Shot Creation

Syracuse University Basketball Case Competition 2024

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Introduction

- Tasked with evaluating various types of shot creation through actions and play types
- Utilize sequencing from SIS data to predict play results and shot quality
- Determine the importance of actions, pace, and team system

Overview

Model

Sequence SIS PBP Data

Cluster

Action Types, Shot Zones

Analyze

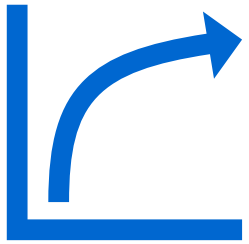
Play Results, Shot Creation

Modeling Methodology

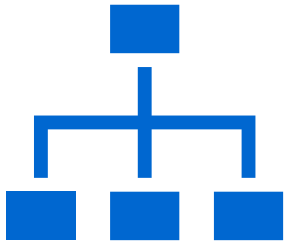
SIS Play Types

SIS Play Zones

Sequence Graph Transformation (SGT)



Principal Component Analysis (PCA)



K-Means Clustering

Step 1: SGT

What is SGT: Function used to extract patterns and find relationships within sequences

Filter for Each Unique Sequence

vs

Initial Action

Player	Play Type	Play Zone
Jarred Vanderbilt	Initiation	Deep Backcourt
Lauri Markkanen	Off-Cut	Right Midrange
Mike Conley	Closeout	Left Corner 3
Jordan Clarkson	Closeout	Mid-Left Above Break 3
Kelly Olynyk	Closeout	Right Above Break 3
Jarred Vanderbilt	Rim Gather	Right Short Mid

Q1: 7:04

Final Action

Apply SGT

SGT Zone Type Result	
(Right Above Break 3, Right Short Mid)	2.207
(Right Midrange, Right Above Break 3)	0.299
(Right Midrange, Right Short Mid)	0.110
(Right Midrange, Mid-Left Above Break 3)	0.812
(Right Midrange, Left Corner 3)	2.207
(Mid-Left Above Break 3, Right Above Break 3)	2.207
(Mid-Left Above Break 3, Right Short Mid)	0.812

Relationship Values

SGT Play Type Result	
(Initiation, Closeout)	0.407
(Initiation, Off-Cut)	2.207
(Initiation, Rim Gather)	0.040
(Closeout, Closeout)	1.742
(Closeout, Rim Gather)	1.106
(Off-Cut, Closeout)	1.106
(Off-Cut, Rim Gather)	0.110

Why SGT: Specializes in the ability to classify relationships in both short and longer sequences

Sequence 1: Initiation, Ball Screen, Closeout

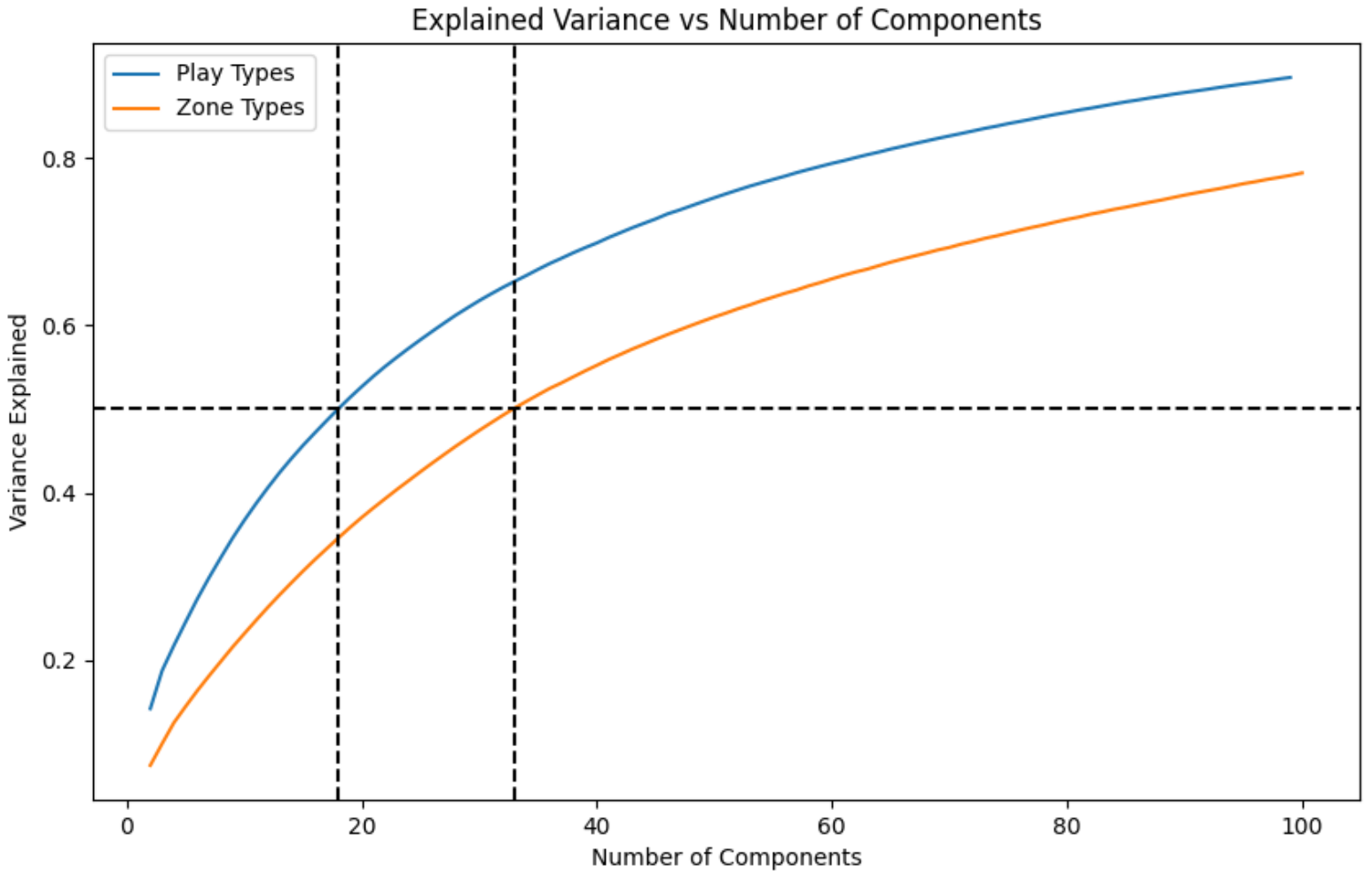
Sequence 2: Ball Screen, Closeout

Step 2: PCA

What is PCA: Used to condense important parameters and translate to Euclidian space

- Used to reduce number of parameters created from SGT
- Optimized to explain **50%** of Variability
- Number of components used for clustering:
  - Zone Type: 33
  - Play Type: 18

