# Does Position or Minutes Played have an Effect on Points-Per-Game in the NBA?

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**Abstract**

The purpose of this project is to observe and investigate the effects of both minutes-per-game and position played on the average number of points an NBA player scores per game, using the statistics gathered by Basketball Reference. 500 NBA players were observed to obtain this data, and all statistics are from the 2018-2019 NBA season, spanning 82 games.

## Background and Significance

How has the NBA changed over time? Is there a position in basketball that tends to provide more points? Could points-per-game also be impacted by minutes played per game? These are the questions NBA teams must consider in their search for the best possible ways to win basketball games. Typically, the more games a team wins, the more revenue it generates through ticket sales, merchandise, and other methods of producing profit. In this study, we examine whether player position or minutes-per-game has an impact on points-per-game average in the 2018-2019 NBA season. We also explain whether or not a relationship exists between minutes-per-game and points-per-game, or between player position and points-per-game.

The NBA has been in existence since 1946, so there have been decades of evolution of the game of basketball. Scoring was largely from ten feet or closer to the basket in the 1960s and 1970s, and even when the 3-point shot was introduced to the NBA in the year 1979, it still took years to catch on. Historically, the NBA has been a big-man dominated league, with centers and power forwards being the primary scoring position. For example, in 1995, there were only two guards in the top 10 points-per-game, and the rest were either power forwards or centers.

However, with the embracing of the 3-point arc, it appears that the NBA has become a shooter-driven league. In 1988, Larry Bird, who many consider to be one of the league's top shooters, made his all-time most 3-pointers in a season with 98. Current NBA player Stephen Curry made 96 3-pointers in ONE MONTH ALONE during the 2020-2021 NBA season. The NBA has transitioned from post-play, back to the basket type of league to a shooting league, but with this evolution, players of all heights have adjusted their style of play, and it is unclear whether or not one position reigns supreme in the current NBA's scoring race.

A player's points-per-game may also be influenced by the number of minutes they play in a game, on average. This analysis investigates the relationship between player position and points-per-game. It also investigates the relationship between minutes-per-game and points-per-game.

## Data

Using BasketballReference.com, we obtained the individual data from 500 NBA players. We considered the quantitative variable minutes-per-game. We also considered the categorical variable player position.

Because there are NBA players who may only play just a handful of games per season due to injury, 10-day contracts, or other factors, we filter out players based on their minutes player per game, and eliminate any NBA player from the data who has not played at least 8 minutes-per-game. This brings us down from 500 observations to approximately 438 observations.

We also filtered out 6 players who are identified as playing more than one position (for example, SG/SF), in order to keep our data to the five positions of basketball. This brings us to 432 observations.

Finally, we filter out NBA players who have played less than 24 games in the 2019 season. This eliminates players who have not played a sufficient amount of games for their data to be considered valid for this study. After this final filter of the data, the dataset contains 335 observations.

Table 1: Summary Statistics for Position and Points-Per-Game

| Pos | N | Mean_Gross | Median_Gross | StDev_Gross |
|---|---|---|---|---|
| SG | 82 | 10.750000 | 9.70 | 5.542190 |
| PF | 62 | 10.351613 | 8.95 | 5.575466 |
| C | 64 | 9.868750 | 9.25 | 5.605294 |
| PG | 66 | 9.866667 | 8.00 | 6.268464 |
| SF | 61 | 9.621311 | 7.50 | 6.204974 |

The table above shows the mean, median and standard deviation from the mean of points-per-game for each NBA position. Although there are only five positions in basketball, some players are identified as playing more than one position, so a separate column is created for those players. However, since the total number of

non-traditional players adds up to only 6, we will exclude those players from the data. When looking at the table, we see that shooting guards have the most listed players by far, and their points-per-game average is the largest. However, the margins between positions and points-per-game is fairly slim; there is only a difference of 1.13 points-per-game between the largest mean and smallest mean. In the game of basketball, this is only a free-throw's worth of points.

Table 2: Summary Statistics for Position and minutes-per-game

| Pos | N | Mean_Gross | Median_Gross | StDev_Gross |
|---|---|---|---|---|
| SG | 82 | 23.78659 | 24.65 | 7.290138 |
| PF | 62 | 23.05161 | 22.65 | 7.191200 |
| SF | 61 | 22.93934 | 20.80 | 7.624309 |
| PG | 66 | 21.97727 | 20.95 | 6.759263 |
| C | 64 | 21.08594 | 20.45 | 7.834050 |

This table shows the average number of minutes player per position in descending order. We see shooting guards top this list of averages again, but similarly to the other table, there is only a slim margin between the largest and smallest mean. The difference, though subtle, makes sense with the NBA's change of style over the past few years, and how it has gone from a center-dominated league to more of a shooter's league.

