

A background image showing two NBA players in action. On the left, a player in a blue Oklahoma City Thunder jersey is looking towards the right. On the right, a player in a white Los Angeles Clippers jersey is looking towards the left. The image is partially obscured by a large orange diagonal shape on the right side.

THE 8 TYPES OF NBA PLAYERS

USING MACHINE LEARNING TO CLASSIFY NBA PLAYERS FROM 2014-2017

1. INTRODUCTION

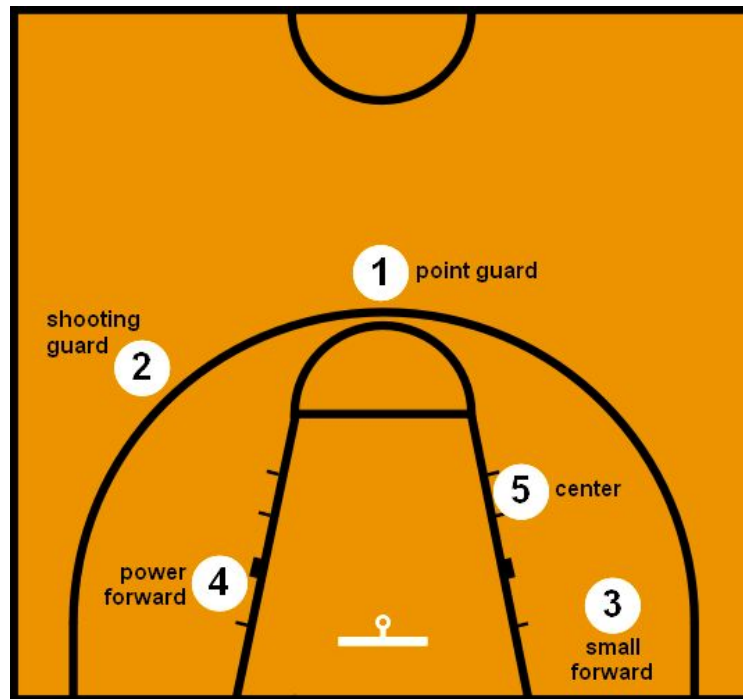
A thick, dark blue horizontal bar that spans the width of the slide, starting from the left edge and ending just before the right edge. It is positioned below the title '1. INTRODUCTION'.

PROBLEM STATEMENT

The traditional five positions incorrectly oversimplify the skill sets of NBA players.

- ▶ Point Guard
- ▶ Shooting Guard
- ▶ Small Forward
- ▶ Power Forward
- ▶ Center

Coaches and scouts have already coined terms such as the “combo guard” or the “swingman” to describe players with in-between skills.



OBJECTIVES

Step 1

Uncover the positions that are intrinsic to today's NBA players and classify players with a positions that best encapsulates their skill sets.

Step 2

Find the best winning combinations in basketball given a player's type of play.



2. METHODS

Data Acquisition with Selenium

Per-100 Possessions

- Statistics weighted by 100 possessions
- Example: 3-Pointers per 100 Possessions

Per 100 Poss Share & more ▼ Glossary

Season	Age	Tm	Lg	Pos	G	GS	MP	FG	FGA	FG%	3P	3PA	3P%	2P	2PA	2P%	FT	FTA	FT%	ORB	DRB	TRB	AST	STL	BLK	TOV	PF	PTS	Ortg	Drtg
2008-09	20	OKC	NBA	PG	82	65	2668	8.4	21.0	.398	0.7	2.5	.271	7.7	18.6	.415	6.7	8.2	.815	3.4	4.2	7.7	8.4	2.1	0.3	5.3	3.7	24.1	99	111
2009-10	21	OKC	NBA	PG	82	82	2813	8.9	21.3	.418	0.4	1.9	.221	8.5	19.4	.438	6.0	7.7	.780	2.6	4.7	7.4	12.0	2.0	0.6	4.9	3.7	24.2	105	106
2010-11	22	OKC	NBA	PG	82	82	2847	11.2	25.3	.442	0.6	1.9	.330	10.5	23.4	.451	9.7	11.5	.842	2.2	4.7	6.9	12.2	2.8	0.5	5.7	3.8	32.6	110	107
2011-12	23	OKC	NBA	PG	66	66	2331	12.8	28.0	.457	1.4	4.3	.316	11.4	23.7	.482	7.5	9.1	.823	2.1	4.5	6.7	8.0	2.5	0.5	5.3	3.3	34.5	108	105
2012-13	24	OKC	NBA	PG	82	82	2861	12.1	27.6	.438	1.7	5.4	.323	10.4	22.2	.466	8.3	10.3	.800	2.0	5.7	7.7	10.9	2.6	0.4	4.9	3.4	34.2	111	103
2013-14	25	OKC	NBA	PG	46	46	1412	12.3	28.2	.437	2.4	7.6	.318	9.9	20.6	.482	8.6	10.4	.826	2.0	7.4	9.4	11.4	3.1	0.2	6.3	3.7	35.7	108	102
2014-15	26	OKC	NBA	PG	67	67	2302	13.7	32.0	.426	1.9	6.3	.299	11.8	25.8	.457	11.9	14.2	.835	2.7	7.9	10.6	12.5	3.0	0.3	6.4	4.0	41.1	111	103
2015-16	27	OKC	NBA	PG	80	80	2750	11.8	26.1	.454	1.8	6.2	.296	10.0	19.9	.503	8.4	10.3	.812	2.6	8.7	11.3	15.1	2.9	0.4	6.2	3.6	33.9	115	103
2016-17	28	OKC	NBA	PG	60	60	2085	14.2	33.8	.422	3.1	9.1	.342	11.1	24.6	.451	12.4	14.9	.833	2.5	12.5	15.0	14.5	2.3	0.5	7.9	3.3	44.0	110	104
Career		NBA			647	630	22069	11.6	26.7	.433	1.5	4.8	.310	10.1	21.9	.460	8.7	10.6	.820	2.5	6.5	9.0	11.7	2.6	0.4	5.8	3.6	33.3	109	105

