0% ^{NS} | | 34.5%** | | 46.4% | |
| Pts/possession | 1.0 | 1.1 | 0.9 | 1.1 | 1.1 | 1.1 | 1.3 | 1.2 | 1.5 | 1.3 | 1.5 | 1.2 | 1.2 | 1.2 |

M: mean; SD: standard deviation; TOV: turnover.

Play type definitions: see Table 1. Percentages are column wise in each case. Number of actions: passes, handoffs, screens, cuts, drives. FG% – made / attempted field goals. Continued possession: see definitions in Table 1. Pts/play: points per play. Pts/possession: points per possession (in each case including potential free throws).

χ^2 test for single cells (2×2 , $df = 1$, comparison with remaining play types in each case) – NS: not significant ($p > 0.05$), * $p < 0.05$, ** $p < 0.01$. Duration: $F = 172.64$; $p < 0.01$; $\eta^2 = 0.47$; post hoc Scheffé: inbound < transition < 1 × 1, complex, pick and roll < 1 × 1-isolation; 1 × 1 < pick and roll. Number of actions: $F = 132.77$; $p < 0.01$; $\eta^2 = 0.40$; Scheffé: complex > inbound > pick and roll > 1 × 1, 1 × 1-isolation > transition. Shot range: $\chi^2 = 131.04$; $df = 10$; $p < 0.01$; $\varphi = 0.36$. Defence pressure: $\chi^2 = 85.89$; $df = 5$; $p < 0.01$; $\varphi = 0.31$. Total FG%: $\chi^2 = 17.14$; $df = 5$; $p < 0.01$; $\varphi = 0.13$. 2P%: $\chi^2 = 20.26$; $df = 5$; $p < 0.01$; $\varphi = 0.19$. 3P%: $\chi^2 = 16.32$; $df = 5$; $p < 0.01$; $\varphi = 0.23$. Outcome: $\chi^2 = 28.59$; $df = 10$; $p < 0.01$; $\varphi = 0.17$. Turnover: not significant ($p > 0.05$; $\varphi = 0.07$). Pts/play: $F = 5.64$; $p < 0.01$; $\eta^2 = 0.03$. Scheffé: complex, transition > 1 × 1, 1 × 1-isolation, pick and roll; pick and roll > 1 × 1-isolation. Outcome possession: $\chi^2 = 21.21$; $df = 5$; $p < 0.01$; $\varphi = 0.15$. Pts/possession: $F = 5.68$; $p < 0.01$; $\eta^2 = 0.03$. Scheffé: complex, inbound, transition > 1 × 1, 1 × 1-isolation; complex, transition > pick and roll.

points. ‘1 × 1 play’ and ‘1 × 1-isolation play’ turned out as less effective than ‘complex team play’ in particular. Specifically, they were typified by significantly decreased numbers of cooperative actions, frequent 2-pts attempts, under-represented 3-pts shots, over-represented tightly contested shots, low FG% and low pts/play as well as pts/possession (Table 3). In contrast, ‘complex team play’ involved significantly more cooperative actions within comparable duration of a possession and led to 80.9% moderately or uncontested shots, significantly enhanced FG% and more pts/play (1.2 ± 1.2) and pts/possession (1.3 ± 1.2) than ‘1 × 1 play’ (0.8 ± 1.1 and 1.0 ± 1.1) and particularly ‘1 × 1-isolation play’ (0.7 ± 1.1 and 0.9 ± 1.1). ‘Pick and roll

play’ can be characterized as just intermediate between ‘complex team play’ and ‘1 × 1’ / ‘1 × 1-isolation play’ regarding these aspects.

No significant differences in the risk of a turnover were revealed between any play types (all $p > 0.05$).

