HoopInSight

Analyzing and Comparing Basketball Shooting Performance through Visualization

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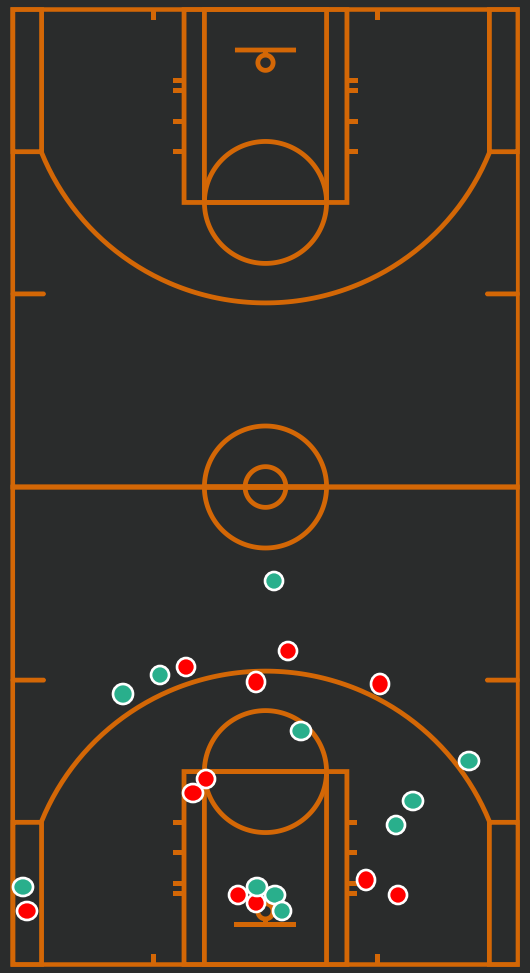
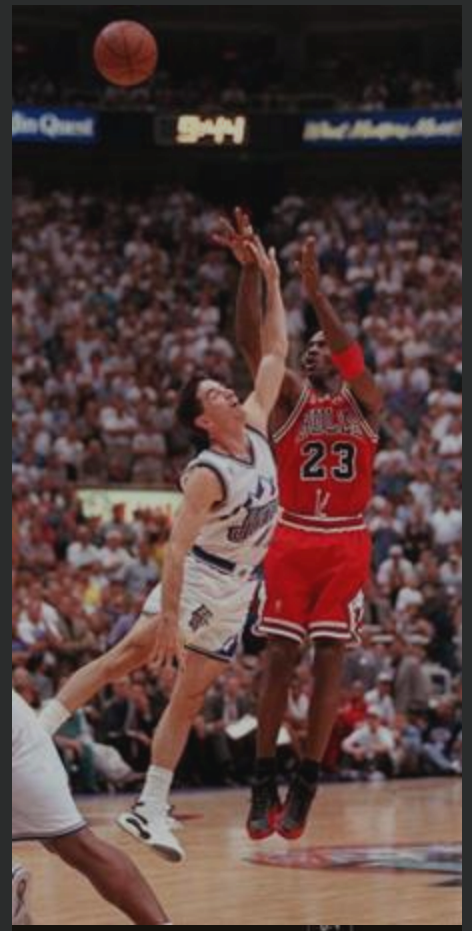
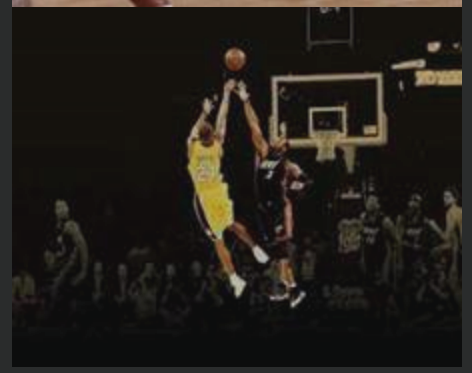
VIS2023

Motivation

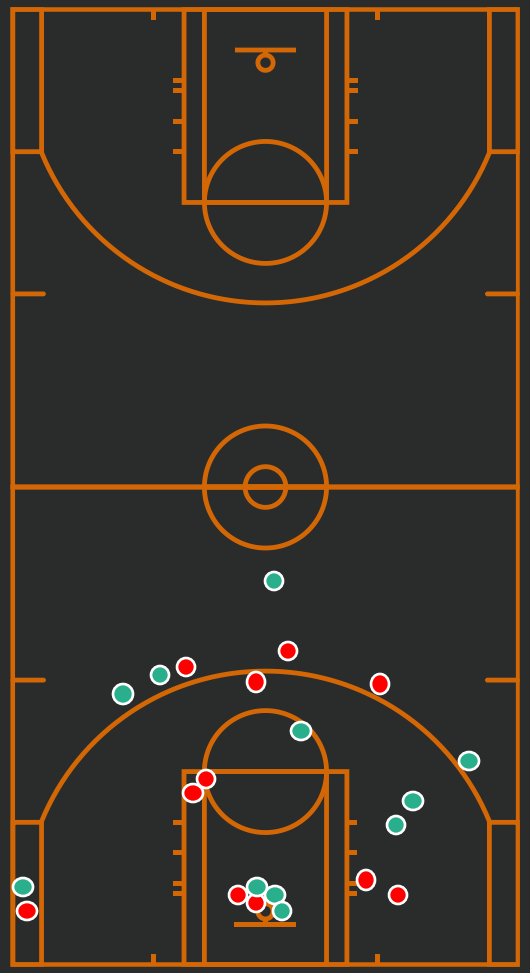


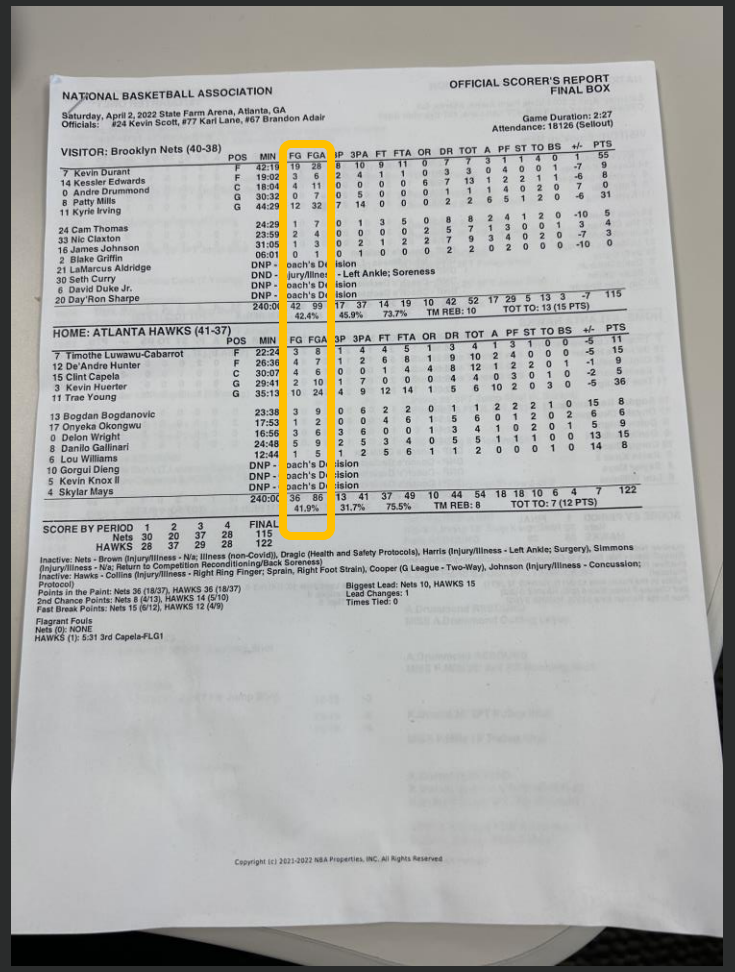




Motivation

$$Field\ Goal\ Percentage(FG\%) = \frac{Field\ Goal\ Made\ (FG)}{Field\ Goal\ Attempts\ (FGA)}$$





NATIONAL BASKETBALL ASSOCIATION — OFFICIAL SCORER'S REPORT — FINAL BOX

Saturday, April 2, 2022 State Farm Arena, Atlanta, GA
Officials: #24 Kevin Scott, #77 Karl Lane, #67 Brandon Adair

Game Duration: 2:27
Attendance: 18126 (Sellout)

VISITOR: Brooklyn Nets (40-38)

	POS	MIN	FG	FGA	3P	3PA	FT	FTA	OR	DR	TOT	A	PF	ST	TO	BS	+/-	PTS
7 Kevin Durant	F	42:19	19	28	8	10	9	11	0	7	7	3	1	1	4	0	1	55
14 Kessler Edwards	F	18:02	3	6	2	4	1	1	0	3	3	0	4	0	0	1	-7	9
0 Andre Drummond	C	18:04	4	11	0	0	0	0	6	7	13	1	2	2	1	1	-6	8
8 Patty Mills	G	30:32	0	7	0	5	0	0	0	1	1	1	4	0	2	0	7	0
11 Kyrie Irving	G	44:29	12	32	7	14	0	0	0	2	2	6	5	1	2	0	-6	31
24 Cam Thomas		24:29	1	7	0	1	3	5	0	8	8	2	4	1	2	0	-10	5
33 Nic Claxton		23:59	2	4	0	0	0	0	2	5	7	1	3	0	0	1	3	4
16 James Johnson		31:05	1	3	0	2	1	2	2	7	9	3	4	0	2	0	-7	3
2 Blake Griffin		06:01	0	1	0	1	0	0	0	2	2	0	2	0	0	0	-10	0
21 LaMarcus Aldridge		DNP -	oach's D		ision													
30 Seth Curry		DND -	jury/Illnes		- Left Ankle; Soreness													
6 David Duke Jr.		DNP -	oach's D		ision													
20 Day'Ron Sharpe		DNP -	oach's D		ision													
		240:0	42	99	17	37	14	19	10	42	52	17	29	5	13	3	-7	115
			42.4%		45.9%		73.7%		TM REB: 10			TOT TO: 13 (15 PTS)						

HOME: ATLANTA HAWKS (41-37)

	POS	MIN	FG	FGA	3P	3PA	FT	FTA	OR	DR	TOT	A	PF	ST	TO	BS	+/-	PTS
7 Timothe Luwawu-Cabarrot	F	22:24	3	8	1	4	4	5	1	3	4	1	3	1	0	0	-5	11
12 De'Andre Hunter	F	26:36	4	7	1	2	6	8	1	9	10	2	4	0	0	0	-5	15
15 Clint Capela	C	30:07	4	6	0	0	1	4	4	8	12	1	2	2	0	1	-1	9
3 Kevin Huerter	G	29:41	2	10	1	7	0	0	0	4	4	0	3	0	1	0	-2	5
11 Trae Young	G	35:13	10	24	4	9	12	14	1	5	6	10	2	0	3	0	-5	36
13 Bogdan Bogdanovic		23:38	3	9	0	6	2	2	0	1	1	2	2	2	1	0	15	8
17 Onyeka Okongwu		17:53	1	2	0	0	4	6	1	5	6	0	1	2	0	2	6	6
0 Delon Wright		16:56	3	6	3	6	0	0	1	3	4	1	0	2	0	1	5	9
8 Danilo Gallinari		24:48	5	9	2	5	3	4	0	5	5	1	1	1	0	0	13	15
6 Lou Williams		12:44	1	5	1	2	5	6	1	1	2	0	0	0	1	0	14	8
10 Gorgui Dieng		DNP -	oach's D		ision													
5 Kevin Knox II		DNP -	oach's D		ision													
4 Skylar Mays		DNP -	oach's D		ision													
		240:0	36	86	13	41	37	49	10	44	54	18	18	10	6	4	7	122
			41.9%		31.7%		75.5%		TM REB: 8			TOT TO: 7 (12 PTS)						