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Advanced Metrics

- In-depth on-court percentages
- Example: True Shooting Percentage (TS%)

Advanced Share & more ▼ Glossary

Season	Age	Tm	Lg	Pos	G	MP	PER	TS%	3PAr	FT%	ORB%	DRB%	TRB%	AST%	STL%	BLK%	TOV%	USG%	OWS	DWS	WS	WS/48	OBPM	DBPM	BPM	VORP
2008-09	20	OKC	NBA	PG	82	2668	15.2	.489	.118	.391	7.6	9.7	8.6	27.5	2.1	0.4	17.6	25.8	-0.1	2.0	1.9	.035	0.1	-0.2	-0.1	1.3
2009-10	21	OKC	NBA	PG	82	2813	17.8	.491	.090	.364	6.0	10.3	8.2	38.6	2.0	0.9	16.6	25.7	2.7	3.4	6.1	.105	1.4	0.6	2.1	2.9
2010-11	22	OKC	NBA	PG	82	2847	23.6	.538	.074	.454	5.2	10.3	7.8	42.7	2.8	0.8	15.9	31.6	6.3	3.1	9.4	.159	4.4	0.5	5.0	5.0
2011-12	23	OKC	NBA	PG	66	2331	22.9	.538	.155	.326	5.0	9.4	7.4	29.8	2.5	0.7	14.2	32.7	5.5	2.4	7.9	.163	3.7	-0.5	3.2	3.0
2012-13	24	OKC	NBA	PG	82	2861	23.9	.532	.195	.375	4.8	11.8	8.6	38.4	2.6	0.6	13.2	32.8	7.0	3.9	11.6	.195	4.7	0.3	5.0	5.1
2013-14	25	OKC	NBA	PG	46	1412	24.7	.545	.271	.370	4.6	15.9	10.5	40.2	3.1	0.4	16.1	34.4	3.7	2.3	5.2	.178	5.2	1.2	6.4	3.0
2014-15	26	OKC	NBA	PG	67	2302	29.1	.536	.196	.445	5.9	16.7	11.4	47.0	3.0	0.5	14.3	38.4	7.5	3.2	10.6	.222	8.8	2.2	11.0	7.6
2015-16	27	OKC	NBA	PG	80	2750	27.6	.554	.236	.397	6.1	18.1	12.4	49.6	2.9	0.6	16.8	31.6	10.0	4.0	14.0	.245	7.6	2.4	10.0	8.3
2016-17	28	OKC	NBA	PG	60	2085	29.5	.546	.271	.441	5.8	27.8	16.9	56.5	2.3	0.8	16.3	41.9	5.4	3.4	8.7	.201	9.8	4.5	14.3	8.5
Career		NBA			647	22069	23.5	.531	.178	.399	5.7	14.0	10.0	40.9	2.6	0.6	15.6	32.3	48.0	27.7	75.7	.185	4.9	1.1	6.0	44.7

Shot location data available for the 2008-09 through 2016-17 seasons.

Shot location data is unofficial. Minor differences with official season totals may exist.

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NOTE: The data for 2016-2017 was collected up until the NBA All-Star Break. The minimum threshold for analysis was at least 40 games played.