## Model

We fit four different models that display the relationships between our explanatory and response variables. The first model demonstrates the distribution of points-per-game across the different player positions. The second demonstrates the distribution of minutes-per-game across each position. The third model displays the relationship between points-per-game and minutes-per-game, and the final model displays the relationship between points-per-game and position, both in a scatter plot.

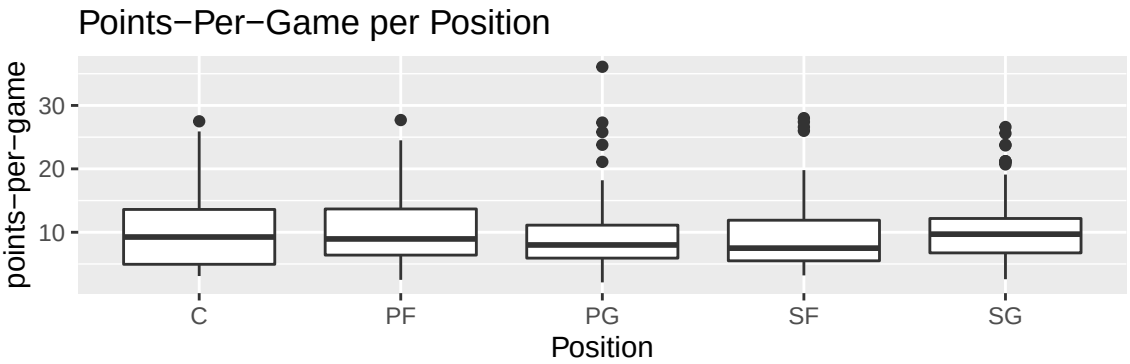


Figure 1: Distribution of Points-Per-Game across Different Positions

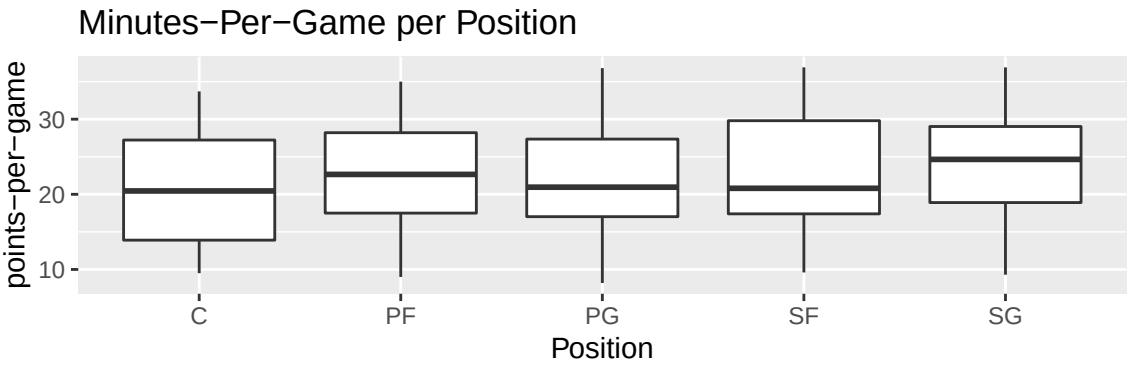


Figure 2: Distribution of Minutes-Per-Game across Different Positions

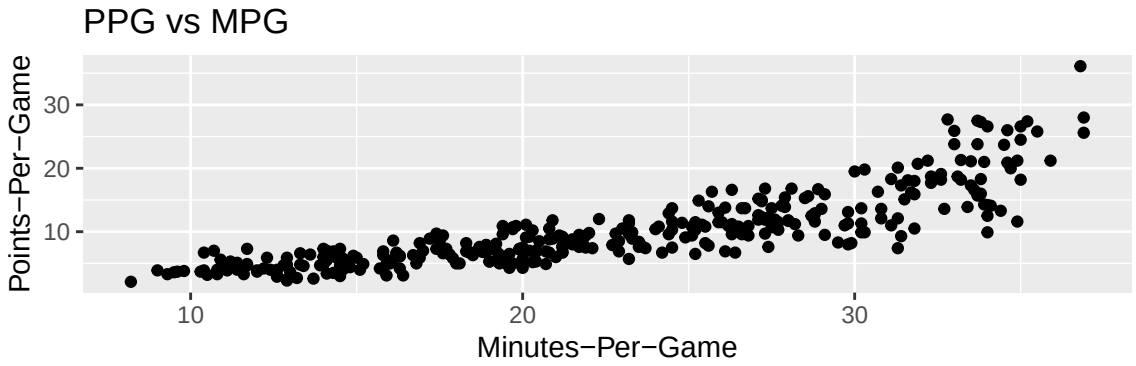


Figure 3: Distribution of All Points-Per-Game with Minutes-Per-Game

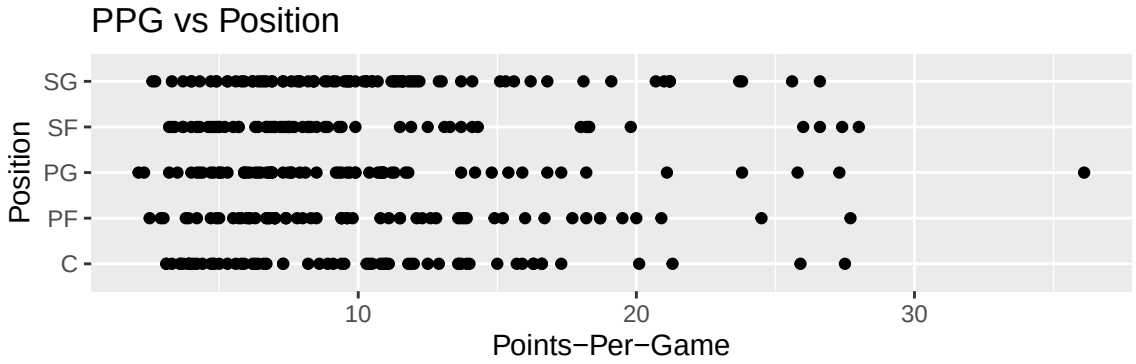


Figure 4: Distribution of All Points-Per-Game for each Position

Table 3: Table 3: Table of Model Coefficients

| | Estimate | Std. Error | t value | Pr(>\|t\|) |
|---|---|---|---|---|
| (Intercept) | -4.3019806 | 0.6282265 | -6.847818 | 0.0000000 |
| MP | 0.6720465 | 0.0233724 | 28.753870 | 0.0000000 |
| PosPF | -0.8381624 | 0.5573006 | -1.503968 | 0.1335489 |
| PosPG | -0.6011021 | 0.5471848 | -1.098536 | 0.2727739 |
| PosSF | -1.4930141 | 0.5593910 | -2.668999 | 0.0079849 |
| PosSG | -0.9337110 | 0.5236809 | -1.782977 | 0.0755119 |

The estimated regression equation is:

$$\widehat{\text{Points-Per-Game}} = -4.30 + 0.672 * \text{Minutes Played} - 0.838 * I_{PowerForward} - 0.601 * I_{PointGuard} - 1.49 * I_{SmallForward} - 0.934 * I_{Sh}$$

The intercept represent the number of points scored per-game by a center who has played zero minutes. In this case, it does not make sense to interpret the intercept; players cannot score points while having played zero minutes, and the amount of points scored also cannot be negative, as it is shown in the coefficients table. We estimate that a player's points-per-game is expected to increase by 0.672 points for every additional minute played, assuming position is held constant. According to this model, a power forward is expected to score 0.83 less points-per-game than a center, a point guard is expected to score 0.60 less points-per-game than a center, a small forward is expected to score 1.49 less points-per-game than a center, and a shooting guard is expected to score 0.93 less points-per-game than a center. All four of these interpretations are assuming that minutes-per-game is held constant.

The value of R-squared is 0.7168. This indicates that 71.68% of the variability in points-per-game scored is explained by the model, using minutes-per-game and position as explanatory variables.