Post SGT Parameters	
Zone Types	Play Types
361	324

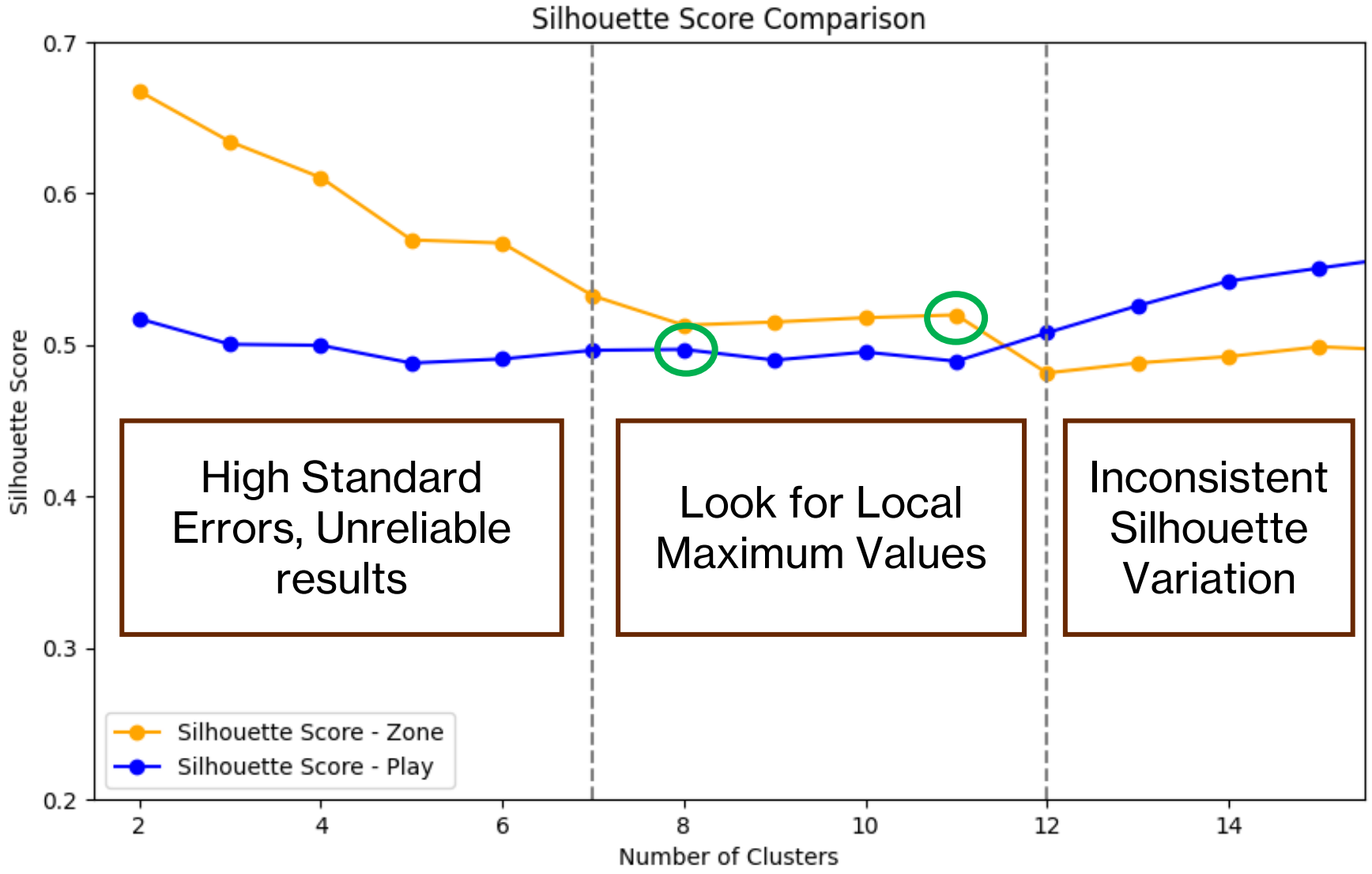


Step 3: K-Means

What is K-Means: Machine Learning method to optimize and assign clusters to data

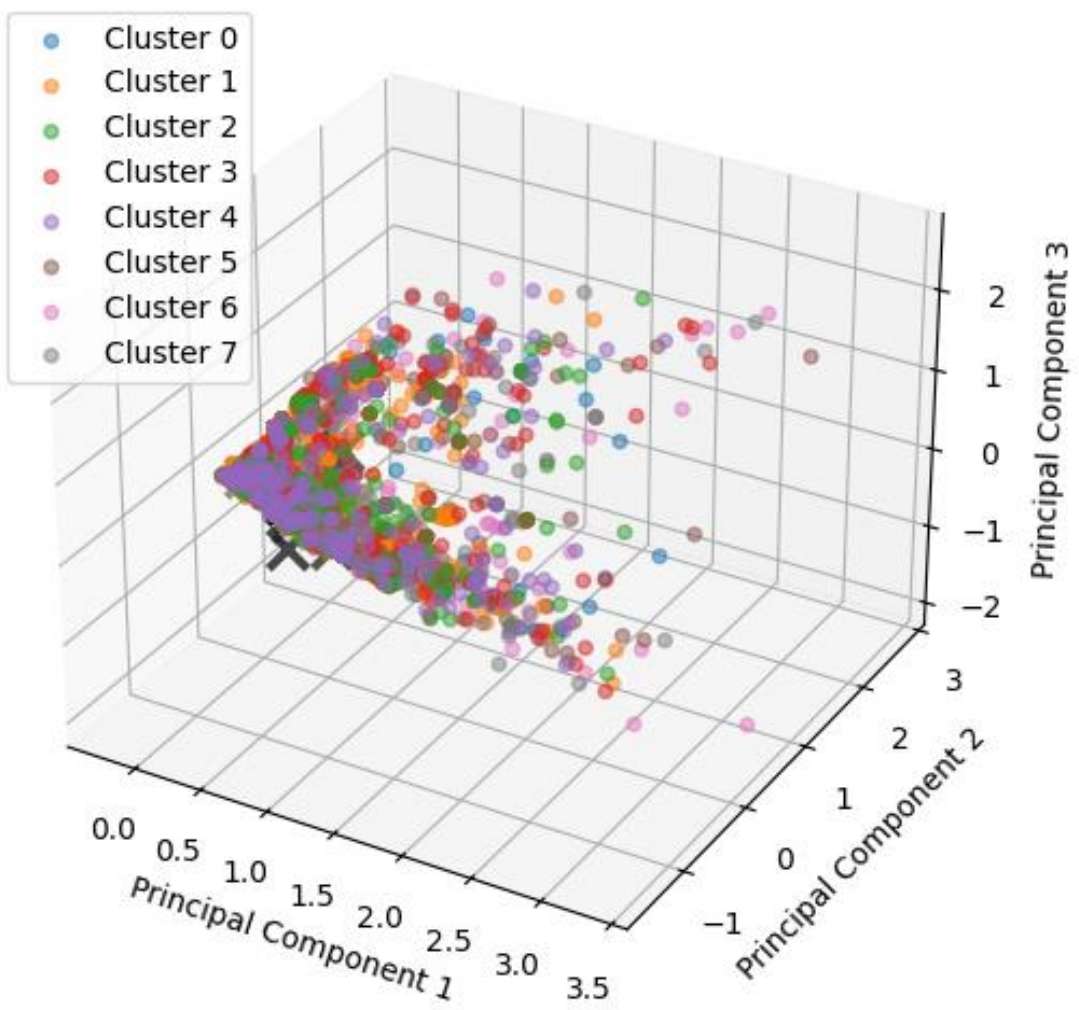
- Used **Silhouette Scores**, measuring goodness of fit, to optimize number of clusters