Shooting Metrics

- Shooting percentages by distance
- Example: Field Goal% from 0-3 feet away

Web Scraping in Action

Movavi Screen Capture Studio 3 Capture Effects Window Help

A.J. Price Stats | Basketball-Reference.com

file:///Users/alexcheng/Downloads/us.sitesucker.mac.sitesucker/www.basketball-reference.com/players/p/priceaj01.html

Chrome is being controlled by automated test software.

A.J. Price Overview Game Logs Splits Shooting Lineups On/Off More Back to top

Per 36 Minutes Share & more Glossary Hide Partial Rows

Season	Age	Team	Lg	Pos	G	GS	MP	FG	FG%	3P	3PA	3P%	2P	2PA	2P%	FT	FTA	FT%	ORB	DRB	TRB	AST	STL	BLK	TOV	PF	PTS	
2009-10	23	IND	NBA	PG	56	2	865	6.0	14.7	.410	2.5	7.2	.345	3.5	7.5	.472	2.5	3.1	.800	0.5	3.2	3.7	4.4	1.5	0.1	2.5	2.2	17.1
2010-11	24	IND	NBA	PG	50	0	795	5.2	14.5	.356	1.9	6.7	.275	3.3	7.7	.427	2.4	3.7	.667	0.7	2.5	3.3	5.0	1.3	0.0	2.4	2.8	14.6
2011-12	25	IND	NBA	PG	44	1	568	3.7	11.0	.339	1.6	5.6	.295	2.1	5.5	.364	1.8	2.2	.800	0.8	3.0	3.9	5.5	1.3	0.1	2.0	1.9	10.9
2012-13	26	WAS	NBA	PG	57	22	1278	4.5	11.6	.390	2.0	5.6	.350	2.6	6.0	.427	1.4	1.7	.790	0.6	2.6	3.2	5.8	0.9	0.1	1.8	2.1	12.4
2013-14	27	MIN	NBA	SG	28	0	99	6.9	16.7	.413	2.2	8.0	.273	4.7	8.7	.542	0.0	0.7	.000	0.4	3.3	3.6	4.7	0.4	0.0	2.5	1.8	16.0
2014-15	28	TOT	NBA	PG	26	0	324	5.7	15.2	.372	1.7	6.3	.263	4.0	8.9	.450	1.8	2.7	.667	0.7	2.9	3.6	5.1	0.8	0.0	1.6	1.7	14.8
2014-15	28	IND	NBA	PG	10	0	193	7.3	16.6	.438	2.8	7.3	.385	4.5	9.3	.480	2.2	3.4	.667	0.4	2.2	2.6	5.0	0.7	0.0	1.9	1.7	19.6
2014-15	28	CLE	NBA	PG	11	0	87	3.7	14.1	.265	0.0	4.6	.000	3.7	9.5	.391	1.7	2.5	.667	1.7	4.6	6.2	5.4	1.2	0.0	1.2	0.4	9.1
2014-15	28	PHO	NBA	PG	5	0	44	2.5	11.5	.214	0.0	5.7	.000	2.5	5.7	.429	0.0	0.0		0.0	2.5	2.5	4.9	0.0	0.0	0.8	4.1	4.9
Career			NBA		261	25	3929	5.0	13.2	.380	2.0	6.3	.316	3.0	6.9	.439	1.9	2.6	.742	0.6	2.8	3.5	5.2	1.1	0.1	2.1	2.2	14.0
4 seasons		IND	NBA		160	3	2421	5.3	13.9	.381	2.1	6.7	.316	3.2	7.2	.441	2.3	3.1	.737	0.6	2.9	3.5	4.9	1.3	0.1	2.3	2.3	15.0
1 season		WAS	NBA		57	22	1278	4.5	11.6	.390	2.0	5.6	.350	2.6	6.0	.427	1.4	1.7	.790	0.6	2.6	3.2	5.8	0.9	0.1	1.8	2.1	12.4
1 season		MIN	NBA		28	0	99	6.9	16.7	.413	2.2	8.0	.273	4.7	8.7	.542	0.0	0.7	.000	0.4	3.3	3.6	4.7	0.4	0.0	2.5	1.8	16.0
1 season		CLE	NBA		11	0	87	3.7	14.1	.265	0.0	4.6	.000	3.7	9.5	.391	1.7	2.5	.667	1.7	4.6	6.2	5.4	1.2	0.0	1.2	0.4	9.1
1 season		PHO	NBA		5	0	44	2.5	11.5	.214	0.0	5.7	.000	2.5	5.7	.429	0.0	0.0		0.0	2.5	2.5	4.9	0.0	0.0	0.8	4.1	4.9

Per 100 Poss Share & more Glossary Hide Partial Rows

Dimensionality Reduction with Linear Discriminant Analysis

Linear Discriminant Analysis (LDA) is a a method used in statistics and machine learning to find a linear combination of features that characterizes or separates classes of objects. Put simply, LDA attempts to find a feature subspace that maximizes class separability.

