

# NBA Three Point Shot Attempts and Accuracy Distribution

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**Abstract:** Players continuously favor shots from the outside and the trend doesn't seem to sink. This research paper aims to evaluate whether three points shot has become a regular weapon on the offensive end both on regular time and clutch time. The authors found two main results: Firstly, although three points shots are constantly favored more through seasons, during clutch times (4th quarters and overtimes) and important games (playoffs) teams would put less weight on three points shots. Because the team will consider the uncertainty of three points shots during clutch times and important games, to reduce the amount of three points shots. Secondly, teams might take tie game as the safest result. As there is a tradeoff between shooting percentage and scores made (2 points vs 3 points), teams would prefer to be eclectic, thereby resulting in the reverse proportion for various score difference.

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## 1 Introduction

After coach Mike D'Antoni's Seven Second or Less (S-SOL) offense system went viral during 2015-16 season<sup>[1]</sup>. NBA teams started to astonish the basketball world by taking an unprecedentedly massive number of three points shots. Positioning at 23 feet and 9 inches (7.24 meters) away from the rim, three point shots is, indeed, the most difficult type of shot to make<sup>[2]</sup>. Nonetheless, players continuously favor shots from the outside and the trend doesn't seem to sink. This research

paper aims to evaluate whether three points shot has become a regular weapon on the offensive end both on regular time and clutch time.

## 2 Methods

Over the last decade, NBA teams is about 3 to 5 percent better in taking mid-range shots than taking three points shot. However, that is exactly how three points shot stood out: by sacrificing 5 percent of shooting percentage, three points shot is 50 percent better in terms of its return. As a result, shown in Figure 1 and 2, every three points shot in average produces 0.25 point more than mid-range shots. That is, a team would expect to gain 2 points lead, just by switching 8 mid-range shot attempts into three points shots, providing that the two team has the same total amount of shots taken (Shots inside the paint area and restricted area is not counted because it is still a major mean for teams to score).

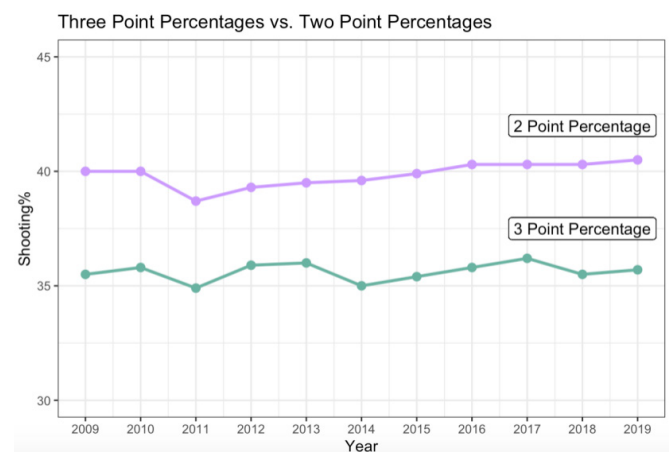
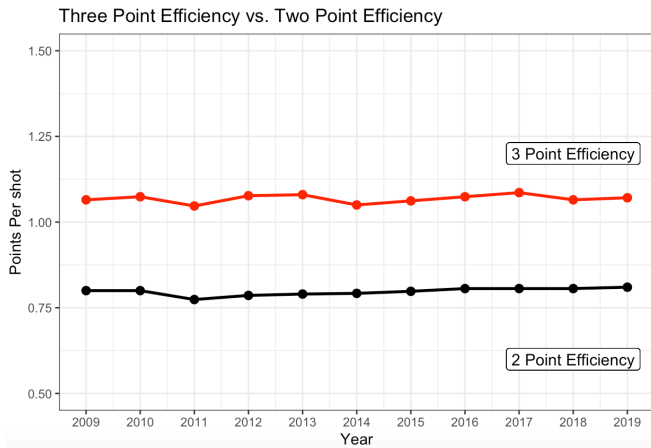


Figure 1. Three Point percentages vs two Point percentages.



**Figure 2.** Three Point Efficiency vs two Point Efficiency.

It is not difficult to recognize the outstanding efficiency of three points shots. Only if players manage to shoot mid-range with 1.5 times the percentage, they shoot three pointers, they will balance their efficiency of both types of shots and therefore having no preference to shoot any certain type.

However, in real games rationality isn't always going to dominate teams' decisions. Although three point shot is a better choice in terms of its return, mid-range shots(not to mention inside shots) still have its comparative advantage in possibility to score. Thus, it is very likely that teams only utilize three points shot in normal time and still prefer two pointers in tight games, although three pointers are always the more efficient shot type. This extent of importance can also apply to playoff games.

