

# National Basketball Association Player Progression Visualization

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**Abstract**—There are many difficulties within the National Basketball Association (NBA) to visualize a player's progression throughout their NBA careers. There are massive amounts of data for each player, but no visualization for their progression from year to year. Creating a visualization for a player's progression will assist coaches, general managers, and other parties in finding a player's worth and comparing their progression with other players. A player progression visualization will ultimately help NBA teams make correct choices in investing in their current players, signing free agents, or trading for better players.

## 1 INTRODUCTION

The NBA contractors and managers are constantly looking for better ways to find the best players for their team. There is currently a number of places that carry data on player's statistics for every year they have been in the NBA, but no visualization on how much a player has progressed from year to year. It is not easy to compare the wall of numbers presented by these databases. Using a bar graph a player's progression can easily be seen in points per game (PPG), rebounds per game (RPG), field goal percentage, player efficiency rating (PER), and many more stats from one year to the next. Viewing a visualization of a player's progression will make it easier for coaches and general managers to determine which players are progressing and which are not. Additionally, this visualization would help determine if a player should be heavily invested in or dropped from the team's roster depending on what the team is currently looking for.

This visualization project is primarily focused on the NBA and improving a team. This would be beneficial for any NBA team as improving their team and becoming a top team in the association will attract more viewers and fans. Additionally, this visualization is not exclusive to the NBA, but it can be applied to all sports as each sport has huge amounts of data for every player. For example, an NHL player's progress can be graphed, such as shooting percentage, total shot attempts, and etc. The only difference is that the statistics differ between every sport.

## 2 RELATED WORK

Data from NBA players has been compiled many times before. There are many databases where player statistics can be gathered and looked at.

An article by Benjamin Wendorf displays a comparison between 4 players, illustrating their percent of team shots over one season (1987-88). Unlike our visualization, this visualization compares multiple players to each other on one graph. This visualization also only displays percent of team shots over one season which allows for better visualization over single games during a NHL season. A line graph is used in order to better display each players measurement over the season. As Wendorf states in his article, this graph compares well-known players to lesser-known players to visualize their work load on their team. Mario Lemieux can clearly be seen to have taken a lot of shots over the season emphasizing his importance on the team during the 87-88 NHL season.

When creating our visualization of NBA player progression, we decided to use multiple seasons instead of game to game progression. Like Wendorf, we wanted to measure a stat for players over a given time period. Unlike Wendorf however, we chose to do multiple stats on separate graphs and only display one player at a time to emphasize player progression as an individual instead of a comparison. A major difference we also chose to do was use a bar graph instead of a line graph like Wendorf. A line graph really would actually display player

progression better but we wanted to display colors as well. That is one big advantage in our visualization compared to Wendorf's visualization. Our colors allow any user to tell right away whether a player is doing good or bad over recent seasons. It also takes a unique approach aside from just displaying a generic line graph.

TSZ also wrote an article that visualizes world cup ice hockey performances by specific players throughout their career. Their visualization consisted of horizontal bar graphs that displayed each average statistic for each player in a different color. Here, you can clearly see which player has a higher average such as goals per game than another player. Colors in this visualization represent different players. TSZ also included vertical bars to represent different performances for goaltenders in world cup ice hockey. These have two graphs in one displaying goals against and average savings percent. This visualization directly correlates a negative stat and positive stat towards certain players to see which country has the most efficient goaltender.

Aside from horizontal bar graphs, we implemented many differences in our visualization. For one, our visualization visualized individual player progression meaning only one player was shown at a time. Unlike TSZ's colors representing different players, our colors represented drops or increases in performance between seasons of an individual player. Both of these color methods are good for their own cases. Differentiating players by color is great if you are comparing players. In our case, we are visualizing player progression meaning our colors should have something to do with drops or increases in stats. Like us, TSZ took full advantage of displaying significant colors in a bar graph. Using a line graph, colors cannot be conveyed as well but do display the change or difference in statistics better for both visualizations.

The vertical graphs to chart goaltenders performance is quite different from our visualization. This graph uses red to display the bad stat (goals against average) and blue for the good stat (average saving percent). In a way, this color scheme is more similar to ours in which one color represents poor performance while another represents a good performance. This visualization also only compares different specific goaltenders, not their progression from one world cup performance to another.