- Optimized Clusters:
  - Zone: 11
  - Play: 8



Cluster Plots

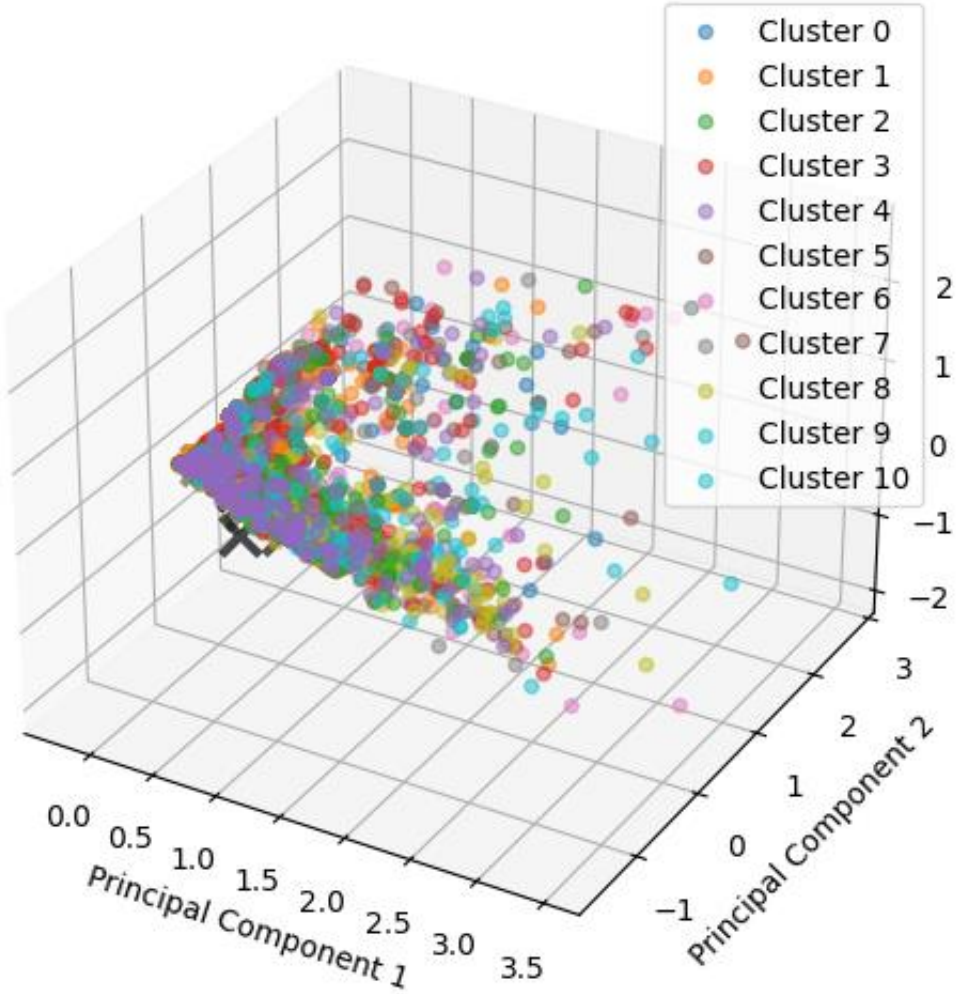
Clustered Analysis of SIS Play Types



Play Type Cluster	
1	65567
3	11185
0	11065
2	6934
4	6674
6	5118
7	4963
5	4780

Zone Type Cluster	
1	78381
3	5938
6	5477
0	4157
4	3572
7	3498
2	3349
5	3330
8	3106
9	2946
10	2532

Clustered Analysis of SIS Shot Zones



Cluster Play Types

Cluster 0	
Initial Action: Ball Screen (83.77%)	
Closeout	(1.04, 27.45%)
Ball Screen	(1.03, 54.32%)
Iso	(0.13, 2.71%)
Off-Move	(0.11, 2.05%)
Final Action: Closeout (63.90%)	

Cluster 1	
Initial Action: Ball Screen (24.13%)	
Ball Screen	(0.49, 34.60%)
DHO	(0.20, 12.34%)
Iso	(0.19, 8.05%)
Closeout	(0.17, 6.36%)
Final Action: Closeout (10.29%)	

Cluster 2	
Initial Action: Ball Screen (89.66%)	
Ball Screen	(2.08, 79.77%)
Closeout	(0.34, 5.49%)
Iso	(0.20, 3.35%)
Off-Move	(0.15, 2.45%)
Final Action: Ball Screen (33.88%)	

Cluster 3	
Initial Action: Ball Screen (44.27%)	
Closeout	(2.47, 50.09%)
Ball Screen	(0.61, 21.74%)
Initiation	(0.19, 4.24%)
Iso	(0.18, 3.44%)
Final Action: Closeout (73.24%)	

Cluster 4	
Initial Action: Ball Screen (70.29%)	
Ball Screen	(1.28, 46.36%)
Iso	(1.19, 22.36%)
Closeout	(0.81, 13.99%)
Off-Move	(0.17, 2.76%)
Final Action: Closeout (36.11%)	

Cluster 5	
Initial Action: Initiation (87.47%)	
Initiation	(1.00, 33.43%)
Closeout	(0.91, 30.04%)
Downhill	(0.46, 12.28%)
Off-Cut	(0.14, 3.16%)
Final Action: Closeout (48.10%)	

Cluster 6	
Initial Action: Ball Screen (61.39%)	
DHO	(1.18, 35.72%)
Closeout	(1.11, 15.77%)
Ball Screen	(1.07, 30.38%)
Iso	(0.36, 5.47%)
Final Action: Closeout (40.88%)	

Cluster 7	
Initial Action: Ball Screen (51.44%)	
Closeout	(2.02, 29.06%)
Ball Screen	(1.71, 50.31%)
Iso	(0.20, 2.58%)
Off-Move	(0.18, 2.54%)
Final Action: Closeout (39.85%)	

Cluster Shot Zones

Cluster 0	
Initial Action: Mid-Left Above Break 3 (52.63%)	
Mid-Left Above Break 3	(1.25, 24.63%)
Mid-Right Above Break 3	(1.20, 19.93%)
Right Corner 3	(0.15, 1.33%)
Left Above Break 3	(0.13, 1.83%)
Final Action: Mid-Right Above Break 3 (55.74%)	

Cluster 1	
Initial Action: Short Backcourt (15.48%)	
Mid-Left Above Break 3	(0.28, 13.26%)
Mid-Right Above Break 3	(0.25, 12.16%)
Left Above Break 3	(0.23, 5.19%)
Short Backcourt	(0.23, 8.23%)
Final Action: Mid-Left Above Break 3 (10.44%)	

Cluster 2	
Initial Action: Left Above Break 3 (33.68%)	
Mid-Left Above Break 3	(1.26, 22.67%)
Left Above Break 3	(1.24, 14.23%)
Right Above Break 3	(0.33, 3.32%)
Mid-Right Above Break 3	(0.23, 5.11%)
Final Action: Mid-Left Above Break 3 (35.62%)	

Cluster 3	
Initial Action: Mid-Left Above Break 3 (37.62%)	
Mid-Left Above Break 3	(1.73, 26.74%)
Right Above Break 3	(0.70, 7.40%)
Mid-Right Above Break 3	(0.24, 7.40%)
Short Backcourt	(0.24, 3.76%)
Final Action: Mid-Left Above Break 3 (26.54%)	

Cluster 4	
Initial Action: Left Above Break 3 (36.31%)	
Left Above Break 3	(1.24, 15.93%)
Mid-Right Above Break 3	(1.16, 17.55%)
Mid-Left Above Break 3	(0.34, 10.29%)
Right Above Break 3	(0.22, 2.50%)
Final Action: Mid-Right Above Break 3 (48.77%)	

Cluster 5	
Initial Action: Right Above Break 3 (44.20%)	
Right Above Break 3	(2.09, 26.51%)
Mid-Left Above Break 3	(0.33, 7.25%)
Left Above Break 3	(0.28, 2.56%)
Mid-Right Above Break 3	(0.25, 10.89%)
Final Action: Right Above Break 3 (39.52%)	

Cluster 6	
Initial Action: Mid-Right Above Break 3 (61.99%)	
Mid-Right Above Break 3	(2.12, 36.64%)
Mid-Left Above Break 3	(0.27, 6.31%)
Left Above Break 3	(0.23, 2.47%)
Right Above Break 3	(0.19, 2.49%)
Final Action: Mid-Right Above Break 3 (44.84%)	