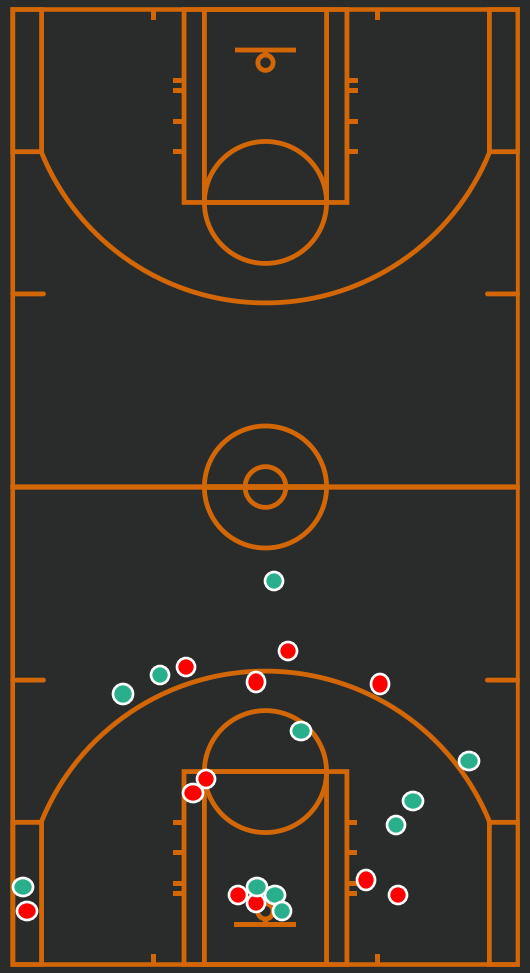
SCORE BY PERIOD	1	2	3	4	FINAL
Nets	30	20	37	28	115
HAWKS	28	37	29	28	122

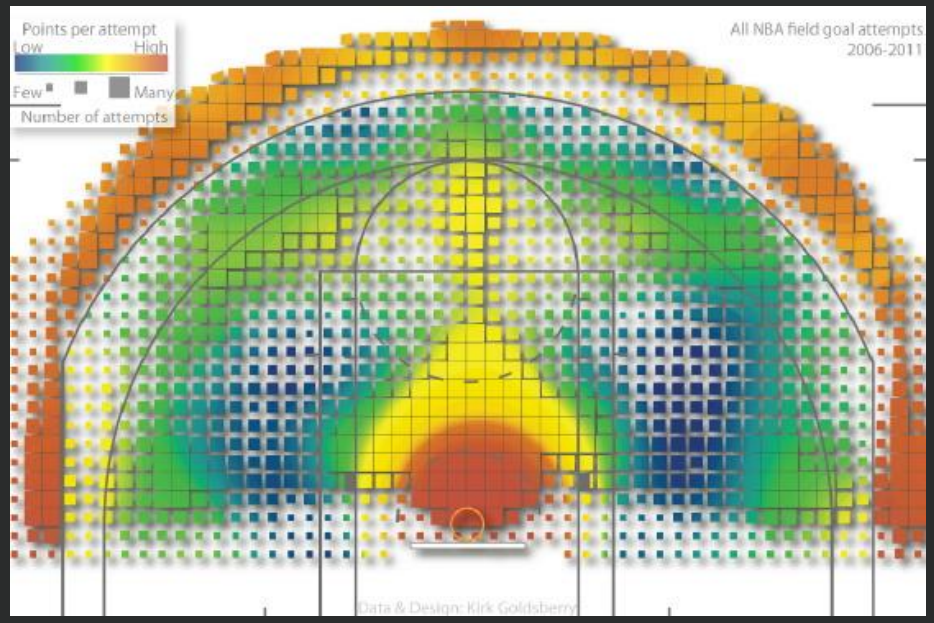
Inactive: Nets - Brown (Injury/Illness - N/a; Illness (non-Covid)), Dragic (Health and Safety Protocols), Harris (Injury/Illness - Left Ankle; Surgery), Simmons (Injury/Illness - N/a; Return to Competition Reconditioning/Back Soreness)
Inactive: Hawks - Collins (Injury/Illness - Right Ring Finger; Sprain, Right Foot Strain), Cooper (G League - Two-Way), Johnson (Injury/Illness - Concussion; Protocol)
Points in the Paint: Nets 36 (18/37), HAWKS 36 (18/37)
2nd Chance Points: Nets 8 (4/13), HAWKS 14 (5/10)
Fast Break Points: Nets 15 (6/12), HAWKS 12 (4/9)

Biggest Lead: Nets 10, HAWKS 15
Lead Changes: 1
Times Tied: 0

Flagrant Fouls
Nets (0): NONE
HAWKS (1): 5:31 3rd Capela-FLG1

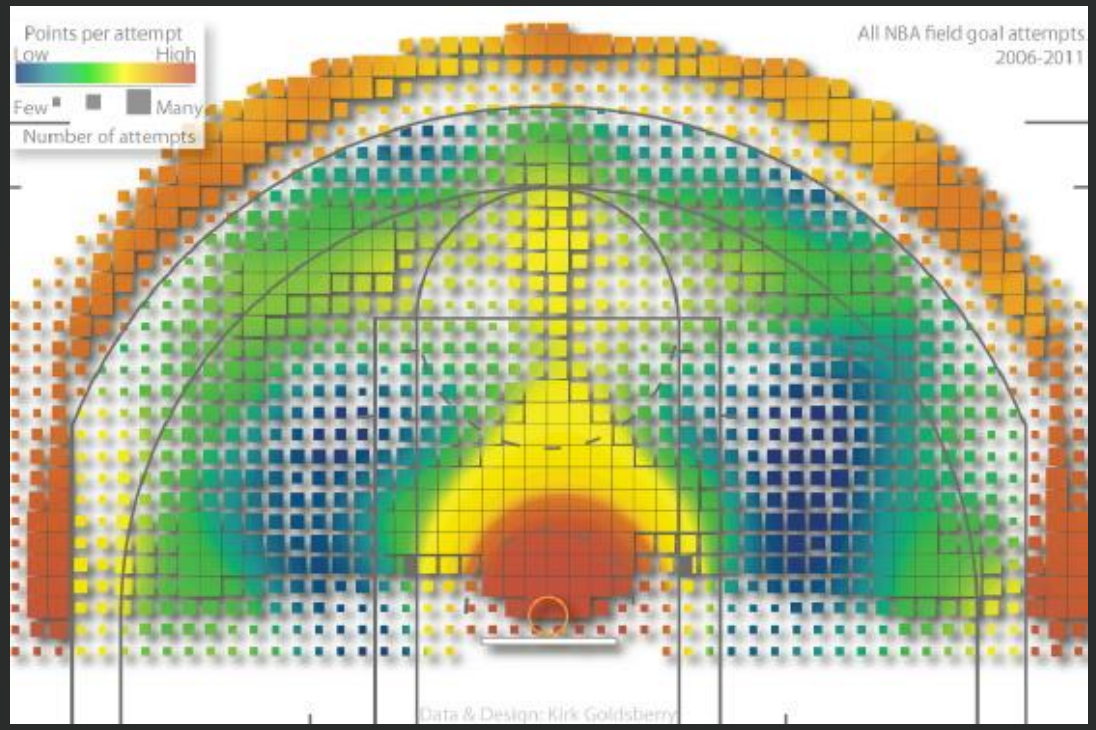
Spatial Basketball Analytics





CourtVision: NBA Visual and Spatial Analytics (2012)
Kirk Goldsberry

Spatial Basketball Analytics



CourtVision: NBA Visual and Spatial Analytics (2012)
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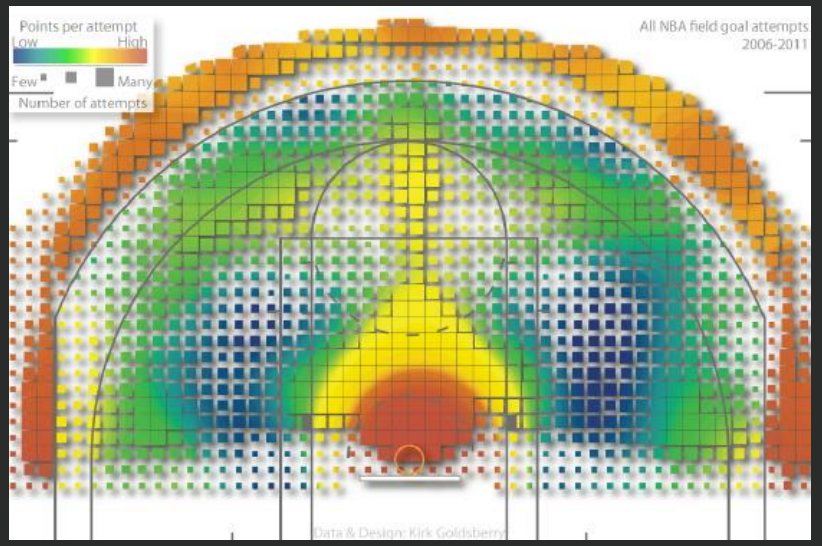
Spatial Basketball Analytics