We also consider a model that involves for the possibility of interaction between points-per-game and position, demonstrated by Table 3:

Table 4: Table of Model Coefficients

Table 4: Table 4: Table of Model Coefficients With Interaction

| | Estimate | Std. Error | t value | Pr(>\|t\|) |
|---|---|---|---|---|
| (Intercept) | -3.4005229 | 1.1259399 | -3.0201637 | 0.0027266 |
| MP | 0.6292949 | 0.0501022 | 12.5602318 | 0.0000000 |
| PosPF | -1.5913814 | 1.7490579 | -0.9098506 | 0.3635756 |
| PosPG | -3.7506598 | 1.7301328 | -2.1678450 | 0.0308960 |
| PosSF | -2.4167765 | 1.7003442 | -1.4213454 | 0.1561752 |
| PosSG | -1.1633475 | 1.6314901 | -0.7130583 | 0.4763214 |
| MP:PosPF | 0.0363209 | 0.0747462 | 0.4859230 | 0.6273492 |
| MP:PosPG | 0.1450436 | 0.0760163 | 1.9080610 | 0.0572643 |
| MP:PosSF | 0.0437239 | 0.0727528 | 0.6009928 | 0.5482637 |
| MP:PosSG | 0.0145079 | 0.0690277 | 0.2101750 | 0.8336628 |

The table produces this equation:

$$\widehat{\text{Points-Per-Game}} = -3.40 + 0.629 * \text{Minutes Played} - 0.838 * I_{PowerForward} - 0.601 * I_{PointGuard} - 1.49 * I_{SmallForward} - 0.934 * I_{Sh}$$

Similarly to Table 2, we will not use the intercept, because a player cannot score negative points or score

while playing zero minutes. The value of R-squared for this table is 0.7205. This indicates that 72.05% of the variability in points-per-game is explained by the model, using minutes-per-game and position as explanatory variables.

In this case, an interaction term is not necessary for a few reasons. First, the difference between the R-squared value of our first coefficients model and the R-squared value of our second coefficients is far from significant enough to indicate that there is a need for an interaction term. Second, the NBA is an organization that often cannot be defined solely by numbers on a sheet. An interaction would imply that a player's minutes-per-game depends on their position. However, this is not the case; the NBA has grown to adjust, and teams have gone along with it. One example of this is teams who play "small ball" and place several shooters and a forward on the floor, instead of the traditional five-position lineup. Another example of defying the standard is the "twin towers" strategy, in which NBA teams place two centers into the game for extra defense in the paint. These two examples, along with numerous others, indicate that position does not define minutes played, because the combination of players who play the same position has become common, leaving some positions on some teams to depend on the strategy that the coach has decided.

## Inference

In this section, we use 335 observations from the 2018-2019 NBA season to draw broader conclusions about the implications of minutes-per-game and position on points-per-game. First, we calculate a confidence interval for the expected increase in points-per-game for every additional minute played without specifying position. Then we calculate a confidence interval for the expected increase in points-per-game for every additional minute played by a center, then a shooting guard, and finally a point guard, in order to draw multiple comparisons.

The general form for the regression equation is

$$\widehat{\text{Points-Per-Game}} = b_0 + b_1 * \text{Minutes Played} + b_2 * I_{PowerForward} + b_3 * I_{PointGuard} + b_4 * I_{SmallForward} + b_5 * I_{ShootingGuard}$$

The expected change in points-per-game for a center is represented by [b_1]. We use bootstrapping to calculate a 95% confidence interval for this quantity, as it pertains to all players. Figure 4 displays the bootstrap distribution and the 95% bootstrap percentile confidence interval. We are 95% confident that points-per-game will increase between 0.61 and 0.73 points-per-game, for each additional minute played, by an NBA center.

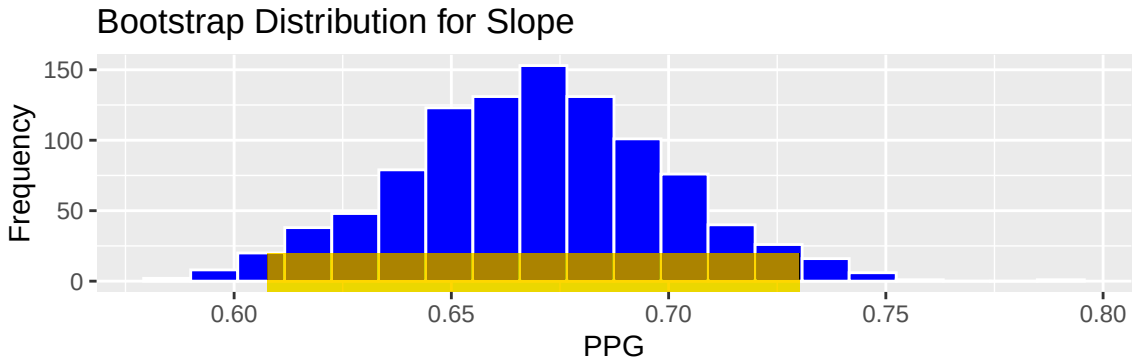


Figure 4: Bootstrap Distribution for Points-Per-Game Increase per Additional Minute Played for Centers

Next, we plot a 95% confidence interval for centers who play 25 minutes-per-game, which is right around the league average for NBA players during this season.