Comparing play types between ‘high pressure’ and ‘usual pressure’ possessions (question 3, Table 4), there was a strong over-representation of ‘transition’ and ‘inbound play’ in ‘high pressure’ and ‘1 × 1-isolation’ and ‘pick and roll play’ in ‘usual pressure’ situations. ‘High time pressure’ plays were significantly quicker while involving comparable numbers of cooperative actions, leading to a roughly three times higher mean action frequency. Unlike ‘usual pressure’, they

Table 4. Play types and outcomes in particularly 'high' and 'usual' time pressure situations.

| | High pressure (n = 257) | | Usual pressure (n = 123) | | Z / χ^2 | p | d / ϕ |
|-------------------------------|-------------------------|------|--------------------------|------|------------------|----|---------------|
| | M | SD | M | SD | | | |
| Score-line (pts differential) | -4.5 | 2.2 | +2.8 | 1.8 | Z = 15.84 | ** | d = 3.68 |
| Remaining game time (s) | 23.8 | 18.8 | 46.1 | 15.0 | Z = 10.02 | ** | d = 1.31 |
| Play type | | | | | | | |
| 1 × 1 play | 17.9% | | 14.6% | | | NS | $\phi = 0.04$ |
| 1 × 1-isolation play | 6.6% | | 29.3% | | $\chi^2 = 35.57$ | ** | $\phi = 0.31$ |
| Pick and roll play | 8.2% | | 34.1% | | $\chi^2 = 40.58$ | ** | $\phi = 0.33$ |
| Complex team play | 11.3% | | 14.6% | | | NS | $\phi = 0.05$ |
| Inbound play | 27.6% | | 2.4% | | $\chi^2 = 33.65$ | ** | $\phi = 0.30$ |
| Transition play | 28.4% | | 4.9% | | $\chi^2 = 27.96$ | ** | $\phi = 0.27$ |
| Duration (s) | 5.3 | 3.7 | 16.7 | 5.8 | Z = 13.12 | ** | d = 2.36 |
| Number of actions | 2.7 | 2.1 | 2.9 | 2.0 | | NS | d = 0.11 |
| Shot range | | | | | | | |
| Within paint | 37.3% | | 32.7% | | | NS | $\phi = 0.04$ |
| Mid-range | 6.4% | | 39.1% | | $\chi^2 = 57.62$ | ** | $\phi = 0.41$ |
| 3P range | 56.4% | | 28.2% | | $\chi^2 = 23.89$ | ** | $\phi = 0.26$ |
| Defence pressure | | | | | | | |
| None/moderate | 63.1% | | 59.1% | | | NS | $\phi = 0.04$ |
| Tightly contested | 36.9% | | 40.9% | | | NS | $\phi = 0.04$ |
| Outcome play | | | | | | | |
| Total FG% | 45.7% | | 30.3% | | $\chi^2 = 7.35$ | ** | $\phi = 0.15$ |
| 2P% | 57.3% | | 30.8% | | $\chi^2 = 12.57$ | ** | $\phi = 0.26$ |
| 3P% | 36.6% | | 29.0% | | | NS | $\phi = 0.06$ |
| Direct score | 49.8% | | 31.7% | | $\chi^2 = 11.06$ | ** | $\phi = 0.17$ |
| Continued possession | 15.2% | | 9.8% | | | NS | $\phi = 0.07$ |
| No score | 35.0% | | 58.5% | | $\chi^2 = 18.81$ | ** | $\phi = 0.22$ |
| Of these: turnover | 4.3% | | 7.3% | | | NS | $\phi = 0.06$ |
| Pts/play | 1.2 | 1.2 | 0.7 | 1.0 | Z = 3.70 | ** | d = 0.42 |
| Outcome possession | | | | | | | |
| Score | 60.7% | | 35.8% | | $\chi^2 = 20.74$ | ** | $\phi = 0.23$ |
| No score | 39.3% | | 64.2% | | $\chi^2 = 20.74$ | ** | $\phi = 0.23$ |
| Pts/possession | 1.4 | 1.3 | 0.8 | 1.1 | Z = 4.65 | ** | d = 0.55 |

M: mean; SD: standard deviation.

Play type definitions: see Table 1. Percentages are column wise in each case. Even as far as 1 × 1, 1 × 1-isolation, pick and roll or complex team plays were employed under 'high pressure', their duration was significantly shorter than the same play types under 'usual pressure', respectively ($7.0 < M < 8.6$ vs. $16.5 < M < 19.5$ s; $7.02 < t < 9.17$; $1.91 < d < 2.64$). Within these play types, pts/possession were higher under 'high' pressure, respectively (mean difference 0.2 to 1.3 pts/possession; significant in pick and roll and complex team play: $2.5 < t < 3.8$; $0.5 < d < 1.3$).

exhibited a clearly polarized shot area profile 'polarized away' from mid-range and boosting paint and 3-pts attempts. They encountered comparable defence pressure on shooters, but the over-proportional paint shots went along with a significantly higher 2P%, and the enhanced absolute frequency of 3-pts attempts together with a comparable 3P% led to more total 3-pts shots scored.