CourtVision: NBA Visual and Spatial Analytics (2012)
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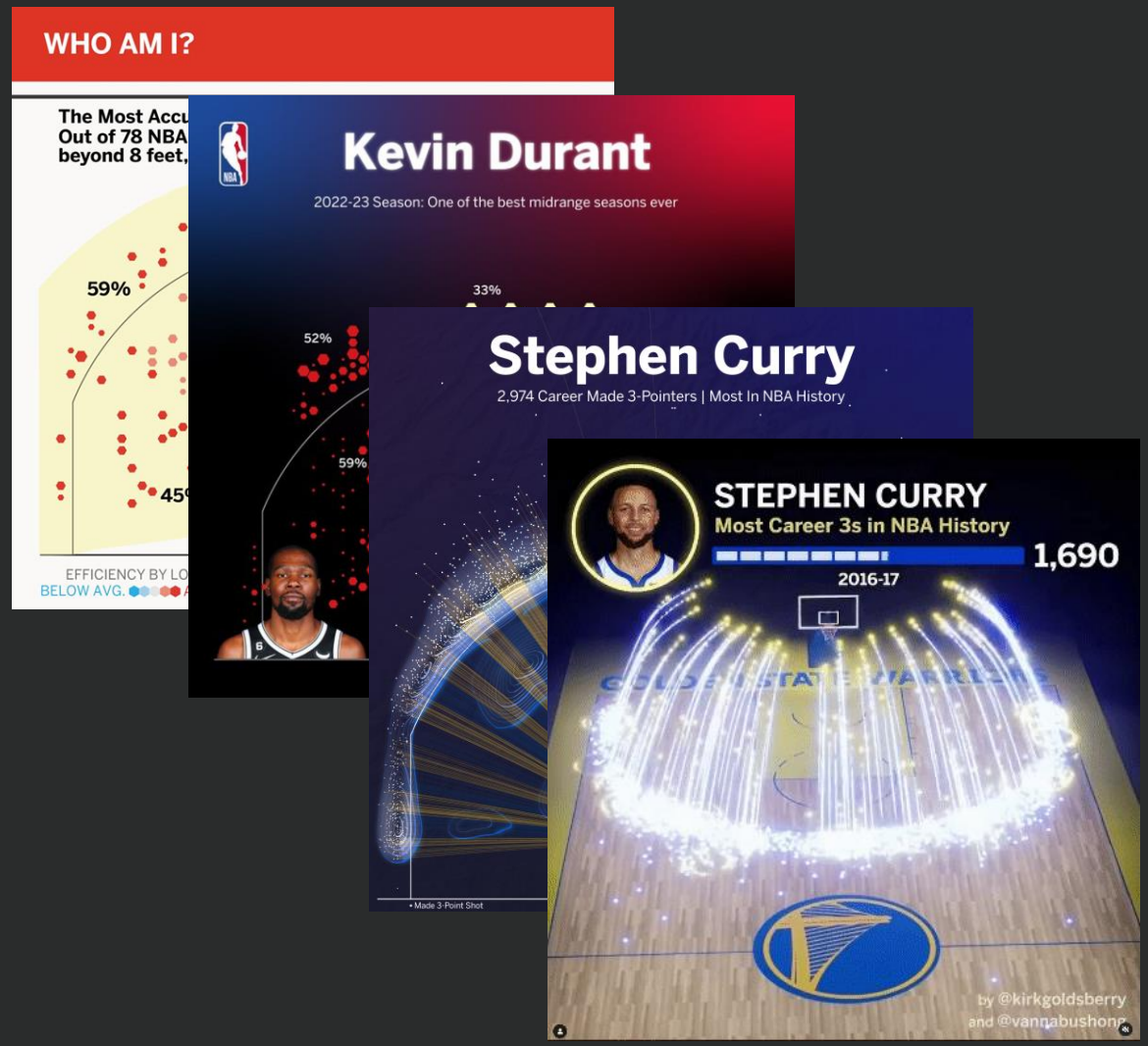


Shot charts are becoming more engaging

COMPARISON!!

COMPARISON metrics

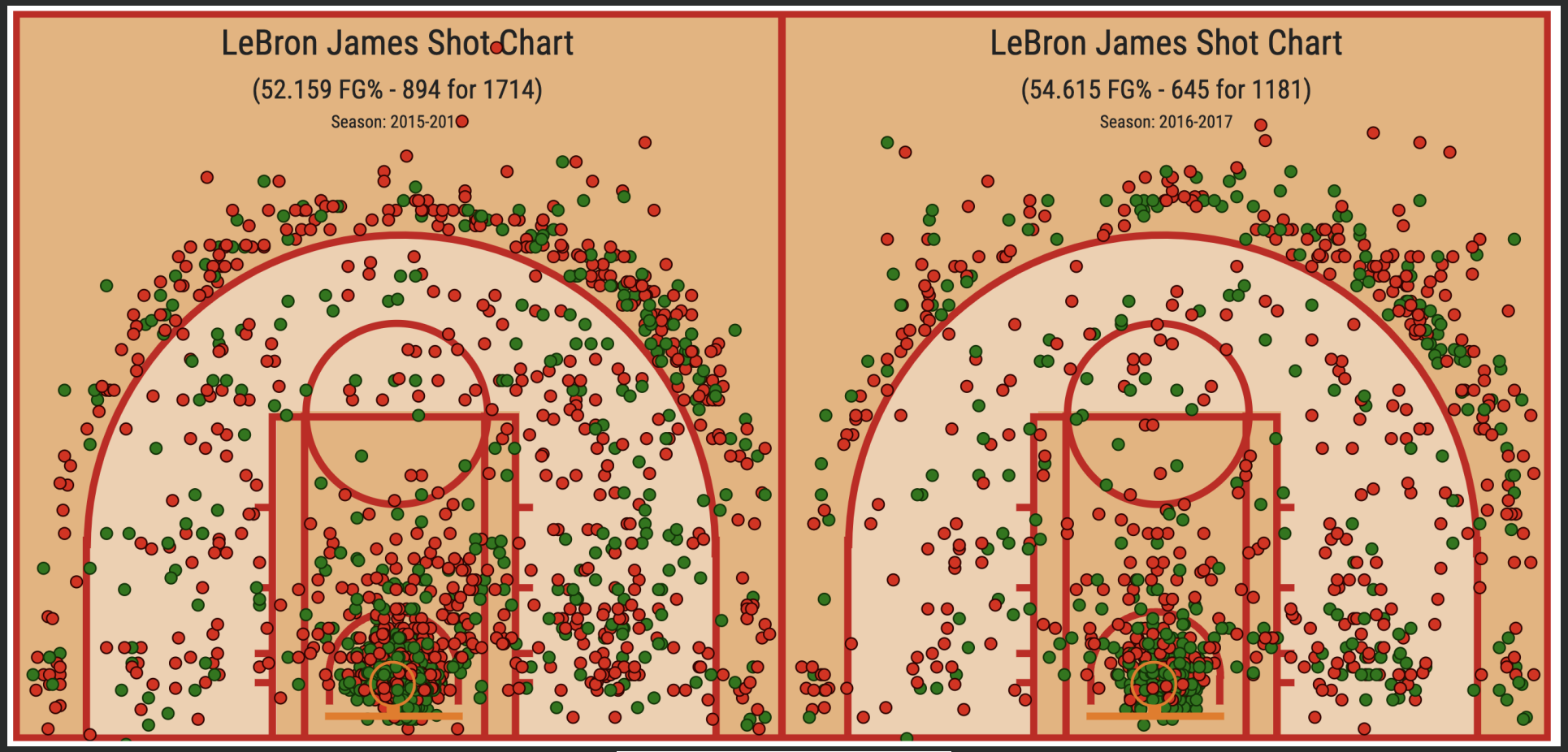
Change in ***frequency***

Where did a player/team take more or fewer shots?

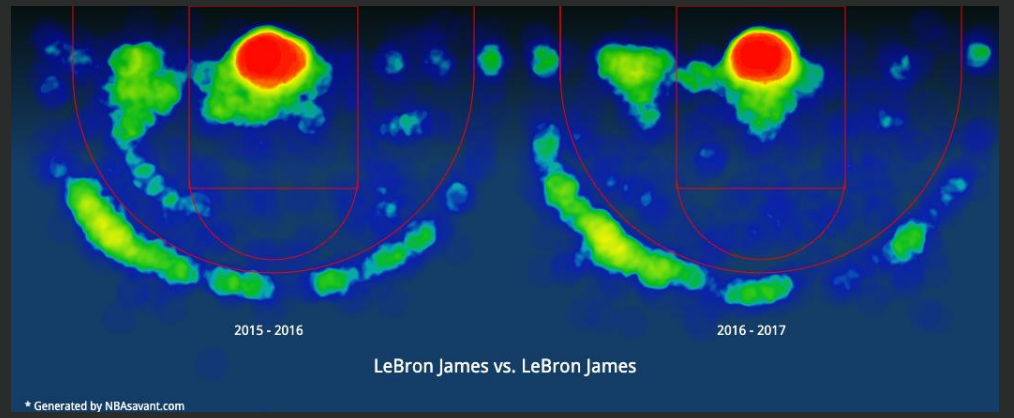
Change in ***efficiency***

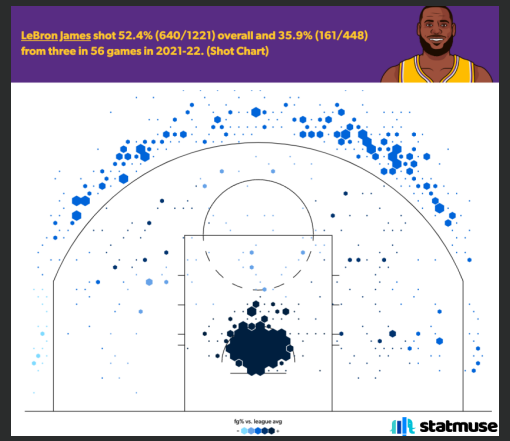
Was a player/team shooting better or worse from different locations?

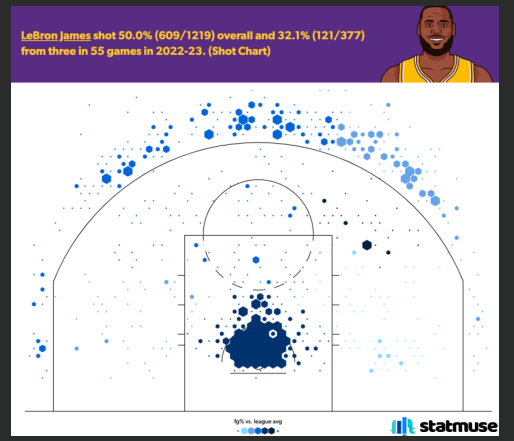
Compare these shot charts

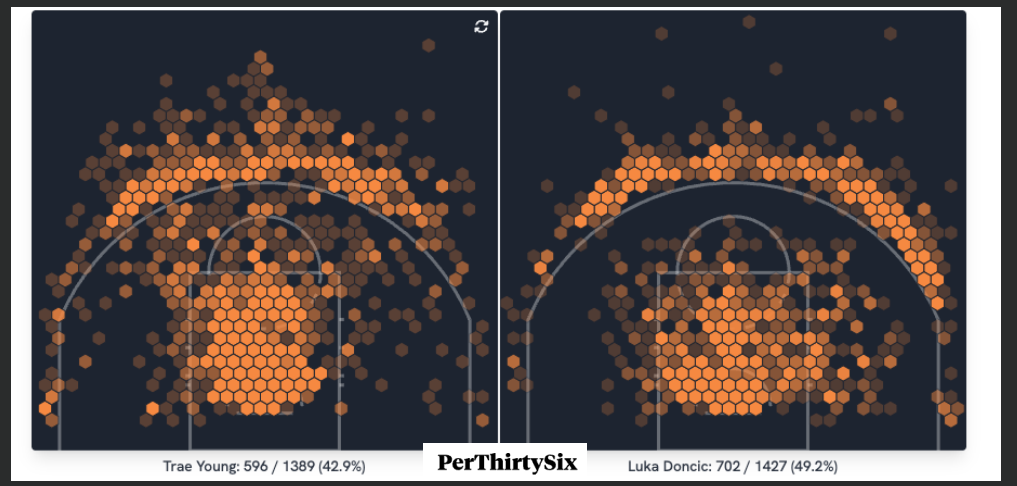


How about these?