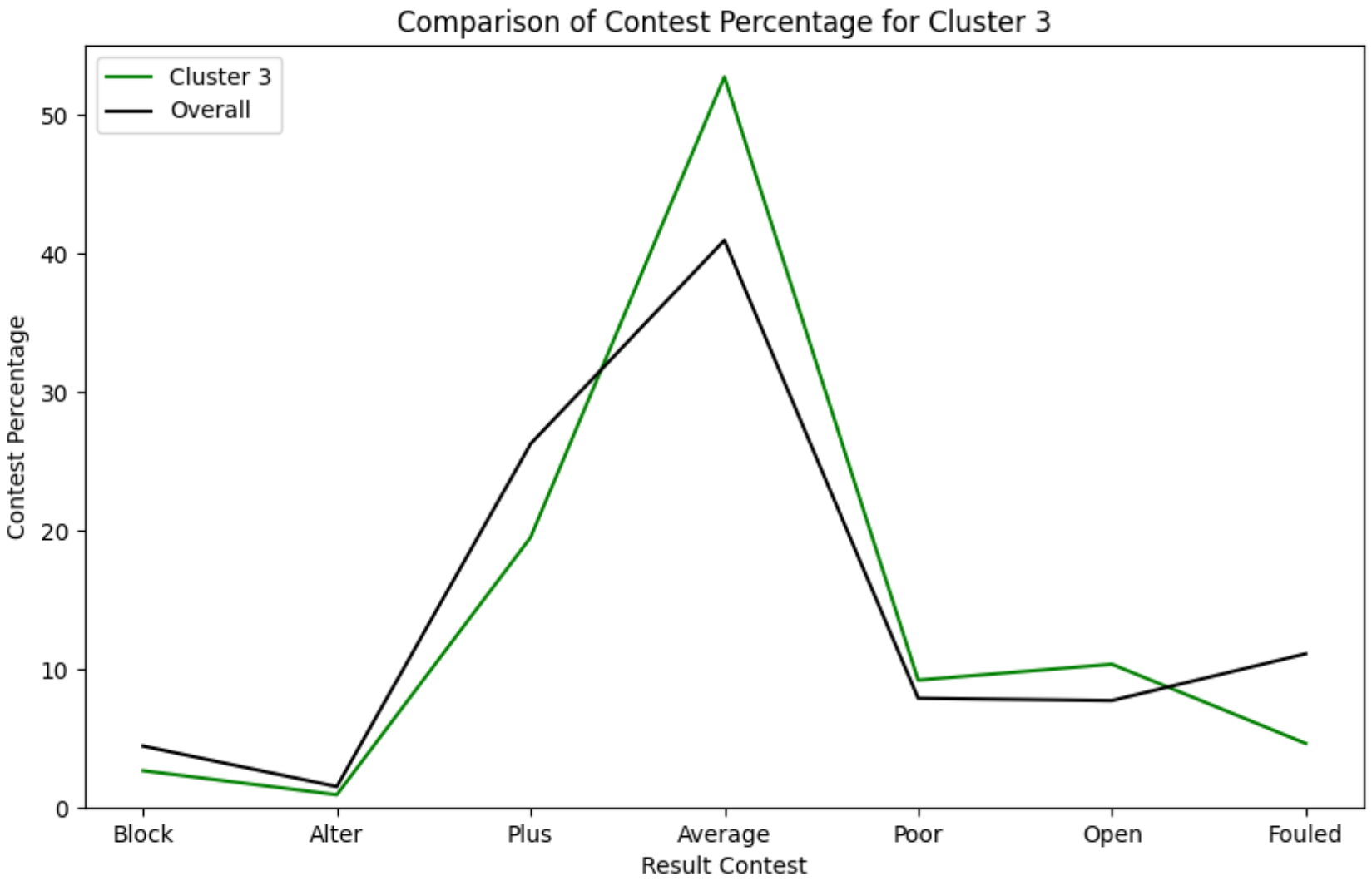
Cluster 7	
Initial Action: Mid-Right Above Break 3 (36.91%)	
Mid-Right Above Break 3	(1.34, 21.09%)
Right Above Break 3	(1.23, 13.39%)
Mid-Left Above Break 3	(0.48, 8.36%)
Left Above Break 3	(0.27, 3.09%)
Final Action: Right Above Break 3 (29.67%)	

Cluster 8	
Initial Action: Mid-Left Above Break 3 (25.34%)	
Right Corner 3	(1.09, 8.98%)
Mid-Left Above Break 3	(0.97, 14.02%)
Right Above Break 3	(0.75, 6.91%)
Mid-Right Above Break 3	(0.63, 9.50%)
Final Action: Right Corner 3 (23.95%)	

Cluster 9	
Initial Action: Left Above Break 3 (50.10%)	
Left Above Break 3	(1.24, 15.64%)
Right Above Break 3	(1.15, 13.19%)
Mid-Left Above Break 3	(0.33, 11.53%)
Mid-Right Above Break 3	(0.19, 5.98%)
Final Action: Right Above Break 3 (42.19%)	

Cluster 10	
Initial Action: Mid-Right Above Break 3 (42.81%)	
Left Above Break 3	(1.24, 13.20%)
Mid-Right Above Break 3	(1.17, 18.77%)
Mid-Left Above Break 3	(0.41, 9.29%)
Right Above Break 3	(0.29, 3.32%)
Final Action: Left Above Break 3 (33.49%)	