Using Bayes' Theorem for Classification

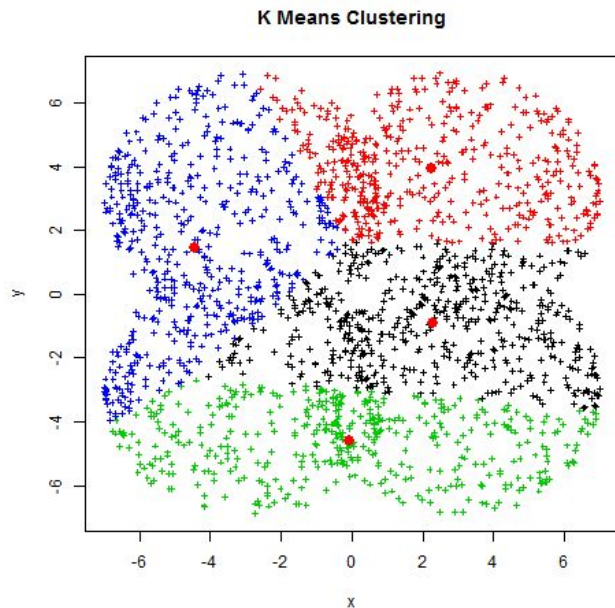
- ▶ Point Guard
- ▶ Shooting Guard
- ▶ Small Forward
- ▶ Power Forward
- ▶ Center

	Principal Component Analysis (PCA)	Linear Discriminant Analysis (LDA)
Classification	Unsupervised	Supervised
Components	2	2
Score	0.5446	0.7185

Cluster the Data with KMeans Clustering

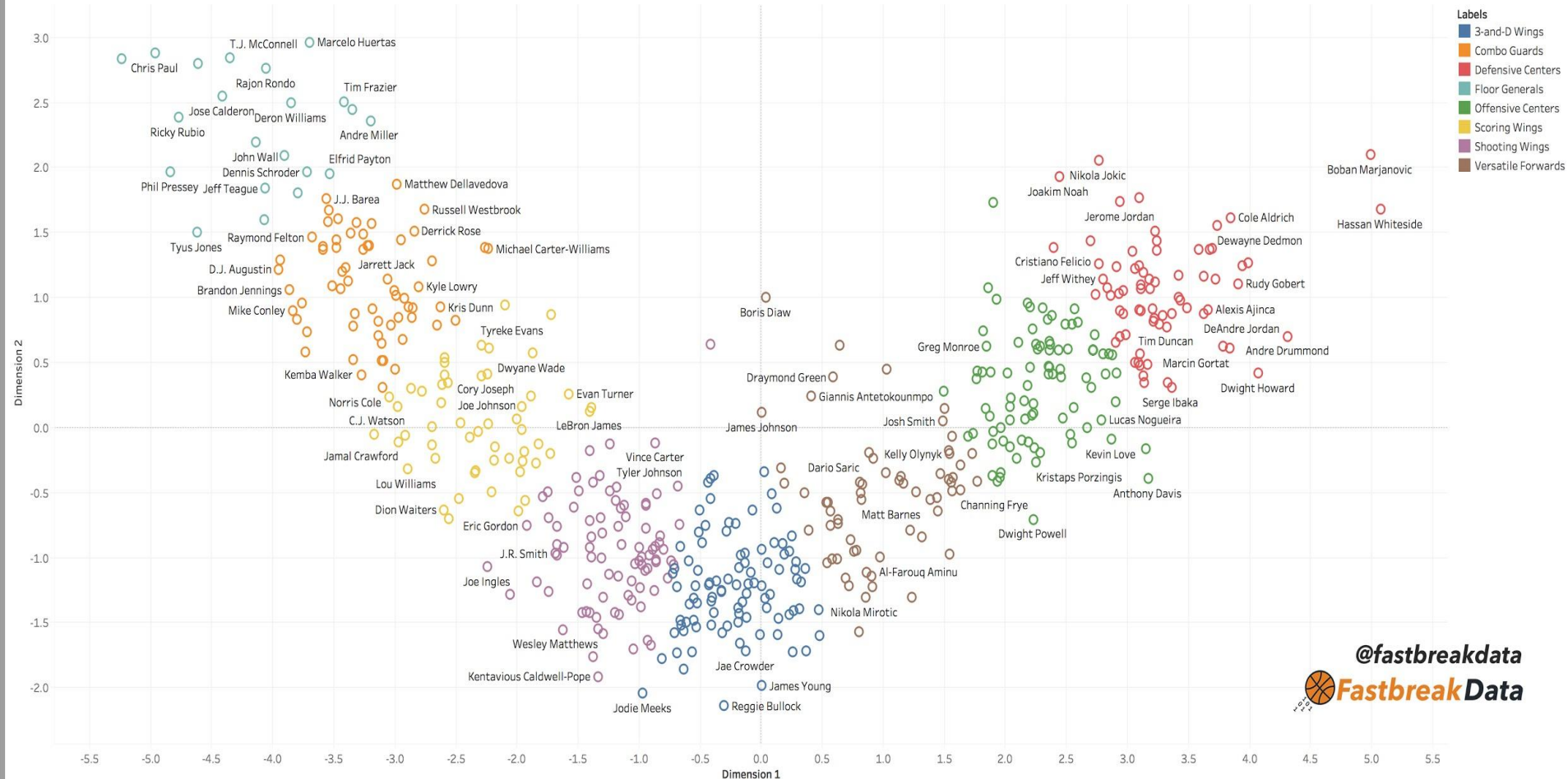
KMeans Clustering is a simple and popular clustering algorithm that finds the cluster centers that best represent certain regions of the data.