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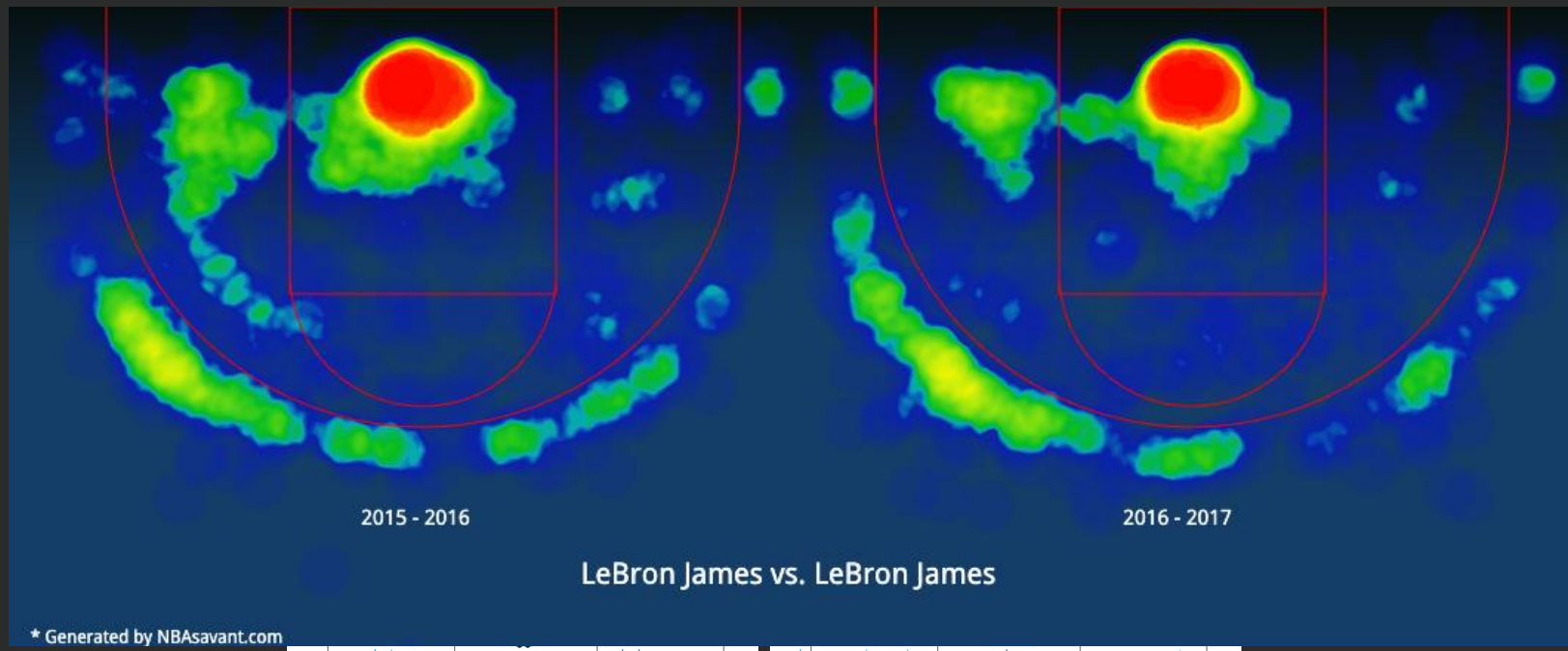

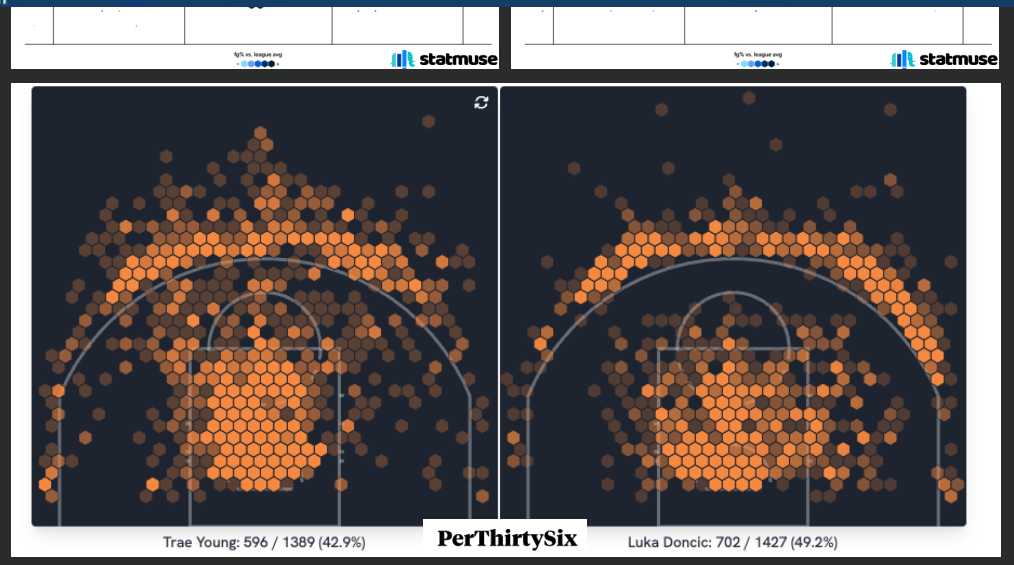

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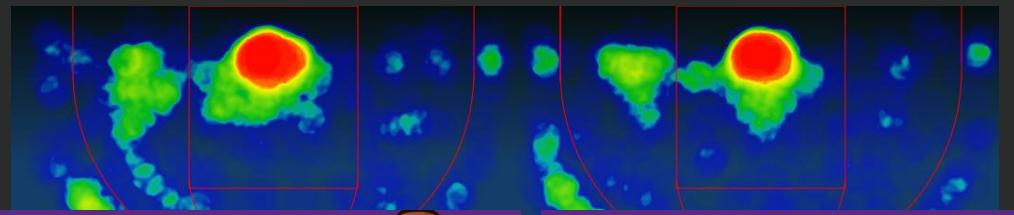