Spacing Offense

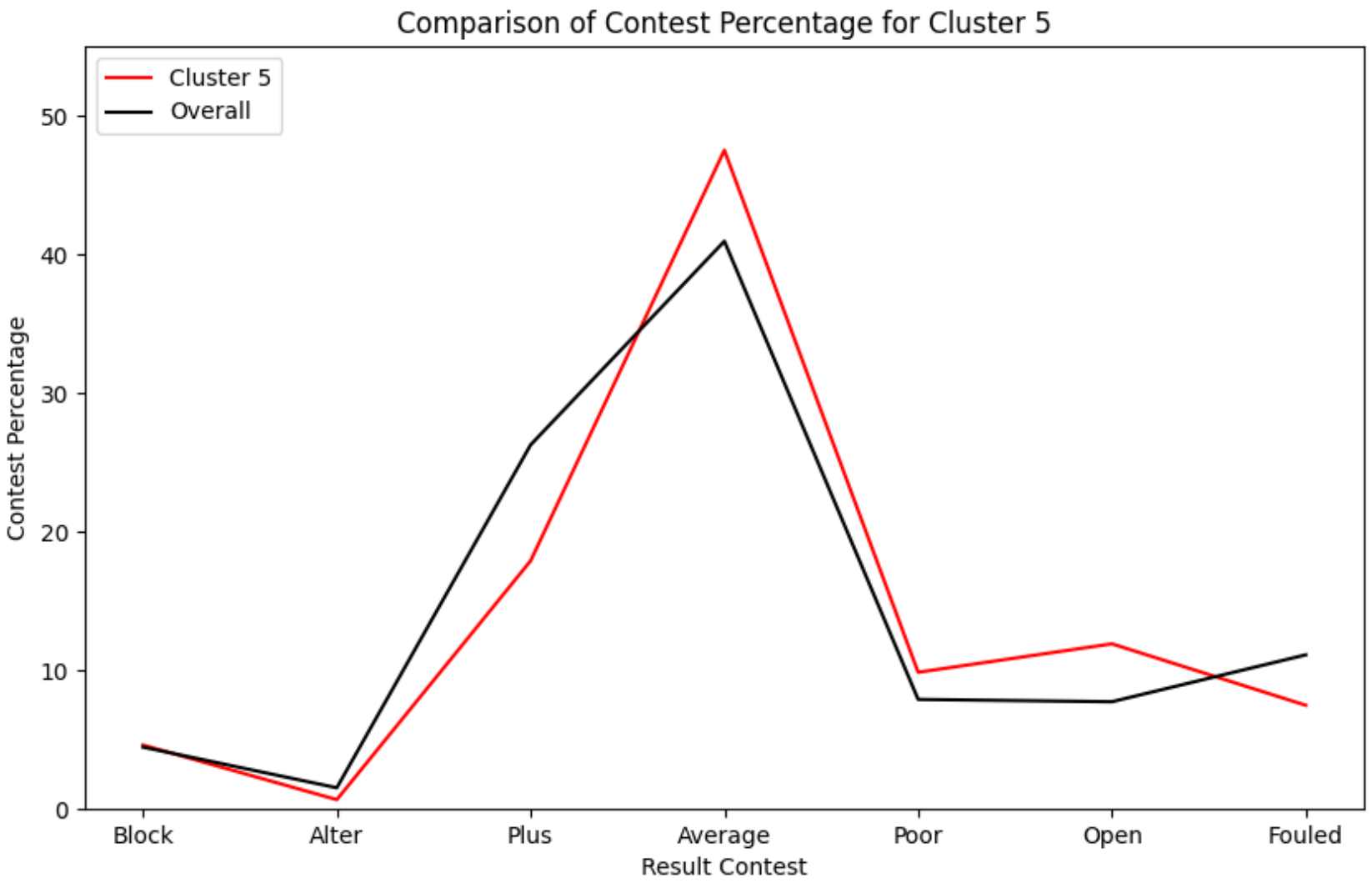


Cluster 3 Top Players			
Player	Total Points	Possessions	PPP
D'Angelo Russell	12	5	1.62
Edmond Sumner	13	7	1.57
Kevin Durant	14	11	1.27
Luka Doncic	13	11	1.18
Nikola Vucevic	13	11	1.18

Cluster 3	
Initial Action: Ball Screen (44.27%)	
Closeout	(2.47, 50.09%)
Ball Screen	(0.61, 21.74%)
Initiation	(0.19, 4.24%)
Iso	(0.18, 3.44%)
Final Action: Closeout (73.24%)	

Cluster 3 Top Teams		
Team	Total Plays	Usage %
BKN	2067	18.4%
CHI	2254	15.0%
DAL	1780	15.0%
IND	1330	11.4%
MIA	1980	10.8%

Read and React Offense

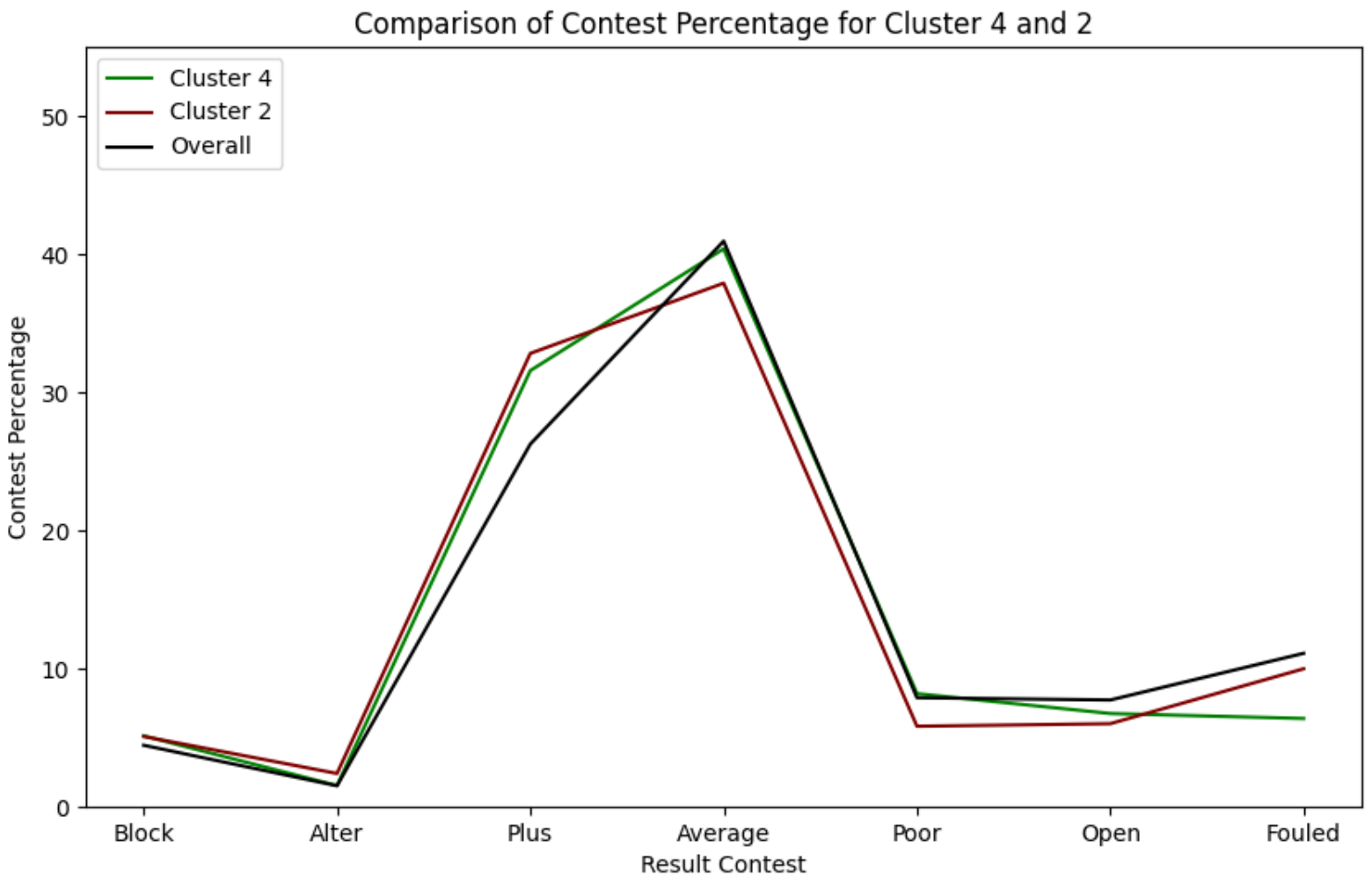


Cluster 5 Top Players			
Player	Total Points	Possessions	PPP
Jaylen Brown	12	5	2.40
Nikola Jokic	13	7	1.86
Tyrese Haliburton	14	11	1.27
Royce O'Neale	13	11	1.18
D'Angelo Russell	13	11	1.18

Cluster 5	
Initial Action: Initiation (87.47%)	
Initiation	(1.00, 33.43%)
Closeout	(0.91, 30.04%)
Downhill	(0.46, 12.28%)
Off-Cut	(0.14, 3.16%)
Final Action: Closeout (48.10%)	

Cluster 5 Top Teams		
Team	Total Plays	Usage %
BKN	593	8.3%
IND	437	8.2%
GSW	675	7.1%
MIN	641	6.9%
SAS	658	5.6%