The decision to have **8 clusters** was based on the best silhouette score, which is a measure of how similar an object is to its own cluster compared to other clusters.



3. RESULTS

Classifying the Modern NBA Player (2014-2017)



FLOOR GENERALS

Responsibilities:

- ▶ Direct the flow of the offense
- ▶ Execute the coach's game plan
- ▶ Set up teammates with opportunities to score

Notable Players:

Chris Paul, John Wall, Rajon Rondo,
Ricky Rubio, Jeff Teague, Dennis
Schroder



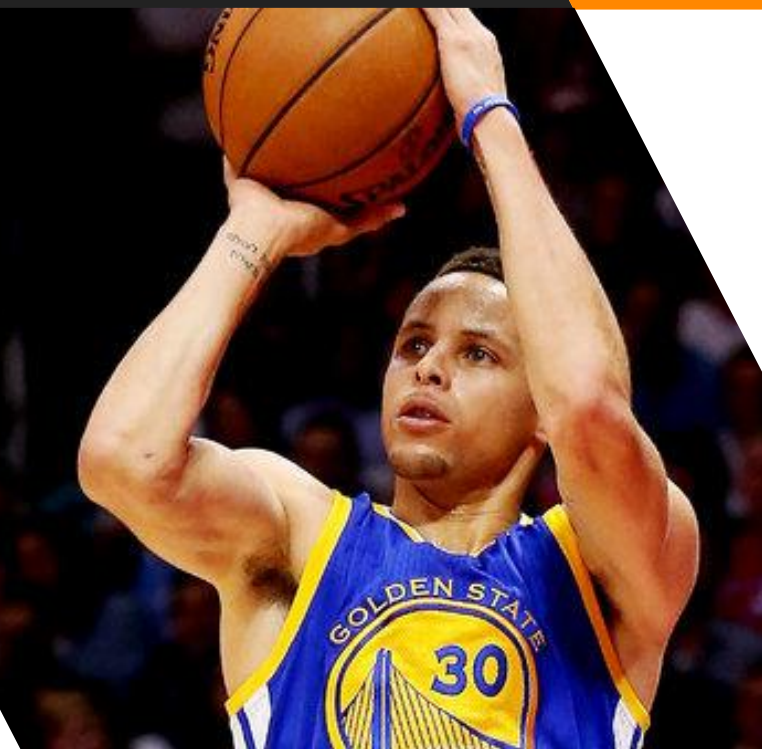
COMBO GUARDS

Responsibilities:

- ▶ Initiate the offense
- ▶ Score the ball/play off-the-ball
- ▶ Set up teammates with opportunities to score

Notable Players:

Stephen Curry, Russell Westbrook,
Kyrie Irving, Mike Conley, Tony Parker,
Damian Lillard, Jeremy Lin



OFFENSIVE WINGS

Responsibilities:

- ▶ Run the offensive game plan
- ▶ Score the ball but also set up teammates with opportunities to score

Notable Players:

LeBron James, James Harden,
Dwayne Wade, Manu Ginobili, Joe
Johnson



SHOOTING WINGS

Responsibilities:

- ▶ Score from the perimeter
- ▶ Space the floor
- ▶ Play off-the-ball

Notable Players:

Avery Bradley, J.J. Redick, Gary Harris,
Kentavious Caldwell-Pope



3-AND-D WINGS

Responsibilities:

- ▶ Defend the opponent's best wing player
- ▶ Score from the perimeter
- ▶ Space the floor

Notable Players:

Kevin Durant, Klay Thompson, Kawhi Leonard, Jae Crowder, Trevor Ariza, Nicolas Batum



VERSATILE FORWARDS

Responsibilities:

- ▶ Defend the opposing team's forwards and centers
- ▶ Have multi-faceted roles
- ▶ Space the floor

Notable Players:

Draymond Green, Dirk Nowitzki,
Giannis Antetokounmpo, Ryan
Anderson, Boris Diaw



OFFENSIVE CENTERS

Responsibilities:

- ▶ Set screens to free offense
- ▶ 2nd-chance opportunities
- ▶ Primarily score in the interior, but also space the floor

Notable Players:

Anthony Davis, Kristaps Porzingis,
Brook Lopez, Al Horford, Kevin Love,
Blake Griffin



DEFENSIVE CENTERS

Responsibilities:

- ▶ Defend the rim, prevent interior penetration
- ▶ Rebound the ball
- ▶ Score in the interior

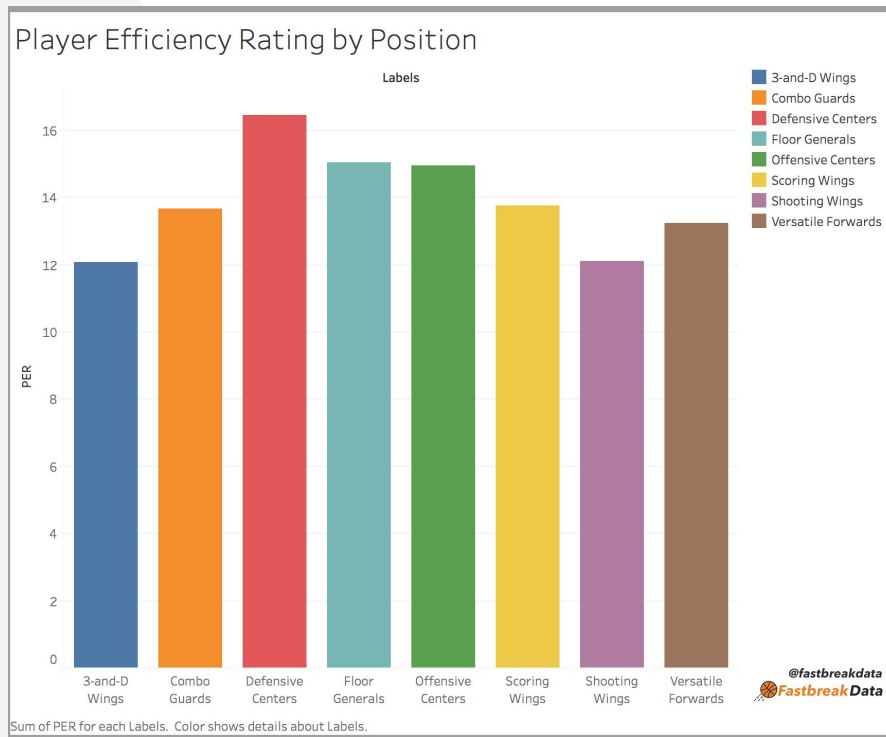
Notable Players:

DeAndre Jordan, Rudy Gobert, Hassan Whiteside, Andre Drummond



4. ANALYSIS

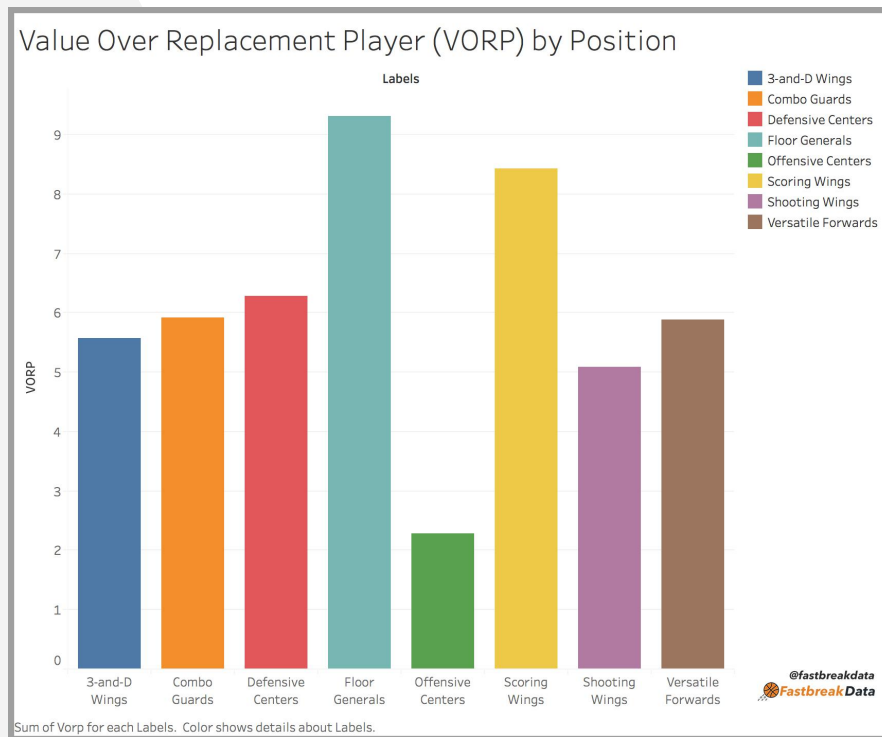
Player Efficiency Rating by Position



ESPN.com columnist John Hollinger first developed the **Player Efficiency Rating (PER)**, a metric that measures a per-minute rating. In John's words:

"The PER sums up all a player's positive accomplishments, subtracts the negative accomplishments, and returns a per-minute rating of a player's performance."

Value Over Replacement Player by Position

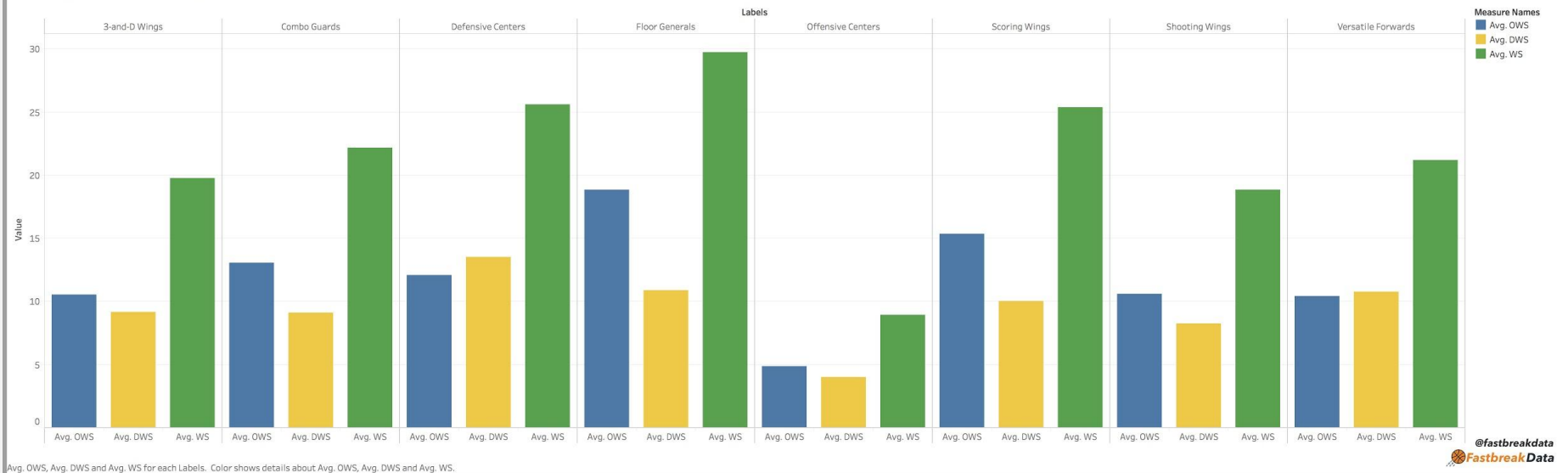


Value Over Replacement Player (VORP) demonstrates how a “replacement player” performing at a “replacement level” provides a baseline in which to compare how much a player contributes to his team’s success.