Another article from the Journal of Strength and Conditioning Research also conducted research and provided visualization comparing a starter and bench player's performance from the beginning to the end of the season. Instead of focusing on the statistics for each player, they were focused on tracking performance characteristics such as vertical jump power, fatigue, focus, and alertness. They visualized their data with a simple bar graph and a line graph, which can be seen in figure 3. At first glance at their visualization, it can be a bit confusing to understand what is being displayed. The bar and line graph displays two players, starter and bench player, that have different colors. Additionally, the x-axis in the bar graph is not labeled and is unclear what the numbers denote and the same with the line graph but for its y-axis.

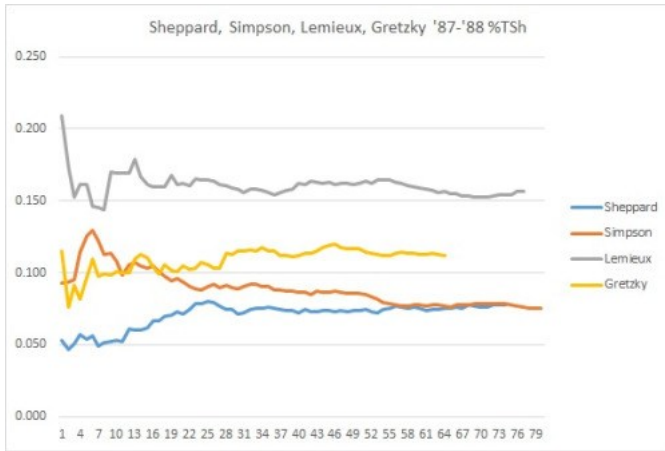


Fig. 1. Players percentage of team shots in season. Image is from [4].

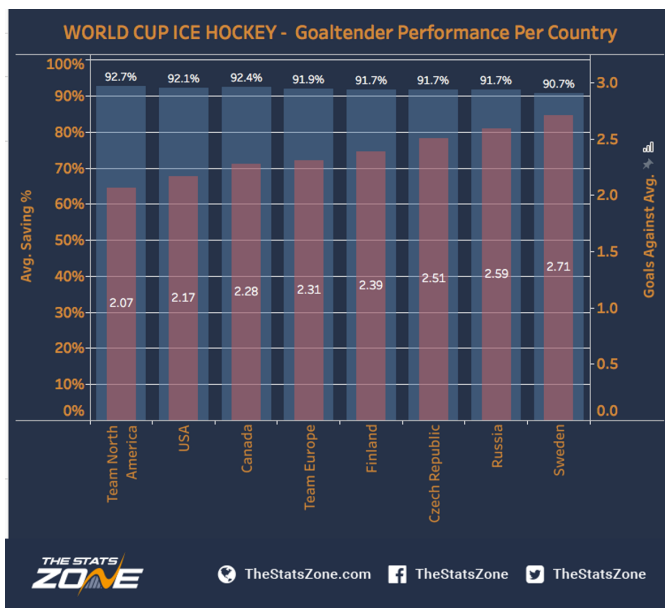


Fig. 2. Goaltender performance visualized for each country. Image provided from [1].

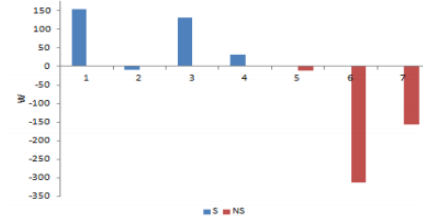
By taking these into consideration, our visualization will be much easier to read at a first glance by choosing an easy to read color scheme and labeled axes.

### 3 METHOD

Our visualization is going to be in the form of row 2D bar graphs of individual players averages per game over each year they were in the NBA. As not all a player's statistics are crucially important, we decided to obtain and display only the most crucial. What we considered to be crucial statistics included points, assists, rebounds, field goal percentage, turnovers, free throw percentage, blocks, three point percentage, player efficiency rating, true shooting percentage per game, and the games played that year. We stored all the data gathered from sites such as Basketball References into a database which we were able to pull into our website. We then used a JavaScript plugin called fusion charts that allowed us to display this data visually in bar graphs.