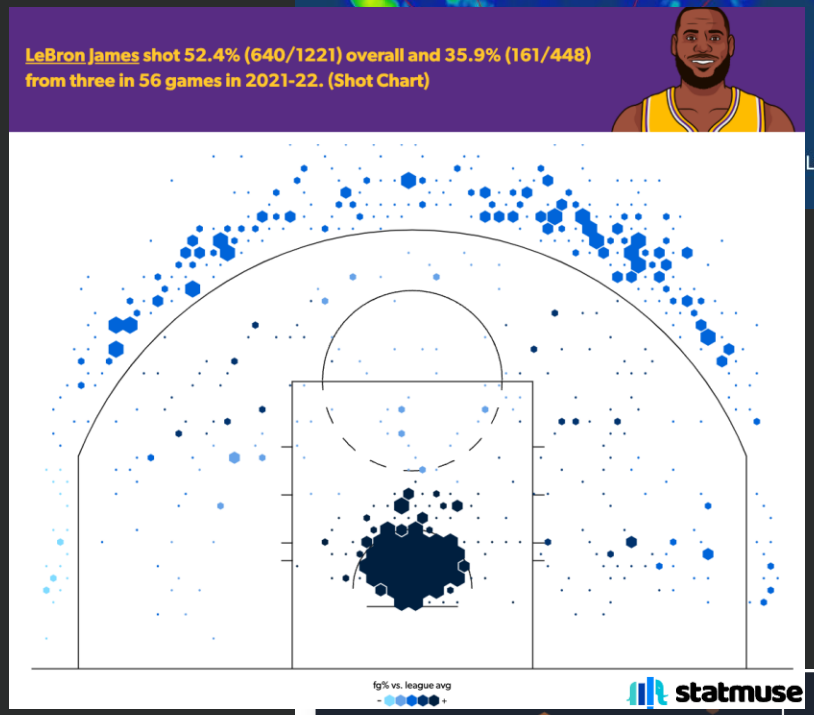

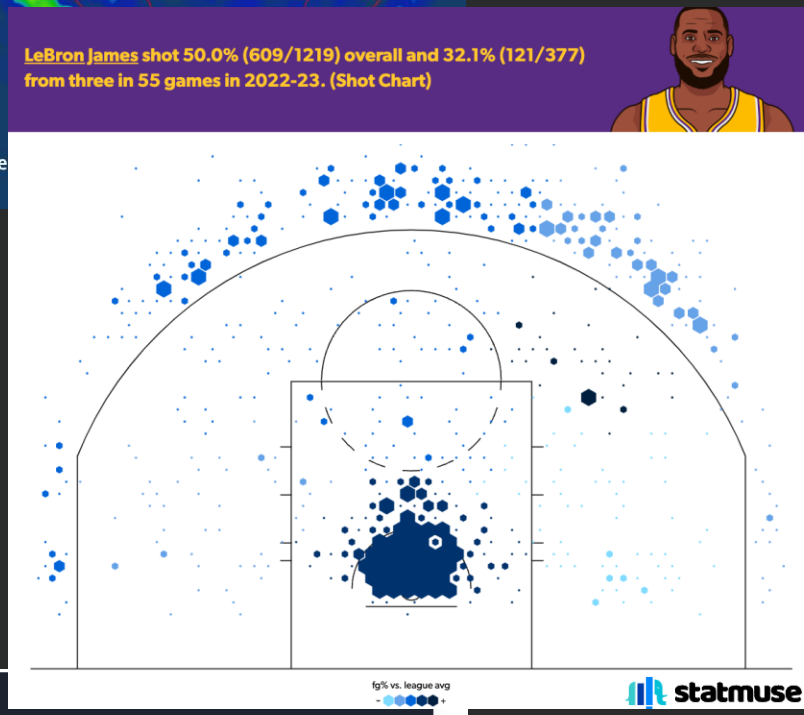

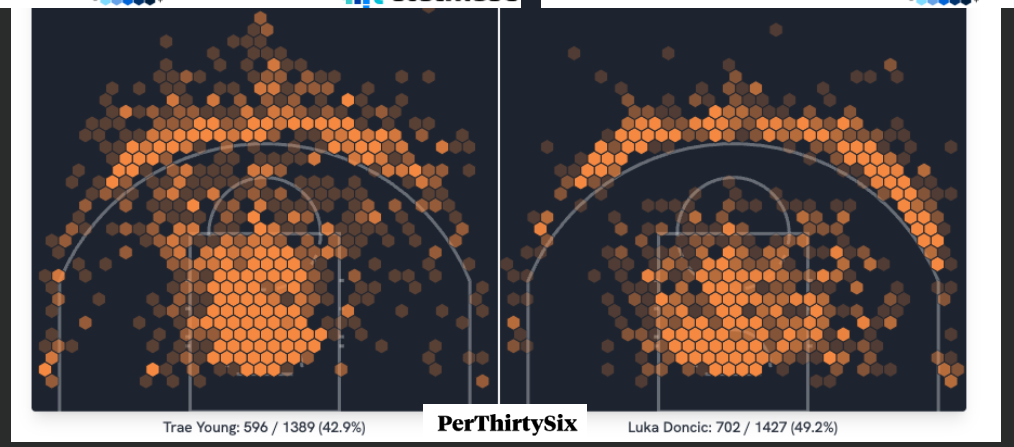

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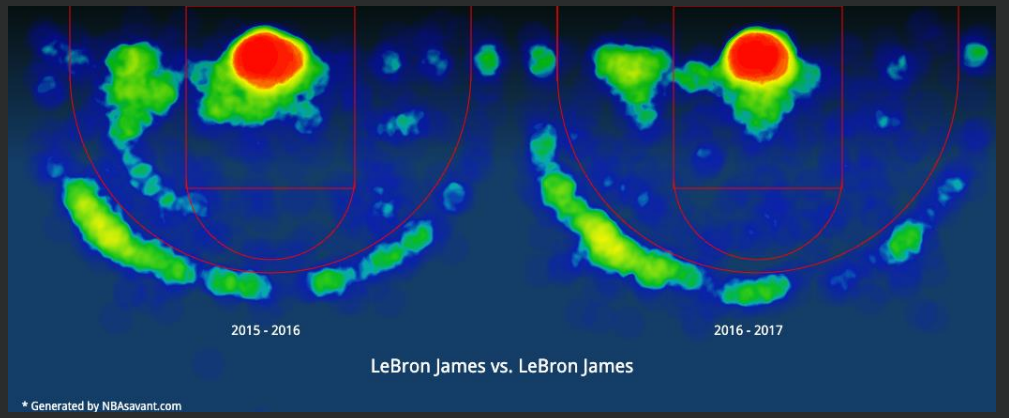
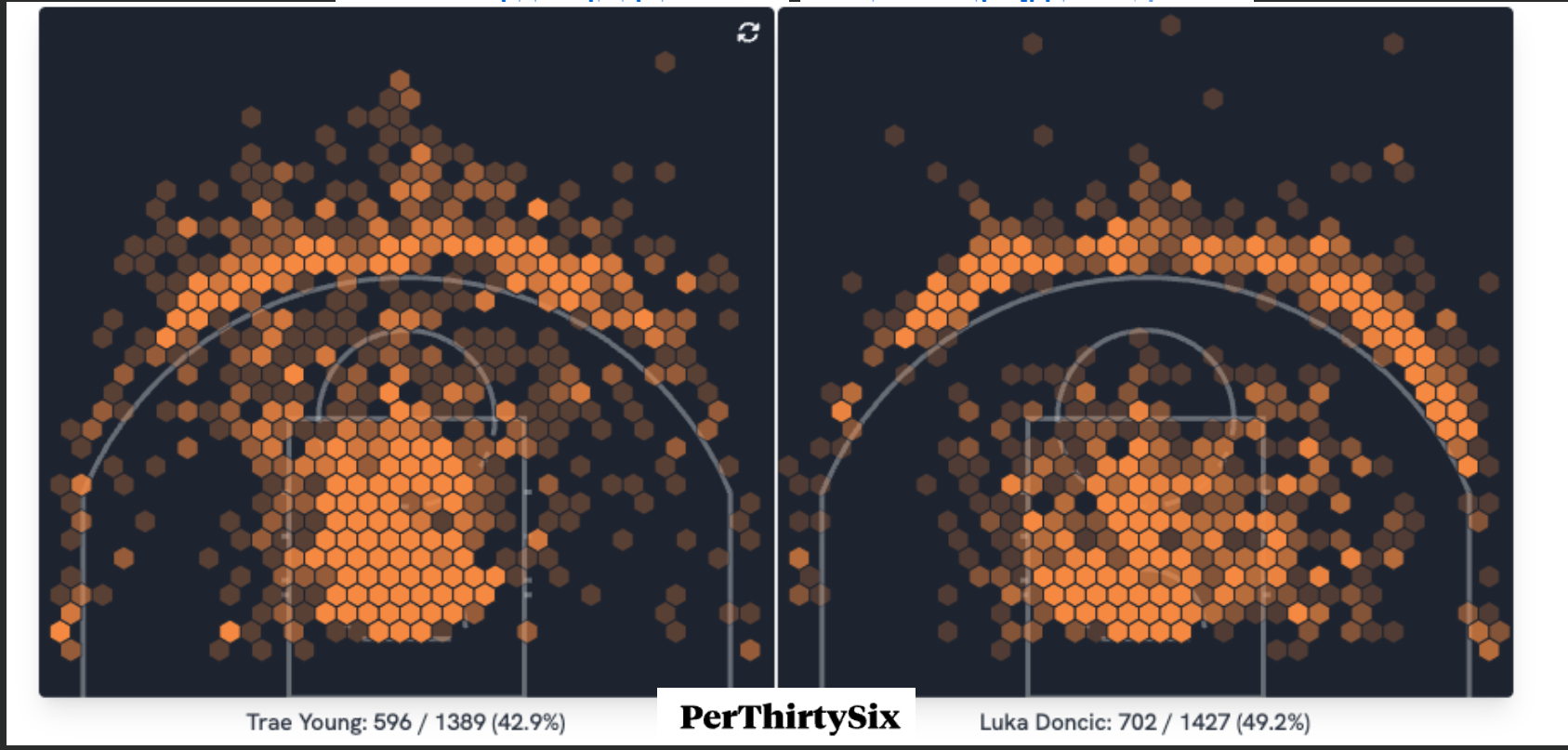
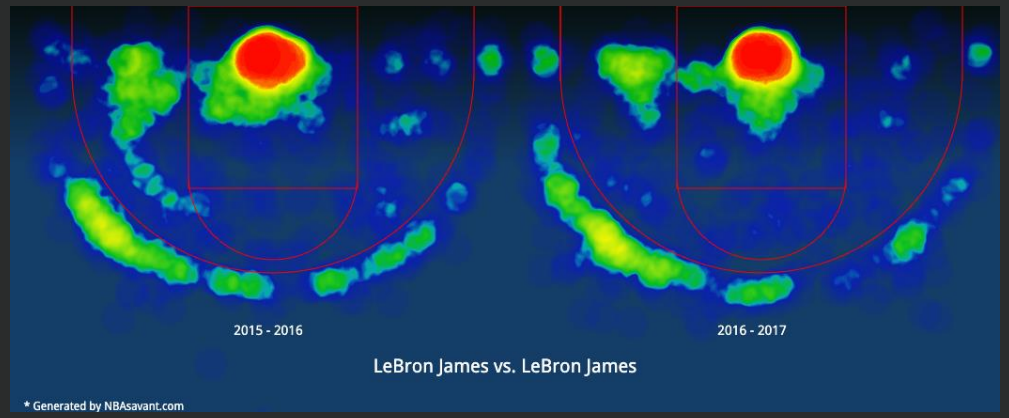
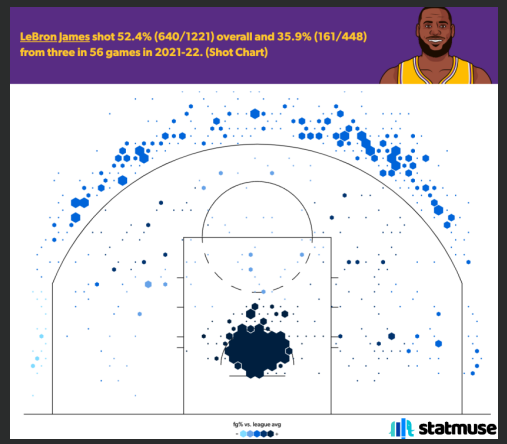
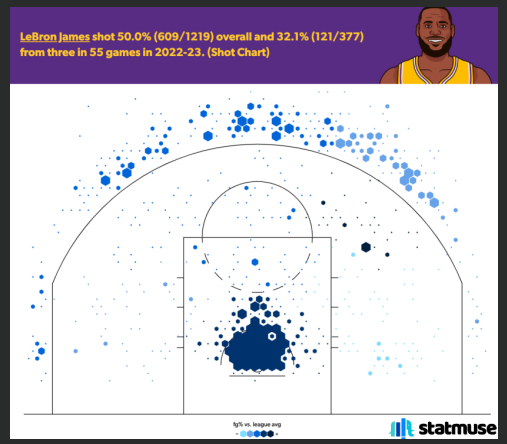
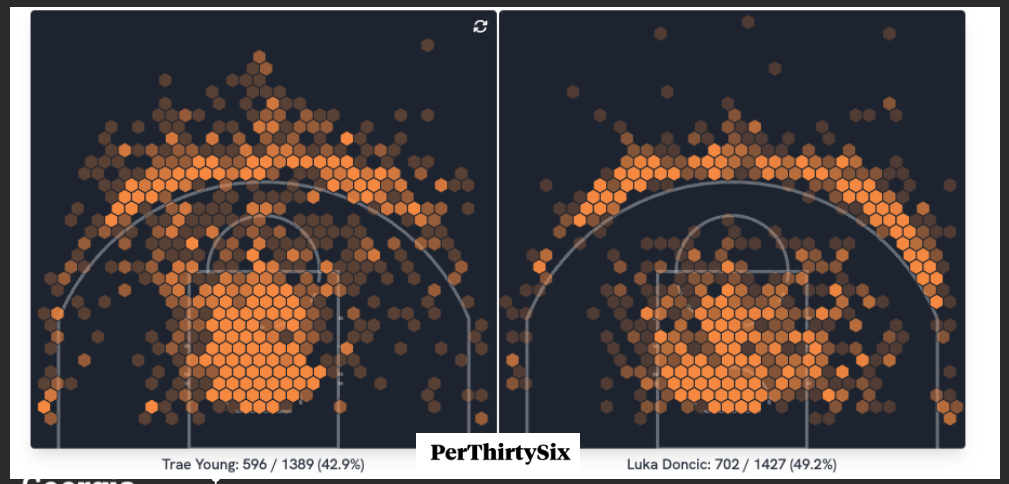





2015 - 2016
2016 - 2017
LeBron James vs. LeBron James
* Generated by NBAsavant.com


LeBron James shot 52.4% (640/1221) overall and 35.9% (161/448) from three in 56 games in 2021-22. (Shot Chart)
statmuse