Estimated regression equation:

$$\widehat{\text{Points-Per-Game}}(\text{Center}) = -4.30 + 0.672 * 25$$

Figure 5 gives us a bootstrap distribution for the expected points-per-game increase of a center playing 25 mpg.

We are 95% confident that a center's points-per-game while playing 25 minutes-per-game will be between 11.74 and 13.23 PPG.

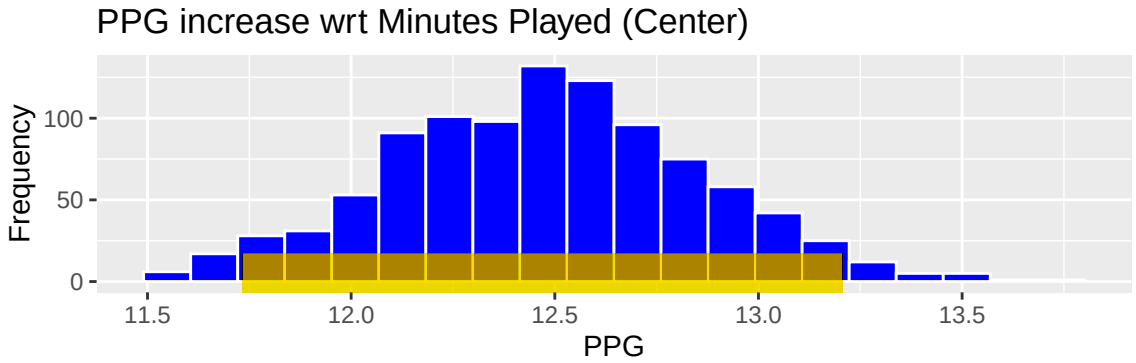


Figure 5: Bootstrap Distribution for Points-Per-Game for 25 MPG Center

Next, we plot a bootstrap distribution for the additional number of points-per-game scored with minutes-per-game increase, but this time, for a shooting guard who plays 25 minutes-per-game. The expected increase in points per game is given by the equation

$$\widehat{\text{Points-Per-Game}}(\text{Shooting Guard}) = -4.30 + 0.672 * 25 - 0.934 * I_{ShootingGuard}$$

Figure 6 gives a 95% bootstrap percentile confidence interval for the expected points-per-game of a shooting guard playing 25 MPG.

We are 95% confident that a shooting guard who plays 25 minutes-per-game will score between 10.9 and 12.2 points-per-game.

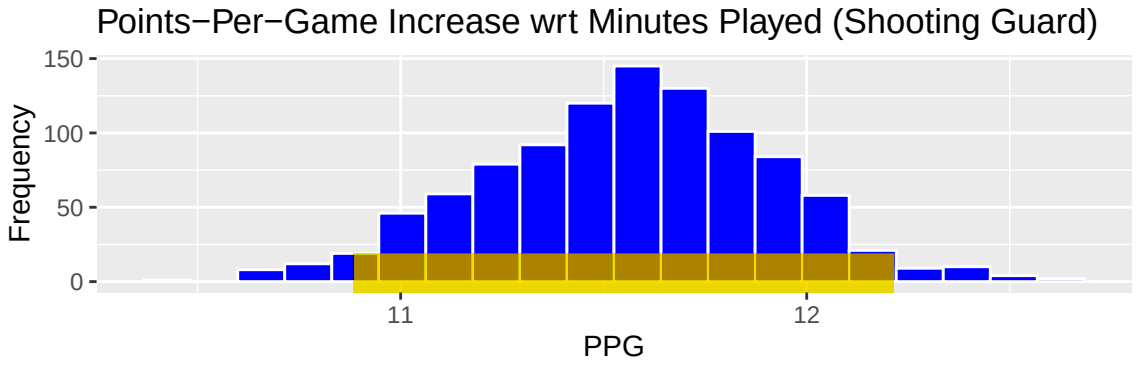


Figure 6: Bootstrap Distribution for Points-Per-Game Increase for Shooting Guard playing 25 MPG

Finally, to compare one last time, we plot another bootstrap distribution, this time for point guards playing 25 minutes-per-game. The expected points-per-game increase is given by the equation

$$\widehat{\text{Points-Per-Game}}(\text{Point Guard}) = -4.30 + 0.672 * 25 - 0.601 * I_{PointGuard}$$

Figure 7 gives a 95% bootstrap percentile confidence interval for the expected points-per-game increase for a point guard.