Iso/Ball Screen Offense



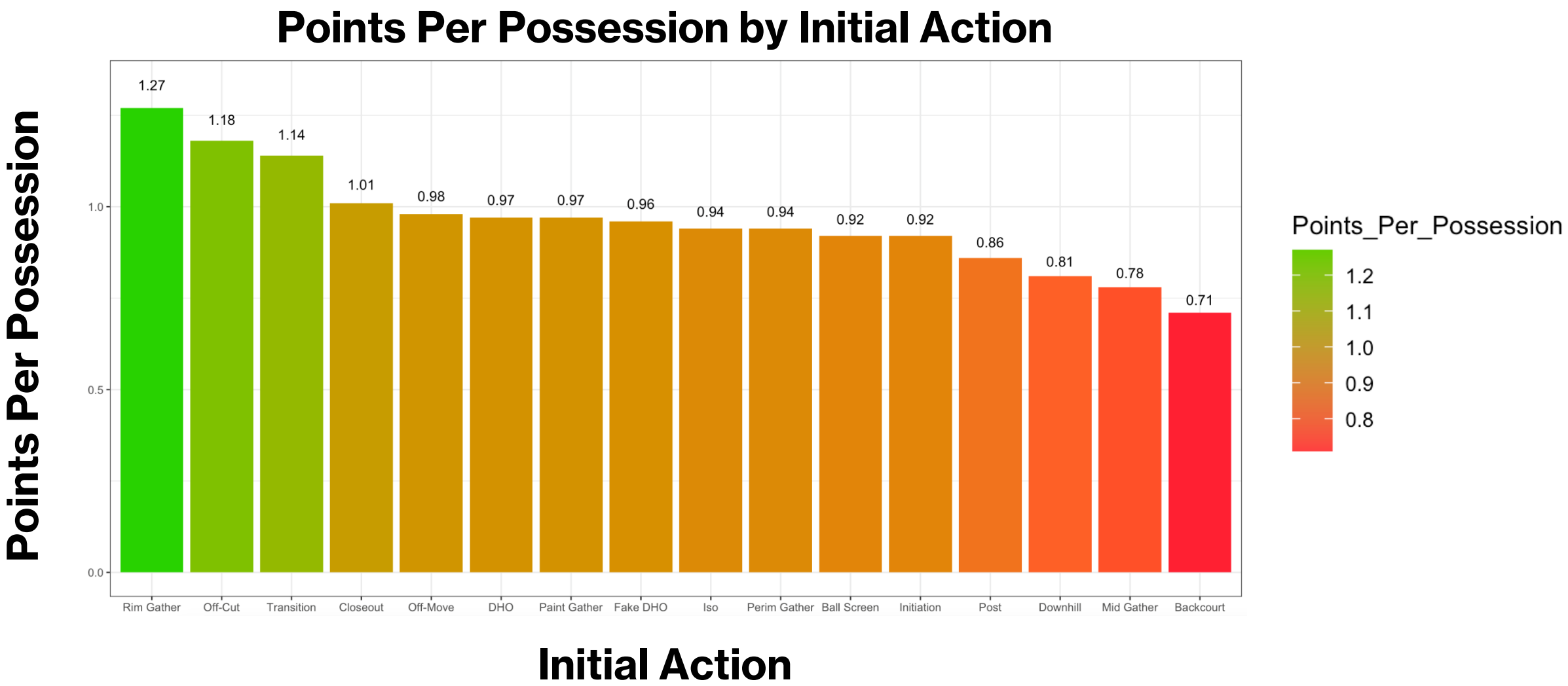
Cluster 2 & 4 Top Players			
Player	Total Points	Possessions	PPP
Tyrese Maxey	31	16	1.94
Jayson Tatum	33	26	1.27
Domantas Sabonis	30	24	1.25
Ja Morant	24	22	1.09
Luka Doncic	30	34	0.88

Cluster 2	
Initial Action: Ball Screen (89.66%)	
Ball Screen	(2.08, 79.77%)
Closeout	(0.34, 5.49%)
Iso	(0.20, 3.35%)
Off-Move	(0.15, 2.45%)
Final Action: Ball Screen (33.88%)	

Cluster 4	
Initial Action: Ball Screen (70.29%)	
Ball Screen	(1.28, 46.36%)
Iso	(1.19, 22.36%)
Closeout	(0.81, 13.99%)
Off-Move	(0.17, 2.76%)
Final Action: Closeout (36.11%)	

Cluster 2 & 4 Top Teams		
Team	Total Plays	Usage %
BOS	1356	8.7%
HOU	1104	8.5%
SAC	1256	8.0%
DAL	1164	7.7%
CLE	1222	7.4%

Initial Actions



Initial Action Leaders

Backcourt

Rank	Name	PPP
1	Julius Randle	1.67
2	James Bouknight	1.00
3	Josh Giddey	1.00

Ball Screen

Rank	Name	PPP
1	Trey Murphy III	2.00
2	Buddy Hield	1.92
3	Mo Bamba	1.89

Closeout

Rank	Name	PPP
1	Darius Garland	2.20
2	Seth Curry	2.17
3	O.G. Anunoby	1.89

DHO

Rank	Name	PPP
1	Desmond Bane	1.27
2	Kelly Oubre Jr.	1.26
3	Lonnie Walker IV	1.25

Downhill

Rank	Name	PPP
1	Jayson Tatum	2.50
2	Collin Sexton	2.33
3	John Wall	1.50

Fake DHO

Rank	Name	PPP
1	RJ Barrett	2.33
2	Karl-Anthony Towns	1.50
3	Kyle Kuzma	1.33

Initiation

Rank	Name	PPP
1	Jalen Smith	1.78
2	Grant Williams	1.73
3	J. Robinson-Earl	1.63

Iso

Rank	Name	PPP
1	Zach Lavine	1.67
2	Anthony Davis	1.42
3	Joel Embiid	1.42

Mid Gather

Rank	Name	PPP
1	O.G. Anunoby	1.71
2	Jaylen Brown	1.50
3	Kevin Durant	1.29

Off-Cut

Rank	Name	PPP
1	Jayson Tatum	1.67
2	Hamidou Diallo	1.33
3	Kenyon Martin Jr.	1.25

Off-Move

Rank	Name	PPP
1	Jaylen Brown	1.63
2	Klay Thompson	1.33
3	Kelly Olynyk	1.13

Paint Gather

Rank	Name	PPP
1	Tari Eason	1.67
2	Jamal Murray	1.33
3	Mason Plumlee	1.25

Perimeter Gather

Rank	Name	PPP
1	Kelly Oubre Jr.	1.44
2	Nikola Vucevic	1.44
3	Lauri Markkanen	1.42