To evaluate whether it is true that teams do not value three points shots during tight periods, I compare the proportion of three points shot in all overtaking shots in different period of different importance. Overtaking shot is defined as any shot that the trailing team takes to tie or surpass their opponents. By recording shooting pattern of overtaking shot, all scenarios of tight periods will be identified since the extent of the seriousness of the game is simply determined by the score difference between the teams. My sample is all NBA games from the 1996-97 season to 2019-2020 season, extracted from basketballreference.com.

The result can be split into two parts. Firstly, the proportion of three points shots in overtaking shots is significantly lower than the general proportion of three points shots. Secondly, this proportion in the context of 4<sup>th</sup> quarters and playoffs, even in 4<sup>th</sup> quarter of playoffs, is surprisingly higher than the overall proportion and for the 4<sup>th</sup> quarter for playoffs, we can see a general

increase from 97-98 season to 18-19 season. Comparing the general proportion of three point shots in all shots taken to the proportion of it in overtaking shots in the context of the 4<sup>th</sup> quarter and overtime in playoffs, we can identify a pattern that the latter proportion is very close to, or, in some seasons even higher than, the former one.

If we only consider these data, the conclusion would be quite simple(but also unexpected): The proportion of three point shot in overtaking shot under any specific context is increasing from 96-97 season until now, and this is natural considering the proportion of three point shot in all shots itself is increasing by time as well. However, there is a sign that three points shots are actually valued to a greater extent in important periods like the 4th quarter and overtime or in the playoffs.

This result is, obviously, quite abnormal. After checking through my procedures I realized that the problem lies in my definition of overtaking shots. For any shot to tie or to surpass, there is only three possible situations, when the two teams has one, two, or three points of score difference. When a team is down by three, the concept of overtaking shot will only allow three points shot to be taken into account. Because of this, I disintegrate all overtaking shots by different score difference and different shot type. This results in six scenarios (one point shot when down by one, a two point shot when down by one, etc). By doing this I can overlook the situation when a team is down by three and they take three points shot. From the rest I evaluate the proportion of three points shots again, and get a new round of result.



**Figure 3.** Three Point when down 2 and 3 Point when down 1.

The adjusted proportion is calculated after deleting the scenario of three point shot taken when down by three and the scenarios of one point shot(basically

free throw) taken when down by one, since those two scenarios will not show the trade off between taking two pointers and three pointers(Figure 3). From this result, we can reach a more reasonable conclusion. Firstly, we can see that the both proportions are increasing through time(naturally following the general three point shot trend). Secondly, both proportions are always lower than the general three points shot proportion in all shots, by 5 to 10 percent. From this specific observation, we can understand that during important periods, three points shot will be taken with more consideration because of its increasing difficulty to score compared to two pointers. Thirdly, a parallel comparison is done to these two adjusted proportion, and there is no significant difference between the two sets of proportion, which indicates that three-point shots have the same function when the team is trailing by one or two points. We can see that as no matter the team is losing by one or two points, three-point shots could always take the lead back, hence the proportion shows little disparity.

Now, since the definition of overtaking shot fails to consider both two pointer and three pointer when there is a three point score difference, I specifically take out all “down by three” scenarios in the 4th quarter and overtimes from 09-10 season to 19-20 season and analyze the shot type taken by players in that period.

greater extent than taking mid-range shots.

From the analysis of data from the “down by three” scenario and the “down by two” scenario we might be able to indicate a behavior of NBA players and teams, that most of them would take the score difference of zero, which is a tie game, as an optimal result. When teams are down by two points, they would rather tie the game than take the lead back by a three pointer, whereas when they are down by three points, they tend to take the risks of shooting threes and tie the game.

### 3 Conclusion

As discussed above, we found two main results: Firstly, although three point shots are constantly favored more through seasons, during clutch times (4th quarters and overtimes) and important games (playoffs) teams would put less weight on three point shots. Because the team will take into account the uncertainty of three point shots during clutch times and important games, so as to reduce the amount of three point shots. Secondly, teams might take tie game as the safest result. As there is a trade off between shooting percentage and scores made (2 points vs 3 points), teams would prefer to be eclectic, thereby resulting in the reverse proportion for various score difference.

**Table 1.** Analyze the shot type taken by players

Season	Total down by three	Total two taken	Proportion
09-10:	2339	509	21.76%
10-11:	2560	562	21.95%
11-12:	1945	443	22.78%
12-13:	2320	535	23.06%
13-14:	2460	552	22.44%
14-15:	2333	527	22.59%
15-16:	2420	512	21.16%
16-17:	2383	510	21.40%
17-18:	2295	502	21.87%
18-19:	2267	480	21.17%
19-20:	1734	361	20.82%

The result is a total flip-over comparing to the previous ones. When the score difference reaches three points, players strangely reverse their shooting pattern, and starts to prefer taking three points shots in a much

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