↑ Floor Generals, Scoring Wings
↓ Offensive Centers

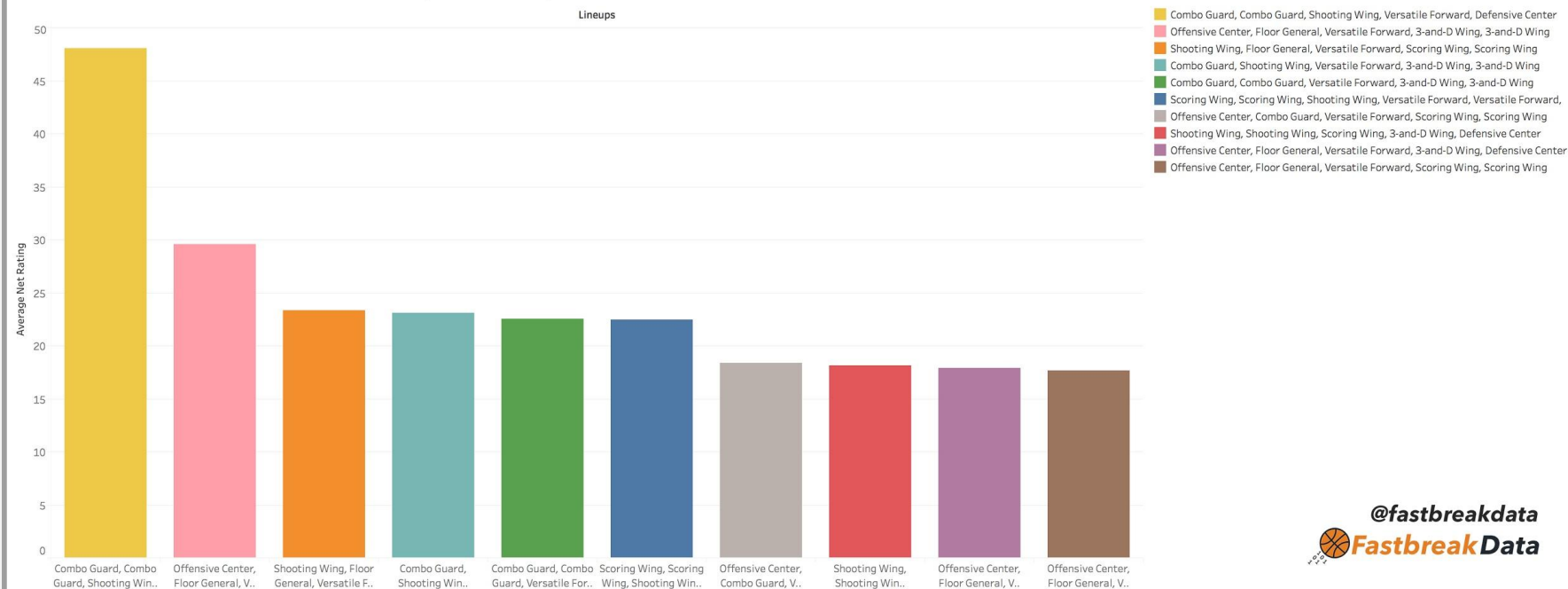
Average Win Shares by Position

Average Win Share by Position



Top Lineups

Top 10 Lineups by Average Net Rating (2014-2017)



5. WHAT'S NEXT?

FURTHER INVESTIGATION

- ▶ Understand the effectiveness of each position *w.r.t* distance
- ▶ Quantify strengths/weaknesses of each type of player
- ▶ Investigate strengths/weaknesses of lineups
- ▶ Increase the sample size!

PLAYER PROFILES



James Harden

Position: PG/SG

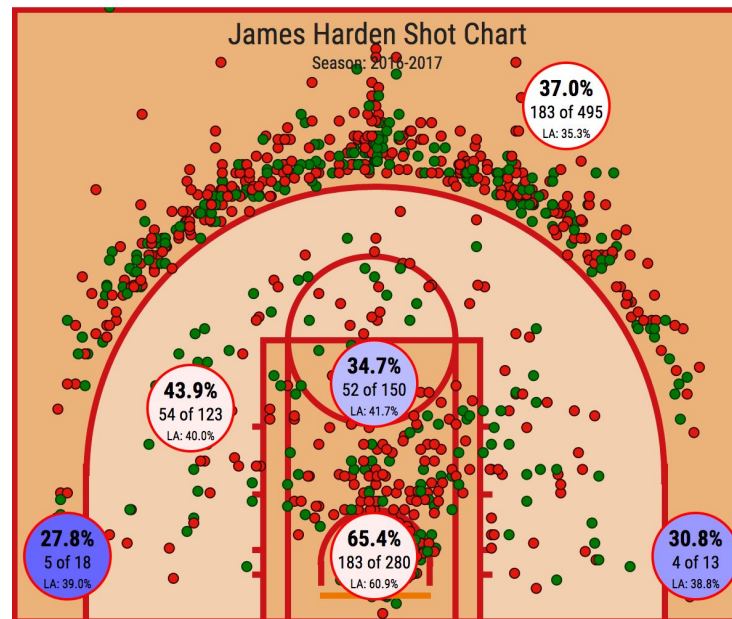
Type: Scoring Wing

Height/Weight: 6-5, 220 lbs

SUMMARY	G	PTS	TRB	AST	FG%	FG3%	FT%	eFG%
2016-17	65	29.1	7.9	11.2	44.3	35.5	85.2	52.9
Career	599	22.0	4.9	5.6	44.3	36.6	85.5	51.9

Potential Teammates:

Defensive Center, 3-and-D Wings, Shooting Wings





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