NBA Spacing Insight

Shaye O'Beirne

2023-07-30

Overview

The use of tracking data in the National Basketball Association (NBA) allows teams to track positional changes in players and game balls, providing coaches and their staff with the ability to review and formulate new offensive and defensive strategies from quantitatively informed insights. An example of this is the use of tracking data to determine the effect of offensive spacing and defensive spacing on shot outcomes in NBA games.

Spacing among players has a large impact on the outcome of a possession. Fundamentally, a team on offense has a better chance of scoring when the defense is more spread out, as the offense has more room to move around and find an optimal shot location. This effectively provides the offense with more scoring options. Conversely, a defense that is more condensed can prevent a shooter from scoring. Therefore, a team on offense should find ways to spread out the defense, and a team on defense should aim to minimize their spacing. It is especially important to note that the effect of spacing on shot outcomes will differ among teams across the league. Coaches will run their offenses accordingly, from team-to-team.

This insight focuses on court spacing for selected teams, and to offer actionable suggestions for both teams to improve shot outcomes, relative to court spacing.

The Shiny App that accompanies this insight allows users to select a team and possession in an NBA Postseason game to determine both Offensive Spacing, Defensive Spacing, and the shot outcome. The App also displays broadcast video of the selected possession, court spacing, and an animation of the transitions in spacing, as well as a shot chart for the selected team, with a line plot that displays the progression in scoring over the course of the game.

Data and Methods

The data used in the analysis is from the first game of the 2022 NBA Eastern Conference Finals, between the Miami Heat and the Boston Celtics. The data includes tracking and event data, generated by Sportradar, as well as play-by-play data, made publicly available by the NBA API.

The methods used to create the spacing visuals are provided by the `kable` and `ggplot2` packages in R. To determine the spacing among players on the court, **Convex Hulls**, a popular topic in geometry, were used. The convex hull of a set of points is a shape constructed around the outer-most points such that all of the points from the set are contained within the shape. In basketball court spacing, this would be equivalent to drawing a closed line around all of the players on a team's five-person lineup, such that the outer most players lie on the circle. To implement this concept in R, the `chull` method was used.

Analysis

The analysis begins by finding the mean of Offensive Spacing and Defensive Spacing, grouped by Quarter (as well as an aggregate measure for the whole game), for successful shots and unsuccessful shots.

Miami Heat

Based on the results from Table 1, the Heat tend to be more successful on shots where the defense is more spaced-out – this is in alignment with the previously mentioned general spacing principles. Among successful shots for the Heat, the defensive spacing was larger on average, indicating **the defense was more spread out**. Additionally, the Heat benefit on shot outcomes when their offensive spacing was condensed; by halftime, the Celtics were leading 62 - 54. Looking at the defensive spacing on shots missed in the first half from Table 1, the spacing was certainly less than the defensive spacing on shots made in the second half. By the end of the second half, the Heat were up 118 - 107, and ultimately won the game.

Table 1: Shot Spacing by Outcome (MIA)

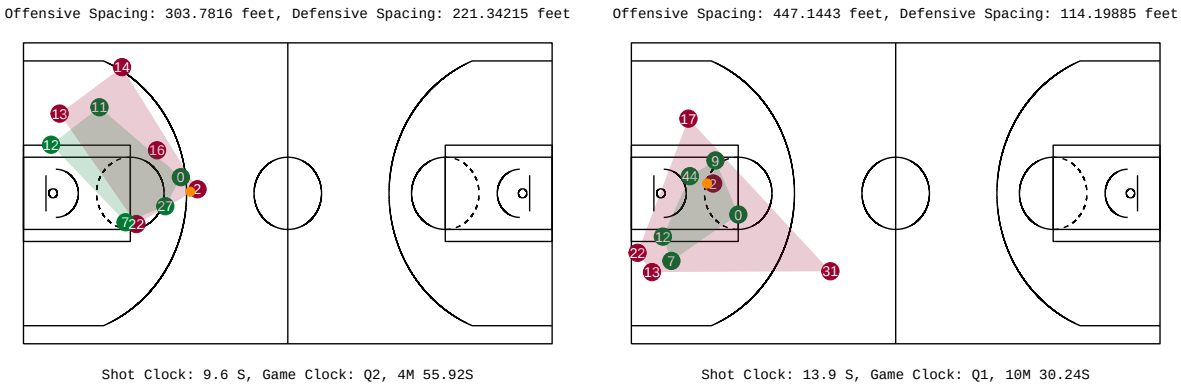
	MIA Possessions					
	Shot Missed			Shot Made		
Quarter	Off Spacing (feet)	Def Spacing (feet)	Ratio	Off Spacing (feet)	Def Spacing (feet)	Ratio
1	503.61	289.03	1.74	522.14	149.85	3.48
2	519.42	227.88	2.28	533.58	373.70	1.43
3	644.92	369.83	1.74	631.35	451.76	1.40
4	621.54	260.08	2.39	667.22	250.91	2.66
Overall	**567.12**	**282.93**	**2.00**	**572.28**	**301.63**	**1.90**

The spacing visuals below corroborate the findings from Table 1. The visual on the left (**Made Shot**) is an example of a possession where the Heat had a scoring opportunity and made the shot. The offensive spacing on Miami's part is condensed, whereas the defensive spacing on Boston's part is relatively more spread out. In this scenario, the shooter (Gabe Vincent, #2) is pushed out to the three-point line by the defense, however the spread of the defense results in only one defender (Jayson Tatum, #0) guarding the shooter. Additionally, Gabe Vincent shot 36.8% from three in the 2022 season [1], which ranked in the 73rd percentile of all NBA players, so getting pushed out to the arc still yielded a good chance of scoring - and the shot was, in fact, successful.