The user will be able to compare not only statistics but also the rate at which the players are improving. By utilizing a color scheme in PHP, each bar in the graph is colored based on its value compared to the value of previous years. A decrease will be denoted by a color gradient between red and yellow. This means that a decrease in performance

**Table 1. Individual player  $\Delta$  scores in Vertical Jump Power from beginning to end of season.**



**Table 1. Pre to Post Season Changes in Subjective Measures of Energy, Fatigue, Focus and Alertness.**

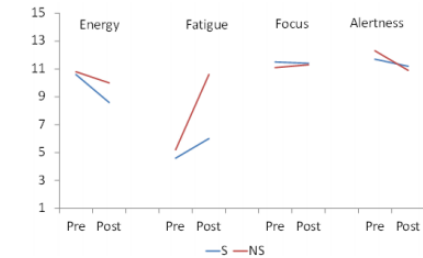


Fig. 3. Gonzalez's visualization of a player's performance characteristics. Image provided from [3].

is colored anywhere between a shade of red, orange, or yellow. An increase in performance will be denoted by a shade of green. If the player neither increases nor decreases in performance, the bar will be colored yellow to show this. Now at first glance, a user is able to see a graph and quickly understand if a player's performance is increasing, decreasing, or static by simply viewing the colors of each bar. An example of our visualization can be seen in figure 4.

### 4 DESIGN CHOICE

We decided to utilize a simple 2D bar graph as it is simple and the most practical for this problem as a player's progress is being visualized. Each bar would indicate a new year and have a new value associated with it. As bars in bar graphs are generally located next to each other, it is easy to see a decrease or increase of a bar's height or length.

If we were to use a line graph, such as the one in figure 1, or a pie chart it would not be practical for this problem. A line graph could be utilized, where a single line would show a player's progression between years, but there would not be a use of a color scheme. We thought that by implementing a color scheme, it would help the user be able to read and understand the visualization easier. Additionally, a pie chart would not fit this model at all as pie charts are not used to show progress, but rather comparing parts of a whole entity. A line graph or pie chart could cause more confusion when viewing the visualization, which is why we decided to use a bar graph.

### 5 IMPLEMENTATION

To build our visualization we decided to create a database of player statistics. In graphs we compiled the data to show individual players statistics over various years. The graphs were created using a graphing tool called FusionCharts for JavaScript. PHP and MYSQL is used to pull the data from the database and plugged into FusionCharts. The PHP will store the results of the MYSQL statement into an array. The array will also contain visualization settings for the bar graph, which will eventually be encoded to json and handed to a FusionChart script that will generate the bar graph based on the provided encoded json data. By utilizing the bar graph in FusionCharts, a player's progression can be seen starting from their earlier years in the top row, to their more recent years in the bottom row. This 2D row bar graph can be seen in figure 3.

The bars on the graph get higher and lower depending on the player's average statistic each year. The bars are also colored depending on

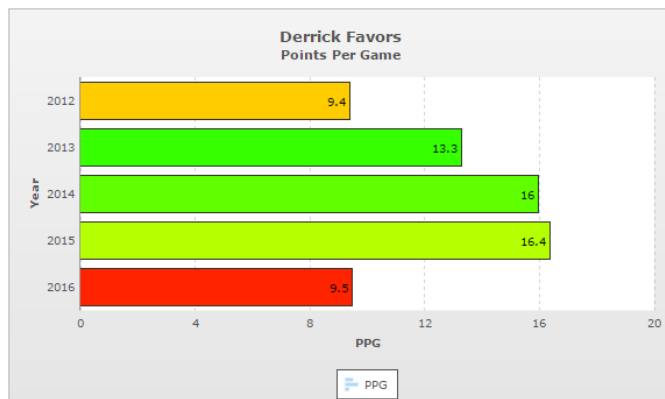


Fig. 4. A 2D row bar graph for an NBA player.

the change in performance between the current year and the last year. Increases in performance are indicated with some shade of green. Decreases in performance are indicated with a shade of orange and red. If the player's statistics do not change at all from the previous year to the next year, the color yellow is used to indicate a neutral state where a player's performance does not improve or diminish.