The play types performed in 'high pressure' situations not only resulted in significantly greater scoring

percentage and direct pts/play. In addition, they also produced 1.6 +/-1.2 points per continuation of a possession (compared to 'usual pressure': 0.8 +/-1.0 points per continuation; $t = 2.11$; $p < 0.05$; $d = 0.73$), leading to a further augmented advantage in pts/possession.

It is worthy of note that, as mentioned above (Methods section), considering all possessions (with or without a play type), 50.7% of all 'usual pressure' vs. 8.9% of 'high pressure' possessions were stopped by

non-shot fouls, leading to two free throws. This proportion even rose to 85.2% of all 'usual pressure' possessions during the final 24 s of the game. Furthermore, teams made 1.6 ± 0.6 pts per two free throws after non-shot fouls and only 0.7 ± 1.1 pts per non-fouled possession in 'usual pressure' situations, compared to 1.5 ± 0.7 Pts per two free throws ($p > 0.05$), but 1.3 ± 1.3 pts/possession per non-fouled possession in 'high pressure' situations ($Z = 4.34$, $p < 0.01$). In consequence, total points scored under 'usual pressure' were composed of 68.5% made through free throws after non-shot fouls, only 28.2% through play types and 3.2% through immediate shots after offensive rebounds or possessions including no identifiable play type. In contrast, total points scored under 'high pressure' were composed of only 9.9% through free throws after non-shot fouls (comparison to 'usual pressure': $\chi^2 = 294.90$), 80.0% through play types ($\chi^2 = 214.49$) and 10.1% through immediate shots after offensive rebounds or possessions with no identifiable play type ($\chi^2 = 13.76$; all $p < 0.01$).

Discussion

This is, to the best of our knowledge, the first designated play type analysis within the endgame of close NBA matches. The central findings are that the teams employed all defined play types, but their frequency was strongly constrained by the type of opening and the momentary score-line. Furthermore, even within these highly accomplished teams, the different play types varied significantly in their outcomes. 'Transition play', 'inbound play' and 'complex team play' were particularly effective in scoring, while '1 × 1 play' and '1 × 1-isolation play' were the least effective play types.

The absolute scale of pts/possession of the sample corresponds to reports from other analyses.^{14,15} The present findings also correspond to studies investigating two-man actions^{1,16,19} and assisted shots,²⁵ consistently indicating that cooperative actions were more effective than ball handlers' solo actions, and concatenating multiple cooperative actions was particularly effective.

The findings suggest that a commonality among the particularly effective play types was increased spatial dynamics.¹ The particularly effective play types were either typified by (i) increased spatial dynamics through high motion speed, creating a shot opportunity before defences are set, leading to many unpressured shots, while realizing a clearly polarized shot range profile and high FG% ('transition play'); (ii) increased spatial dynamics through high action frequency, leading to many unpressured shots and high FG% ('complex team play'); or (iii) increased spatial dynamics through high action frequency, realizing many 3-pts shots while maintaining average FG%, and effective use of

frequent continued possessions from offensive rebounds ('inbound play'). By contrast, '1 × 1 play' and '1 × 1-isolation play' exhibit less dynamics, are more static and employ lower action frequency. The reduced action frequency presumably goes along with less variable options the play may pass into, the succession of the play is more foreseeable, provides defences better possibilities to adapt to the offense play, and leads to more tightly pressured shots and low FG%. The findings are reflected in the play types under 'high time pressure' with over-represented 'transition' and 'inbound' plays and high scoring versus 'usual pressure' with over-represented '1 × 1-isolation' and 'pick and roll play' and comparatively low scoring. Importantly, in these highly accomplished teams, play types involving greater dynamics (motion speed and/or action frequency) did not imply an increased risk of a turnover.