We are 95% confident that a point guard who plays 25 mpg will score between 10.93 and 12.90 points-per-game.

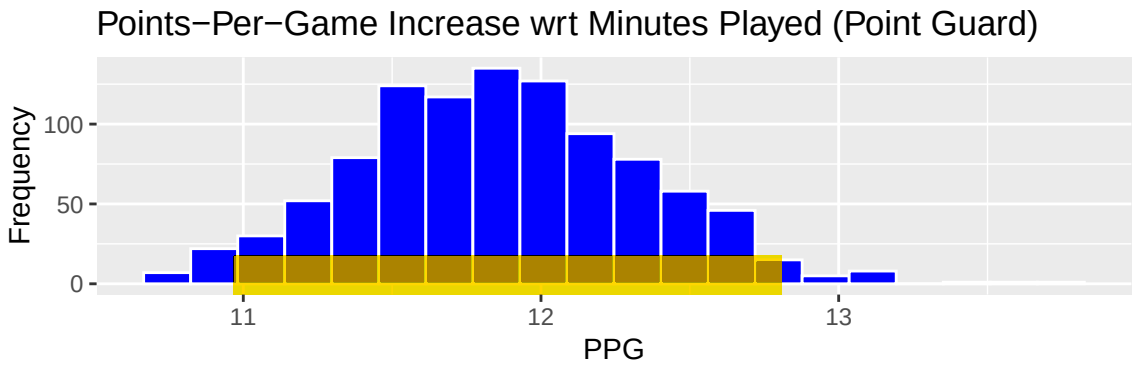


Figure 7: Bootstrap Distribution for Points Per Game for Point Guard playing 25 MPG

## Discussion and Conclusions

We have not found evidence that one position remains superior to others in terms of points-per-game. Our earlier summary tables charted that the difference between the highest points-per-game (shooting guard) and lowest points-per-game (small forward) was only 1.16, which is not a significant margin in basketball, as it does not equate to even one 2-point field goal. Our bootstrapping for three different positions playing 25 minutes-per-game also did not yield a significant margin between the highest and lowest average, suggesting that position does not determine points-per-game.

We have found evidence that minutes-per-game does have a direct effect on points-per-game. Our scatterplot demonstrated a somewhat strong linear relationship, and our regression equation shows the same, when comparing the different numbers that we can plug into the equation (for example, comparing a player who plays 15 MPG to a player who plays 25 MPG). Our bootstrapping for minutes-per-game increase and points-per-game, regardless of position, allows us to be 95% confident that a player's points-per-game will increase with their minutes played increasing. This makes sense, as the more time an NBA player spends on the court, the more they will get the ball in a scoring position. As NBA players' playstyle does not follow a script, there will always be players who are outliers for this conclusion, but eliminating said outliers allows us to come to this conclusion.

There are not signs of interaction between minutes-per-game and position played. This is likely due to the style of NBA play that the individual team has adopted, leaving the traditional sense of playing five different positions in the dust. The difference in R-squared values between our regression model and our interaction model was not significant enough to consider an interaction between these two explanatory variables.

There are several limitations that we should consider when interpreting this data. First, the data from this dataset is only from one NBA season. It is unclear as to whether a dataset from another year around this time would yield a different result (as a fan, I know that several superstar players were injured during this year, which could have skewed the data slightly). In relation to this, since we only tracked 1 year of a player's career, we cannot account for the dozens of outside factors that a player experiences through their career. In addition to injuries, one must also consider player fit, off-years, and even where the player is in their contract; oftentimes, players who are playing in the final year of their contract and are looking to sign another will play harder in order to get more money. It is nearly impossible to measure these factors when dealing with only one NBA season, but we must keep them in mind when interpreting our results.

Our findings are relevant to NBA teams that are searching for new players to improve their roster. They demonstrate that position is not important as fit to the team, and that while position should be kept in mind (coaching a team with 5 of one position is not a great idea), it should not be the primary thought process behind a team's search for their next star in free agency, or even the next NBA draft. Our findings are consistent with prior research; viewing the top points-per-game averages for the last 5 years in the NBA, there is not one position who reigns supreme, but the common factor among all of the players on the list is increased playing time.

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