Conversely, the visual on the right (**Missed Shot**) is an example of a possession where the Heat had a scoring opportunity and *did not* make the shot. Here, it is visible that the offense is more sprawled out, with a condensed defense. In this scenario, the shooter (Gabe Vincent, #2) is closed in on by two defenders (Robert Williams III, #44 and Jaylen Brown, #7), due to condensed defensive spacing. This effectively makes a shot attempt more difficult, and in this case the shot was unsuccessful.

[1] NBA Stats API

-Made Shot **Missed Shot**-



The Miami Heat led the NBA in three-point shooting in 2022, with a team 3P% of 37.9% [2]. The above example demonstrates that a spaced-out defense is beneficial to the Heat, despite having shooters pushed beyond the arc. The results imply that the Heat are most successful on scoring opportunities when their offense is condensed and the defense is sprawled out. By leveraging their three-point shooting strengths, they will thrive in these situations.

Boston Celtics

Based on the results from Table 2, making shots does not require the Celtics to deviate much on offensive spacing, however they do from a significant increase in defensive spacing. The Celtics' offensive spacing was about the same irrespective of the shot being made. The defensive spacing on shots made was significantly larger on average, indicating **the defense was more spread out** on successful shots.

The Celtics had the lead closing in on halftime, as the defensive spacing on the Heat was reduced on the successful shots from the Celtics, but increased in the second half, which could have contributed to the Heat's ability to take the lead and ultimately win the game.

Table 2: Shot Spacing by Outcome (BOS)

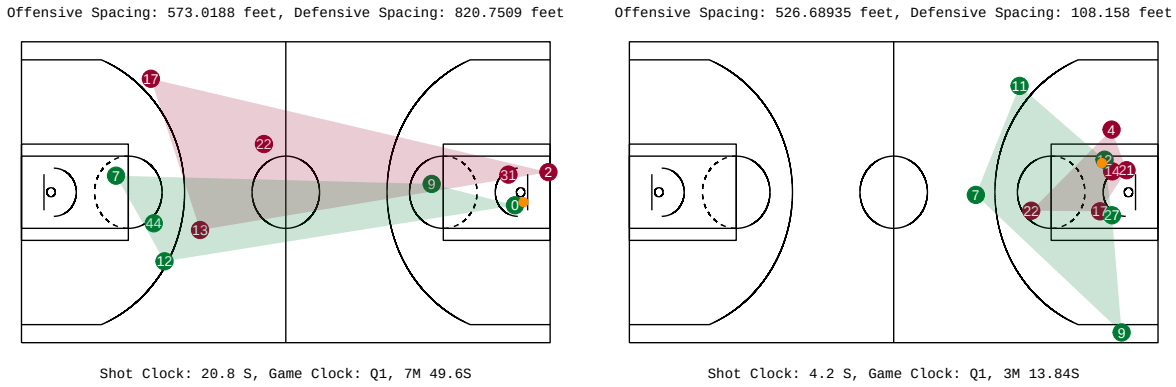
	BOS Possessions					
	Shot Missed			Shot Made		
Quarter	Off Spacing (feet)	Def Spacing (feet)	Ratio	Off Spacing (feet)	Def Spacing (feet)	Ratio
1	491.94	232.61	2.11	561.03	240.03	2.34
2	632.28	264.19	2.39	607.78	200.06	3.04
3	511.12	212.84	2.40	392.18	104.14	3.77
4	624.45	205.69	3.04	580.78	217.88	2.67
Overall	**554.11**	**225.49**	**2.46**	**573.62**	**211.54**	**2.71**

The spacing visuals below corroborate the findings from Table 2. The visual on the right (**Made Shot**) is an example of a possession where the Celtics had a scoring opportunity and made the shot. The Heat have a significantly spread out spacing in this particular possession, and the Celtics spacing is relatively more condensed. The possession was the result of a turnover on the part of the shooter (Jayson Tatum, #0). This resulted in a sprawl for both the offense and the defense. In this case, Jayson Tatum was only faced by one defender (Tyler Herro, #14), and was able to drive to the net, resulting in a successful scoring opportunity.

[2] BasketballReference.com

Conversely, on the left (**Missed Shot**) is an example of a possession where the Celtics had a scoring opportunity and *did not* make the shot. The offense is more spread out, with a condensed defense. In this instance, the shooter (Grant Williams, #12) is closed in on by two defenders (Tyler Herro, #14 and Dewayne Dedmon, #21), due to condensed defensive spacing. This effectively makes a shot attempt more difficult, and in this case the shot was unsuccessful.

Made Shot **Missed Shot**



The data implies that Boston is most effective in spacing out the defense by inducing turnovers and driving to the net. The subsequent increase in defensive spacing resulting from a turnover, paired with driving to the net effectively reduces the presence of defenders, increasing the Celtics chances of a successful shot.

Conclusion

Anecdotally and intuitively, the offense tends to thrive in possessions when the defense is spread out, and the defense is effective at preventing scoring opportunities when they are in a condensed state with a highly-spaced offense. While there is no general threshold for "optimal spacing" of an offense or defense, each team can leverage their strong skills to create successful shot outcomes on possessions. From this analysis, it was determined that both the Miami Heat and the Boston Celtics are more successful when the spacing of the defense layout increases, and both teams can induce a successful shot by taking advantage of their respective strengths.