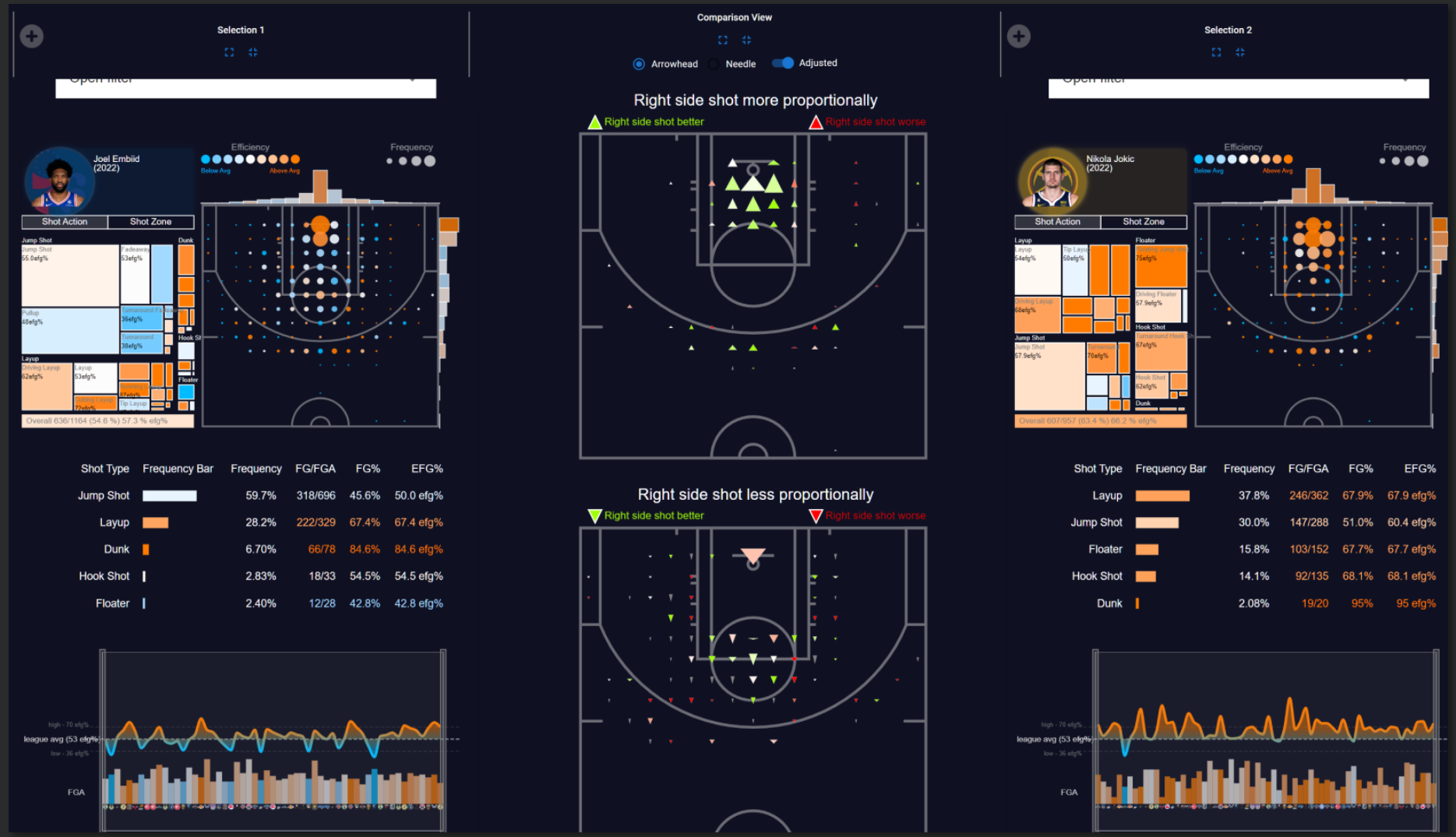

LeBron James shot 50.0% (609/1219) overall and 32.1% (121/377) from three in 55 games in 2022-23. (Shot Chart)
statmuse


Trae Young: 596 / 1389 (42.9%)
PerThirtySix
Luka Doncic: 702 / 1427 (49.2%)

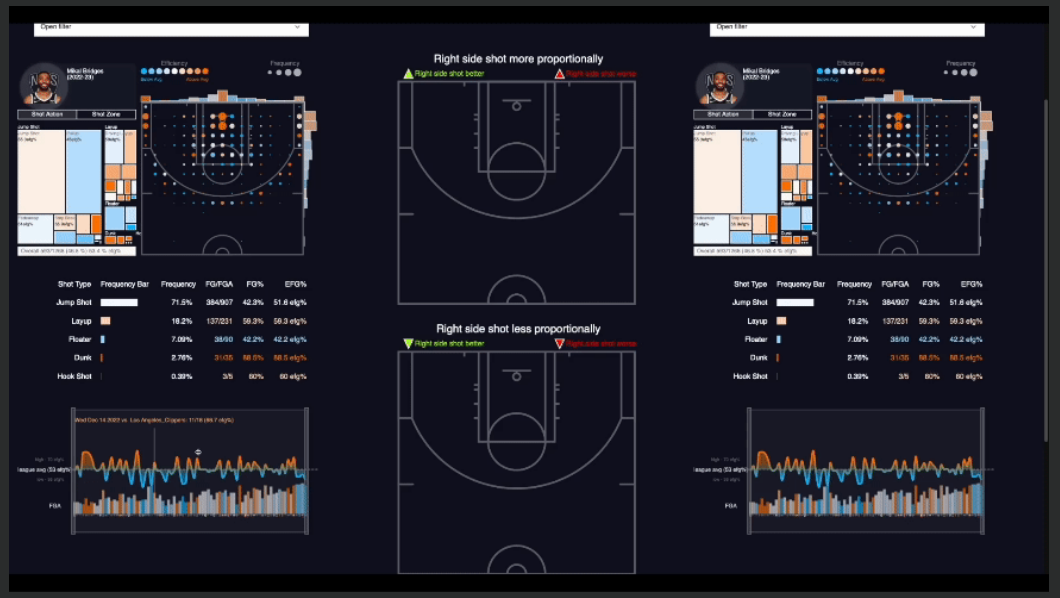

sheepfilms.co.uk

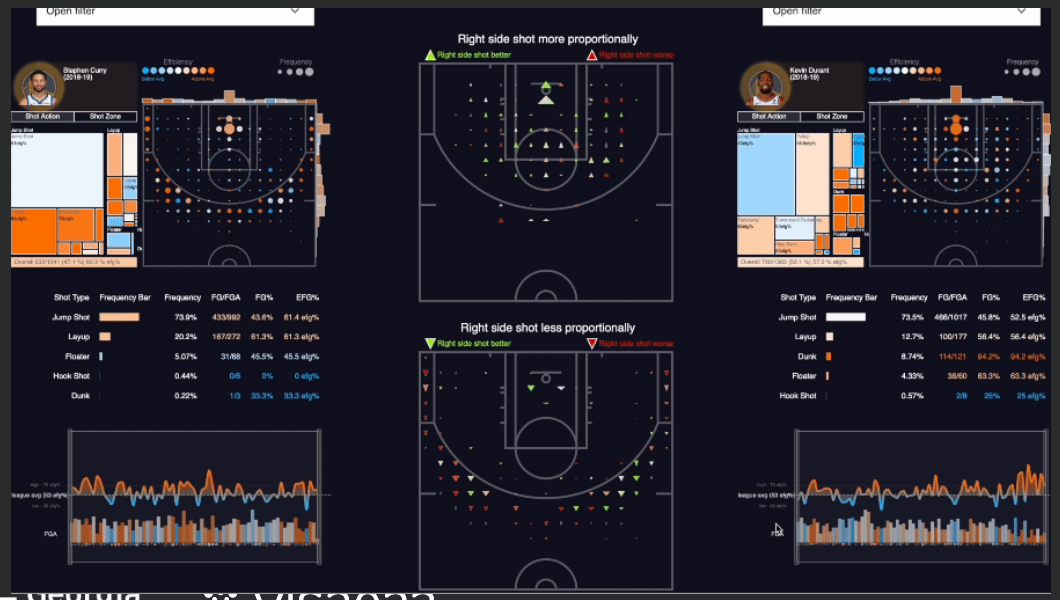
this you?

HoopInSight Interface

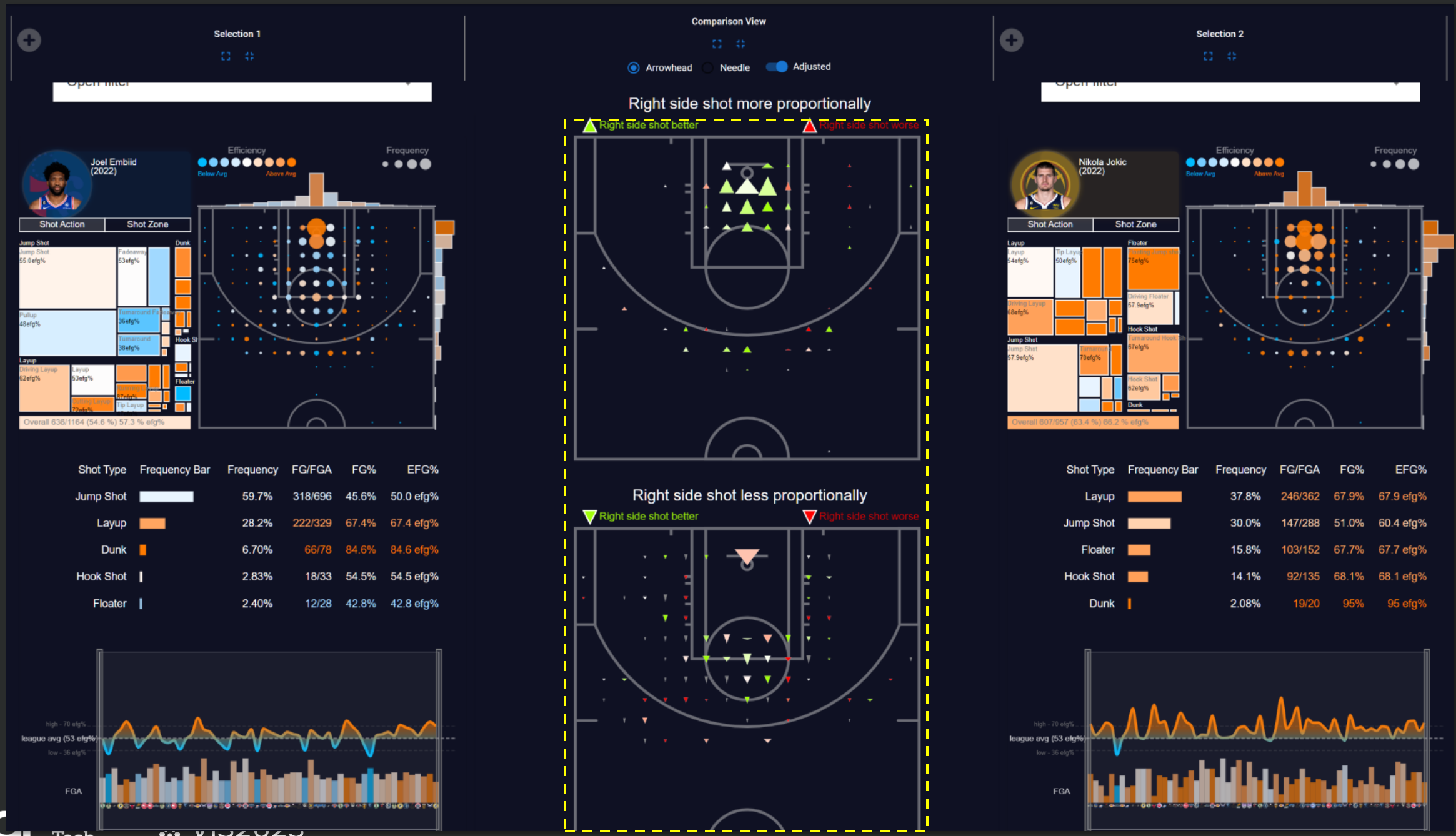



Open filter
Tree Young (2021-22)
Shot Action
Shot Zone
Right side shot more proportionally
Right side shot better
Right side shot worse
Right side shot less proportionally
Shot Type Frequency Bar Frequency FG/FGA FG% EFG%
Jump Shot 55.8% 369/863 41.5% 55.0 efg%
Floater 23.8% 176/369 47.6% 47.6 efg%
Layup 20.1% 175/311 56.2% 56.2 efg%
Hook Shot 0.06% 1/1 100% 100 efg%
Tree Young (2022-23)
Jump Shot 48.4% 248/674 36.7% 48.2 efg%
Floater 28.9% 195/402 48.5% 48.5 efg%
Layup 22.5% 154/313 49.2% 49.2 efg%
Hook Shot 0.07% 0/1 0% 0 efg%
FGA