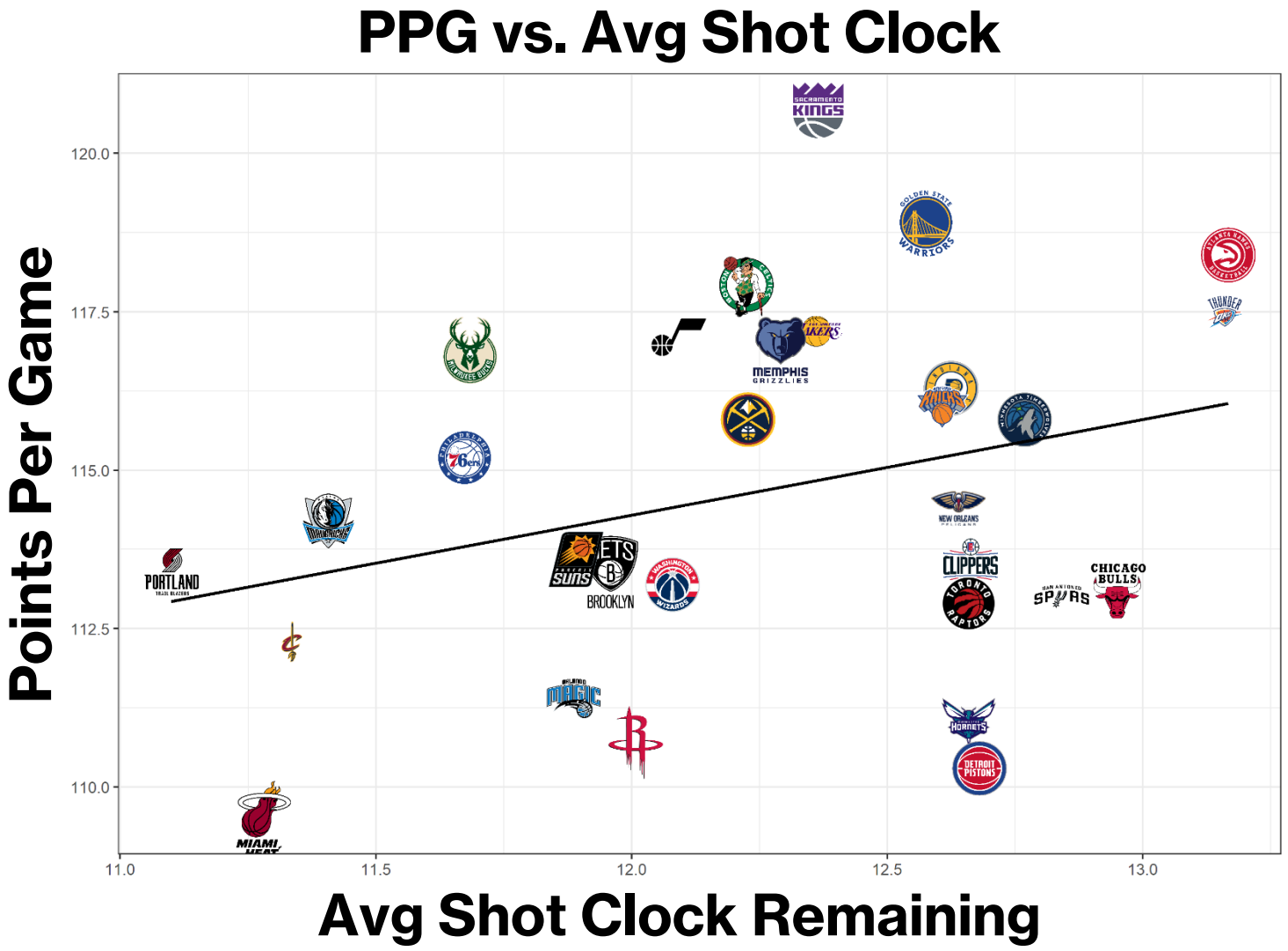
Post

Rank	Name	PPP
1	Joel Embiid	1.50
2	Brook Lopez	1.38
3	Bobby Portis	1.00

Rim Gather

Rank	Name	PPP
1	Bobby Portis	1.67
2	Jakob Poeltl	1.63
3	Isaiah Hartenstein	1.55

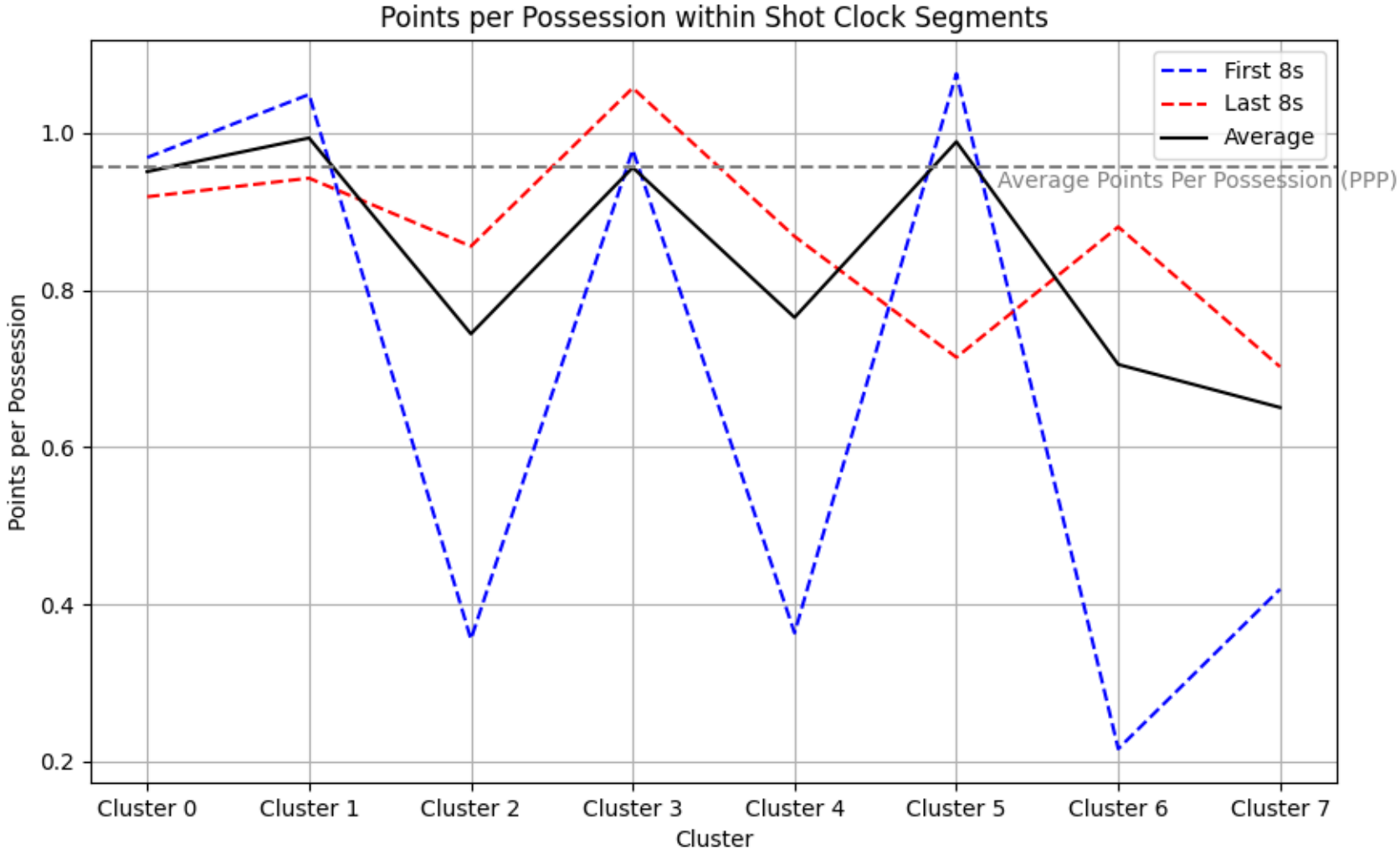
Pace and Shot Creation



- Teams that took shots quickly tended to score more points
- 11/16 playoff teams are above the trendline
- Most of the top-scoring teams had elite playmaking Point Guards:
  - SAC - De'Aaron Fox
  - GSW - Stephen Curry
  - ATL - Trae Young
  - OKC - Shai Gilgeous-Alexander

Pace and Shot Clustering

- Best Cluster for a late shot is Cluster 3 (Spacing Offense)
- Best Cluster for a shot early in the shot-clock is Cluster 5 (Read and React Offense)
- Clusters focusing on Iso and Ball Screen offense (2 & 4 as aforementioned) struggle early in the play clock.