In some cases for NBA statistics, a decrease can be beneficial. For example, one of the statistics that is displayed is the amount of turnovers committed by a player per game and this statistics would be beneficial if it were to decrease. In this case the coloring of the bar graph would be flipped, where a decrease of turnovers is colored a shade of green and an increase in the amount of turnovers is colored a shade of red and orange. The color scheme makes it easy to tell whether or not the player is progressing or not.

Regarding the user interface, the user will be able to select the desired team and player via a drop-down menu on the main page to view the progression of that player in various areas such as rebounding, assists, or total points per game. When the Teams (name of drop down menu) drop down menu is changed (to a NBA team), an Ajax call is made that updates the second drop-down menu, Select Player. This update is run by a SQL SELECT query. The SELECT query will select all the players, based on what the user set the team to be in the first drop down menu, and echo them to the Teams drop down menu. This is done in a while loop because multiple players exist on each team. All the option values for each player in that team will now be a part of the Select Player drop-down menu. The SELECT query looks for all matches between the Team table primary key and the Player table foreign key to select the proper records. When the user updates the Teams drop down menu again and presses the submit button, an Ajax call will be run again for that new team returning new players on the team. The default state for the Teams drop down menu is simply All Teams. This calls its own Ajax method to display all players in the database regardless of what team they are on. For security reasons, prepare statements are used when executing all queries. This is implemented to prevent injection attacks. Without prepare statements, malicious users can send whatever data they want through all the Ajax calls for the drop-down menus. This can alter all the queries giving them access to all the databases used on the web application. With this, malicious users can steal, delete, and add data to the database without permission.

The user of this visualization tool is able to select the team and player from the drop down mentioned before. This can be seen in figure 5 in the top left corner of the web page. As there a lot of statistics being visualized, the bar graphs are organized into a grid so that the separate graphs are easier to view. Compared to scrolling down a long web page of graphs, organizing them into graphs also makes them more user friendly.

## 6 RESULTS

The graph choice, color scheme, and axis labeling seemed to be the best choice. The user interface of our visualization tool can be seen

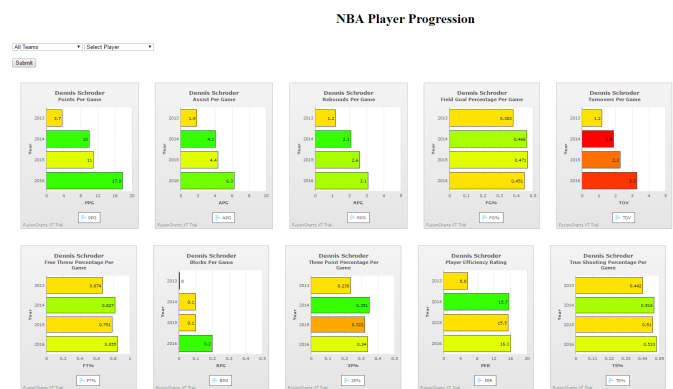


Fig. 5. The user interface of our visualization

in figure 5. Although the figure may be hard too see, it can still be seen that a player is improving their performance in some categories and decreasing in other categories. In this case in figure 5, the bar graph seems to be increasing in value, but the bar is colored red. This is happening because the category is the amount of turnovers per game. As mentioned before, an increase in this statistic is a detriment to the team, whereas a decrease is a benefit.

In the top left corner of the web page in figure 5, there are two drop down menus that allow the user to select a team and a player. If no team is selected, the player drop down menu will include all the players in the database. Once the user selects a player and hits the submit button, all the graphs will update to the correct values for that particular player.

## 7 CONCLUSION AND FUTURE WORK

Future work includes more important statistics for a player and a better user interface. There may be times when an NBA contractor or manager will only want to look at one graph rather than a whole grid of graphs. A third drop-down menu could be implemented to display certain stats that the user wants. In addition to this, the drop-down menu would contain checkable categories so the user could examine all the specific visualizations desired for the player. We would also like to make it easier to not only see the progression of individual players but also how those progressions compare to other players. A declining graph might show decreases in a players performance but not how that compares to other players. Additionally the user interface can be improved by removing the submit button and having the graphs automatically update once a player is selected in the drop down menu. This can be done by sending the data once the drop-down menu is updated instead of an on click method for the submit button. Lastly, adding more statistics would greatly benefit the player progression visualization. This could include defensive rating, offensive rating, and effective field goal percentage.

## REFERENCES

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