Open filter
Right side shot more proportionally
Right side shot better
Right side shot worse
Right side shot less proportionally
Shot Type Frequency Bar Frequency FG/FGA FG% EFG%
Jump Shot 71.5% 384/907 42.3% 51.6 efg%
Layup 18.2% 137/231 59.3% 59.3 efg%
Floater 7.09% 38/90 42.2% 42.2 efg%
Dunk 2.76% 31/35 88.6% 88.6 efg%
Hook Shot 0.39% 3/5 60% 60 efg%
FGA


Open filter
Stephen Curry (2018-19)
Shot Action
Shot Zone
Right side shot more proportionally
Right side shot better
Right side shot worse
Right side shot less proportionally
Shot Type Frequency Bar Frequency FG/FGA FG% EFG%
Jump Shot 73.9% 433/992 43.6% 61.4 efg%
Layup 20.2% 167/272 61.3% 81.3 efg%
Floater 5.07% 31/68 45.5% 45.5 efg%
Hook Shot 0.44% 0/6 0% 0 efg%
Dunk 0.22% 1/3 33.3% 33.3 efg%
Kevin Durant (2018-19)
Jump Shot 73.5% 466/1017 45.8% 52.5 efg%
Layup 12.7% 100/177 56.4% 56.4 efg%
Dunk 8.74% 114/121 94.2% 94.2 efg%
Floater 4.33% 38/60 63.3% 63.3 efg%
Hook Shot 0.57% 2/8 25% 25 efg%
FGA

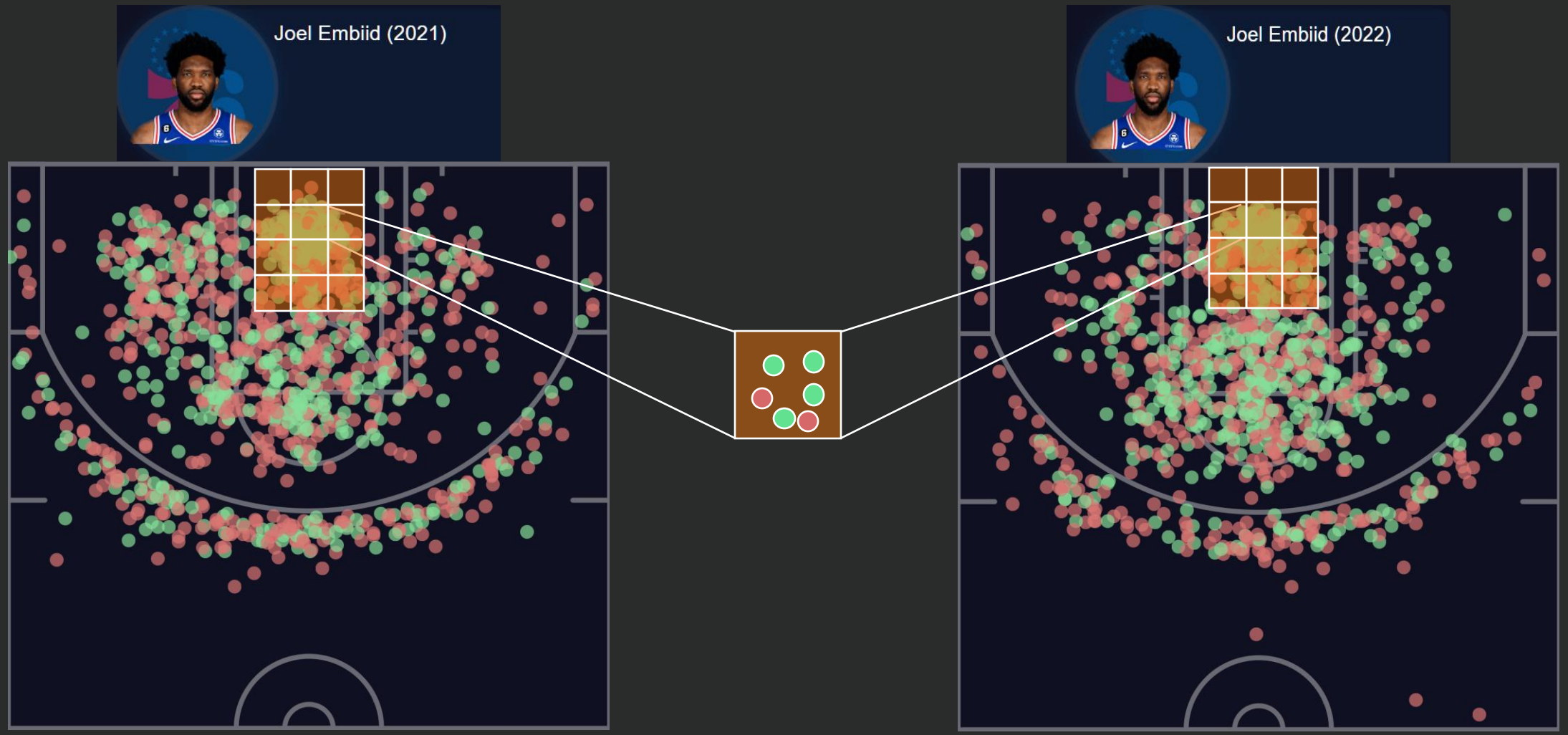

Open filter
Aaron Gordon (2022-23)
Shot Action
Shot Zone
Right side shot more proportionally
Right side shot better
Right side shot worse
Right side shot less proportionally
Shot Type Frequency Bar Frequency FG/FGA FG% EFG%
Layup 35.0% 145/267 54.3% 54.3 efg%
Jump Shot 34.8% 89/265 33.5% 44.9 efg%
Dunk 26.4% 181/201 90.0% 90.0 efg%
Hook Shot 2.36% 8/18 44.4% 44.4 efg%
Floater 1.31% 6/10 60% 60 efg%
FGA