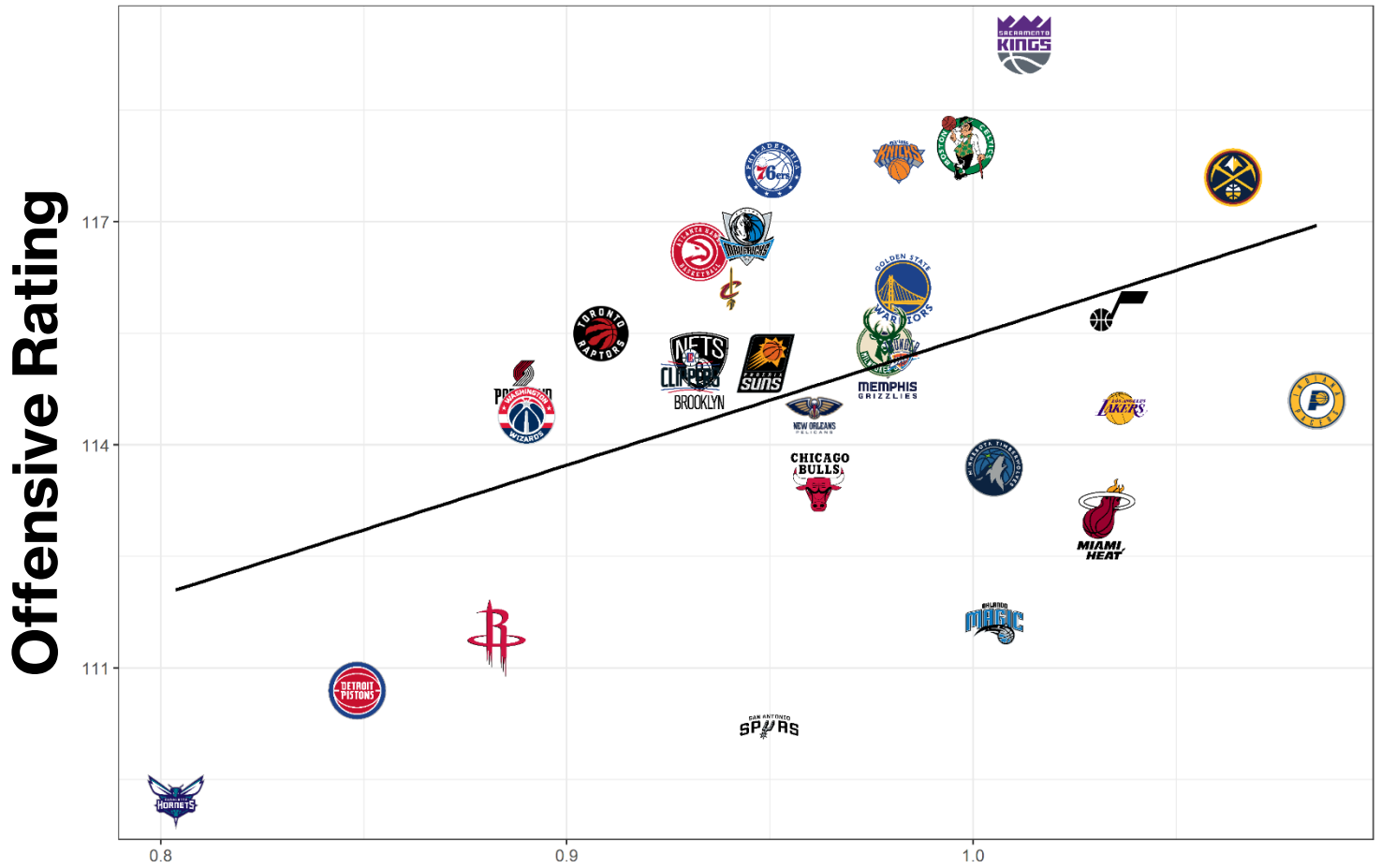
Offensive Personnel

- Looked at each team's top 5 most occurring players on offense and calculated their Average Result Points

- Compared the Average Result Points to the team's Offensive Rating for the season

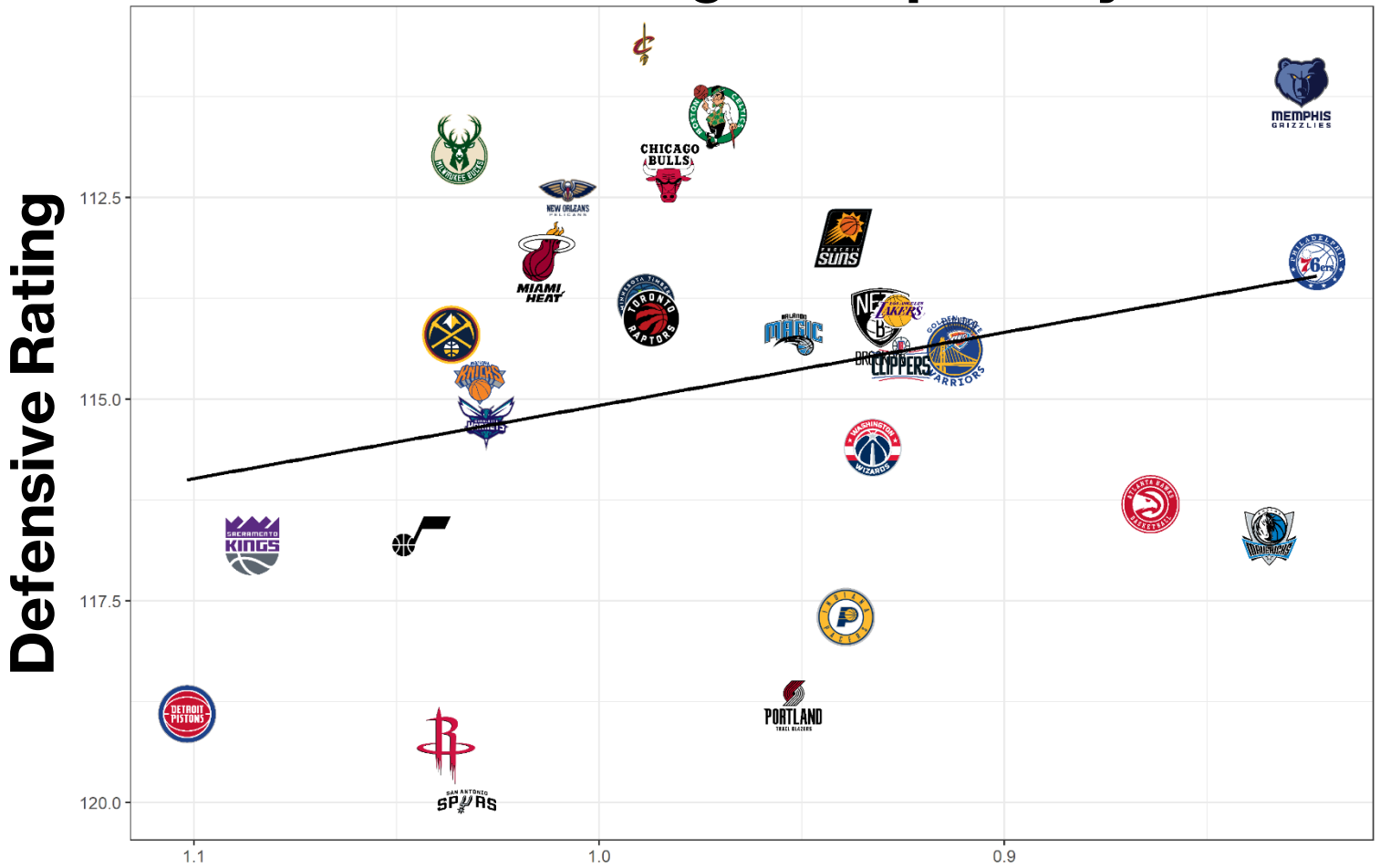
- 13/16 playoff teams are above the trendline

Offensive Rating vs. Top 5 Players



Defensive Personnel

Defensive Rating vs. Top 5 Players



- Used the same approach and found each team's top 5 most occurring players on defense and found their Average Result Points
- Not as strong a correlation as the Offensive Side
- 12/16 playoff teams are above the trendline

Conclusion

- Found strong indication that both Spacing and Read and React play style sequencing were the most efficient

- Offenses that heavily utilize Ball Screens and Isolation only work when a team has elite offensive players

- Most efficient play styles utilize Initiation Drives & Cuts early in the shot clock while using spaced shooting when time runs out

Potential Improvements

- Collect more play-by-play data for a larger sample of actions and sequences
- Experiment with more ways to incorporate Personnel and Play Style
- Focus on driving actions in shot zone clustering
- Attempting different clustering techniques to account for variability

Thank You!
Questions?