The questions arise why teams employ play types that are clearly inferior in scoring at all ('1 × 1 play', '1 × 1-isolation play') and why plays were more effective under 'high' than 'usual time pressure'. 'Long' possessions are employed particularly when protecting an endgame lead. Plausibly, teams may seek to delay the game, 'run down' the clock, control which player exactly gets the shot opportunity, while minimising the risk of a turnover through cautious ball control and reduced action frequency. Respective recommendations in the coaching literature are inconsistent, however, in that they suggest, on the one hand, to keep attacking, pressuring and stirring defences but, on the other hand, to decelerate the play, 'freeze' the ball and cautiously select a 'high percentage' shot opportunity.^{26,27} The present data clearly suggest that the leading teams elected to exhaust the time, reduce action frequencies, employ less 3-pts and augmented 2-pts attempts – but did mostly not manage to actually create 'high percentage' shots.

Skinner²⁸ suggested that players skip 'moderate' early shot opportunities, expecting that a 'good' opportunity will arise later. However, he demonstrated that the probability of a 'good' opportunity decreases with advancing time, a fortiori after 18 s. Furthermore, though not well researched, one may speculate that during 'long' possessions, the longer available time may induce players to contemplate more about diverse options (to shoot or wait; which action to choose) while in 'high time pressure' situations, players have no time for contemplation and may execute plays more resolutely and with stronger decision.

Uhlmann and Barnes²⁵ examined another potential motive for electing less complex plays focused on one single player ('1 × 1 play', '1 × 1-isolation play' and partly also 'pick and roll play'). They showed that, indeed, the proportion of assisted goals positively affected team performance while solo scoring influenced it negatively. Yet, solo scoring rose while assisted goals

decreased in high stake games (playoffs) compared to lower stake games (regular season). Their data suggested that one reason was the fact that the frequency of a player's solo scoring positively influenced his subsequent salary while providing assists reduced the salary.

Practical implications

The findings suggest some clear practical implications for coaches in high-level basketball. First, coaches are well-advised to instruct their teams to attempt a transition play whenever possible. Second, within set plays, more complex play types involving greater spatial dynamics through higher action frequency are mostly more effective compared to less complex play types, while inducing no increased turnover risk. Third, while the trailing teams stopped most of their opposition's possessions by non-shot fouls, forgoing fouls may actually be a promising alternative. For example, the present data suggest that in a 'two possession game' situation, i.e. trailing by -4 or -5 points when approximately 45 s of the game are left, stopping both of the opponent's remaining possessions by non-shot fouling and providing them two free throws each time, the probability to come back and win the game is 0.03% (when trailing by -5 points) or 0.34% (-4 points). Alternatively, fouling neither of the opponent's possessions – and assuming the duration and scoring of the opponent's (then not fouled) possessions correspond to the non-fouled possessions recorded here – the probability to win the game would be 2.49% (when trailing by -5 points) and 8.24% (-4 points). While the absolute probability to come back remains relatively low, still, it would increase by factor 74 (trailing by -5) and factor 25 (trailing by -4 points).

Fourth, in applied analytics, meaningful evaluation of play types clearly requires taking account of a possession's opening type and the momentary score-line. Furthermore, at an NBA performance level, the position of the defender's hands is critical in assessing defence pressure, rather than just the defender's proximity to the shooter.^{1,10,29} Technically, respective assessment requires systematic qualitative observation and manual annotation. Also, besides just the direct scoring, analytics should take account of different play types' varying probabilities of continued possessions and their effective utilisation.

Methodological considerations and future directions

This study does have limitations. For example, while teams did not differ significantly in play types' frequencies and play type distribution was robust across different offense clusters and their interaction with defence clusters, still, varying characteristics of the individual players on the floor, opponents' varying defence

behaviour or potential variation in the psycho-physical demands on players during the preceding 46 min of the game may affect the situational election and effectiveness of play types. In addition, we extracted games from the post-Allstar regular season. Offense tactics may potentially differ through earlier periods of the season or playoffs.^{14,26}

This investigation focused on play types as the initial outset for creating shot opportunities. Future research may scrutinise further details why and how exactly some play types were superior and others inferior in scoring. In particular, the advanced technical and computational power (spatial tracking, time–motion analysis) may help analyse in more detail how patterns of the interplay of gaining separation from defenders and gaining proximity account for success or failure of the play types. Furthermore, the reasons for the plays' low effectiveness under 'usual time pressure' and high effectiveness under 'high pressure' suggest another clear research priority. Finally, play types should be compared between end-games and earlier sequences of the game.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

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