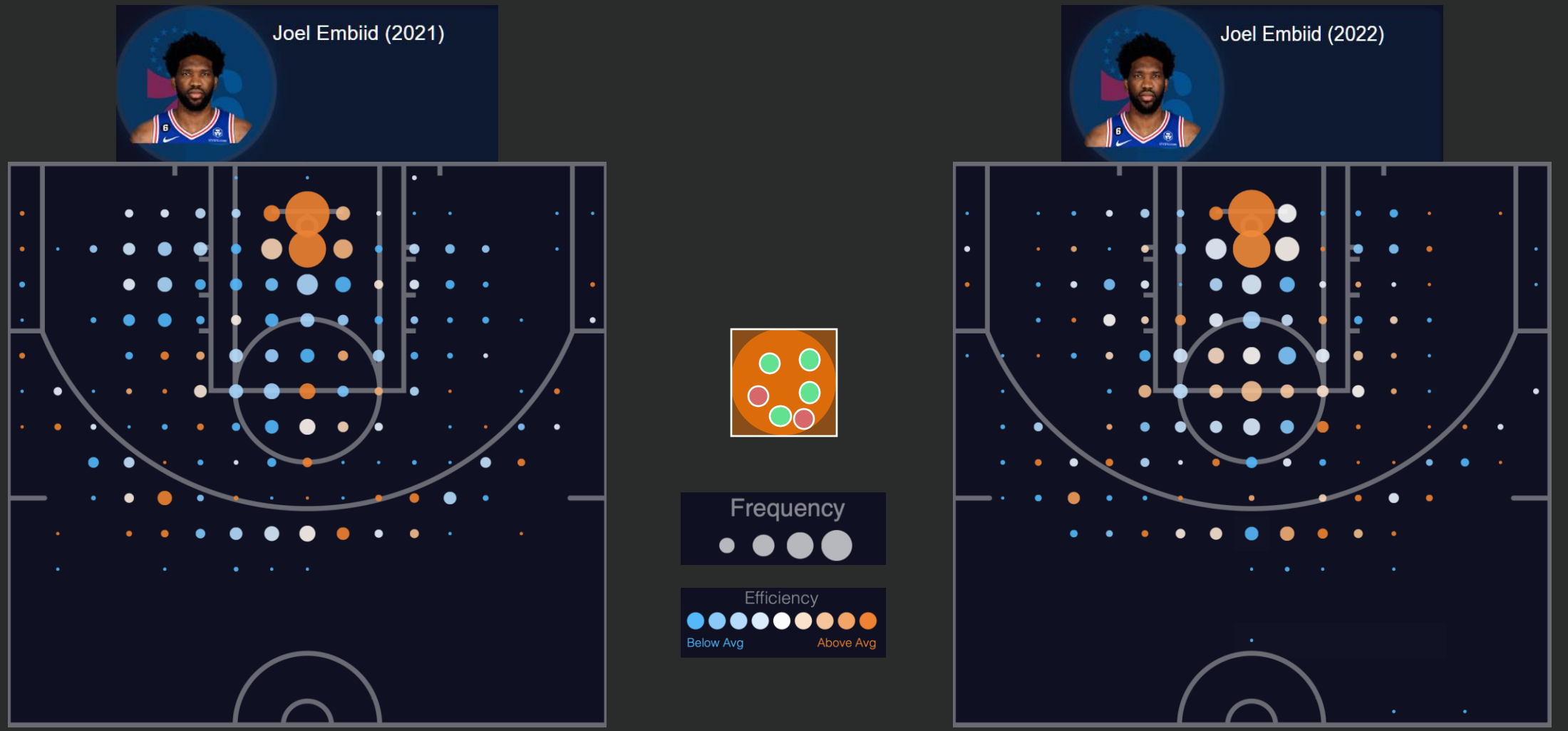


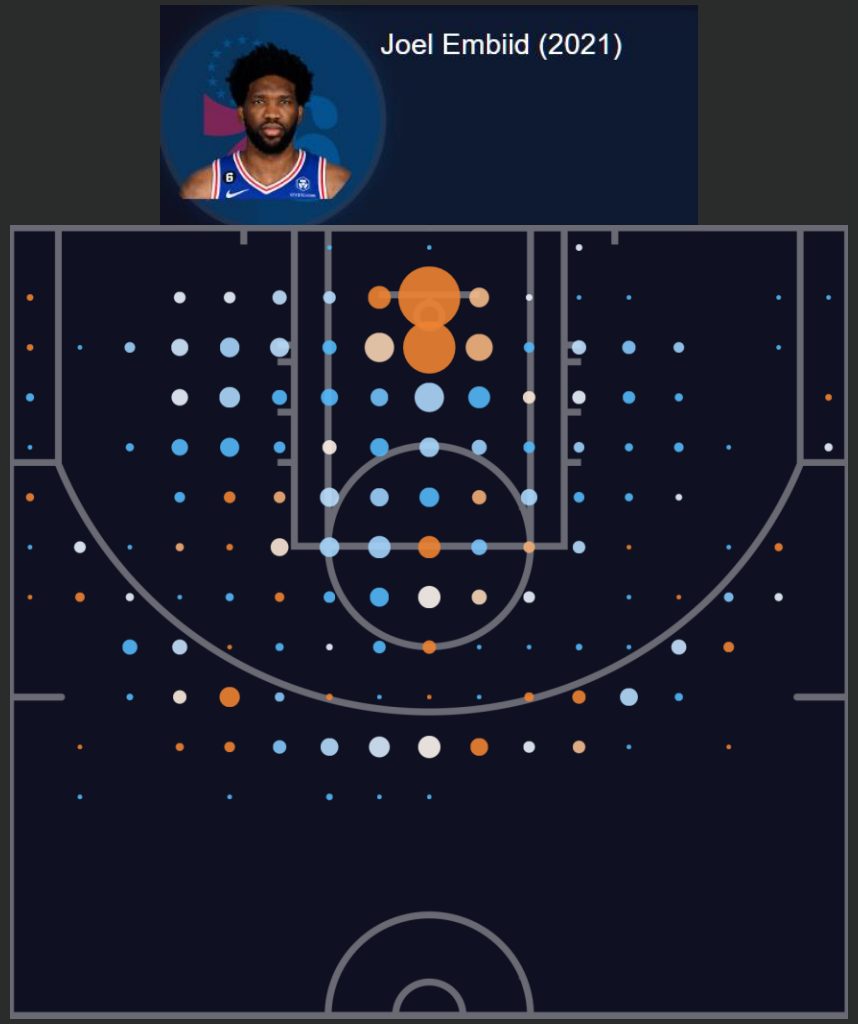
Shot Type	Frequency Bar	Frequency	FG/FGA	FG%	EFG%
Jump Shot		59.7%	318/696	45.6%	50.0 efg%
Layup		28.2%	222/329	67.4%	67.4 efg%
Dunk		6.70%	66/78	84.6%	84.6 efg%
Hook Shot		2.83%	18/33	54.5%	54.5 efg%
Floater		2.40%	12/28	42.8%	42.8 efg%

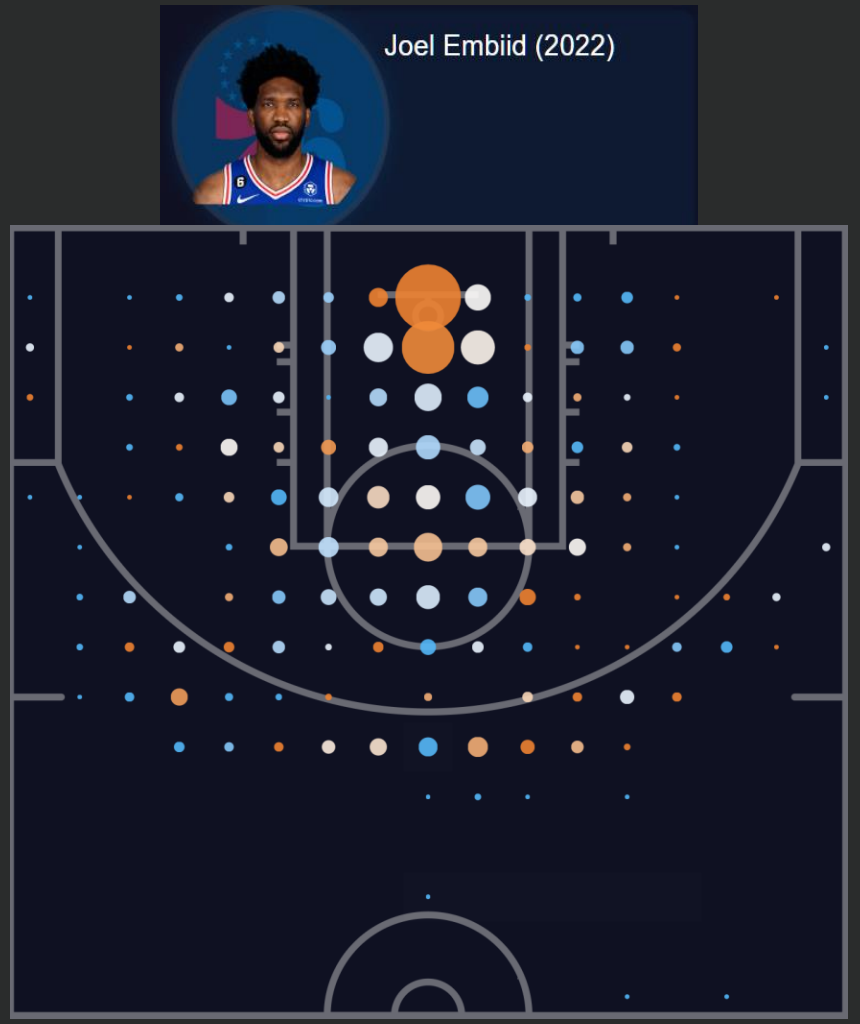
Shot Type	Frequency Bar	Frequency	FG/FGA	FG%	EFG%
Layup		37.8%	246/362	67.9%	67.9 efg%
Jump Shot		30.0%	147/288	51.0%	60.4 efg%
Floater		15.8%	103/152	67.7%	67.7 efg%
Hook Shot		14.1%	92/135	68.1%	68.1 efg%
Dunk		2.08%	19/20	95%	95 efg%

Design Visual Technique




Joel Embiid (2021)
Joel Embiid (2022)
Frequency
Efficiency
Below Avg
Above Avg

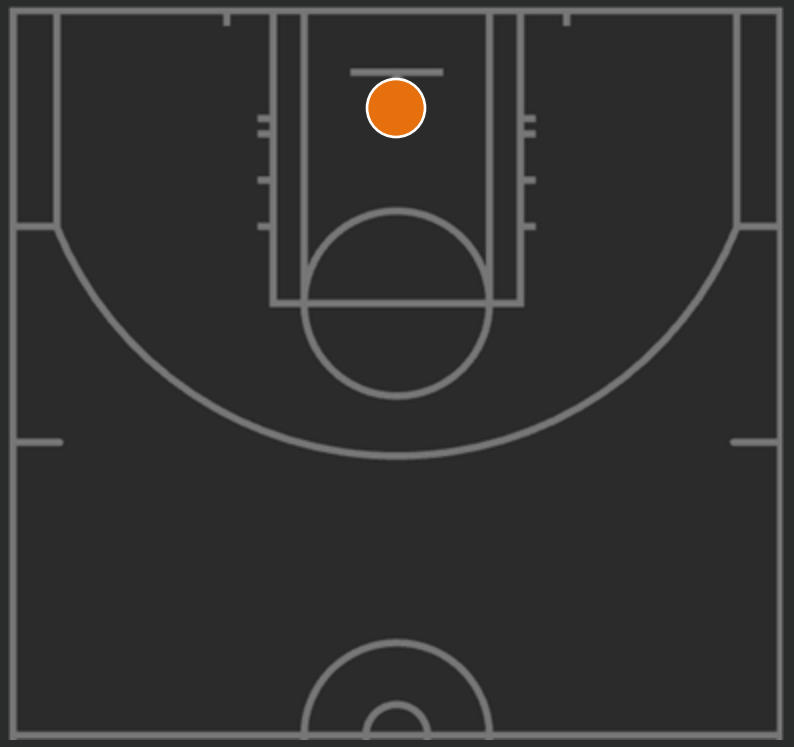




- Where did he take more or fewer shots?
- Was he shooting better or worse from different locations?

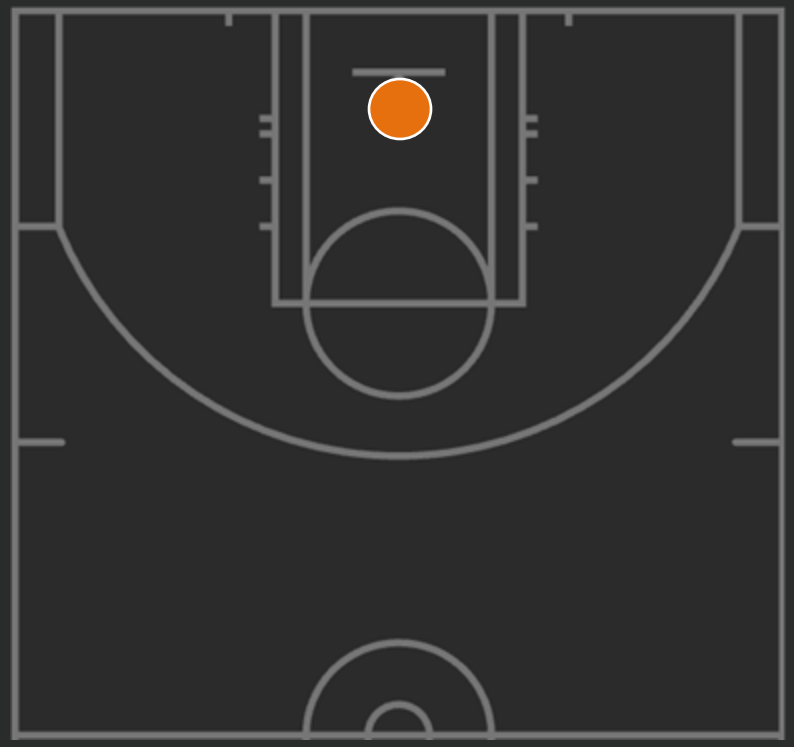
2022 season

50/80 = 63% shots made



2023 season

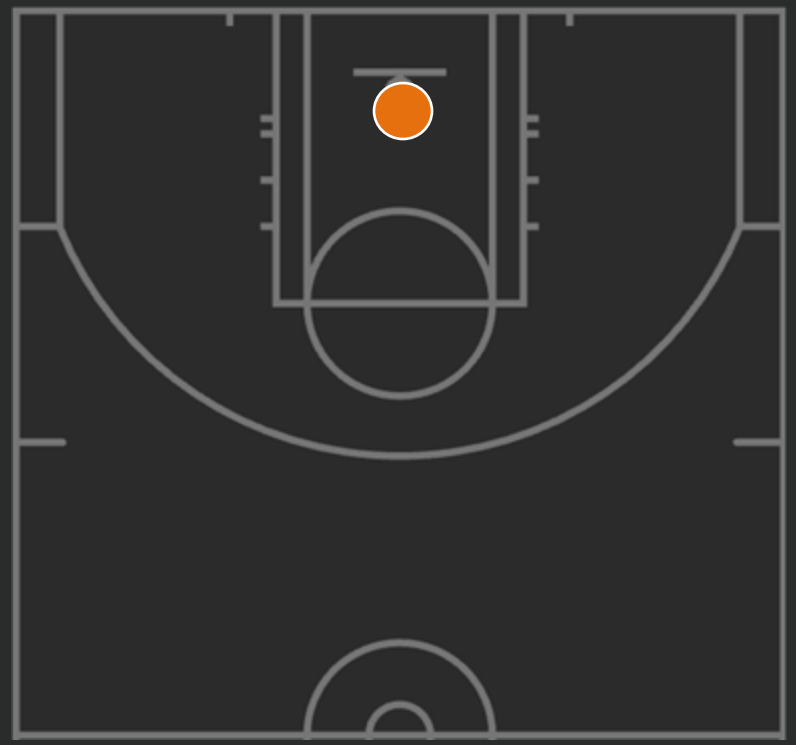
53/90 = 59% shots made



Hypothetical statistics
Assume both sides took the same number of shots overall

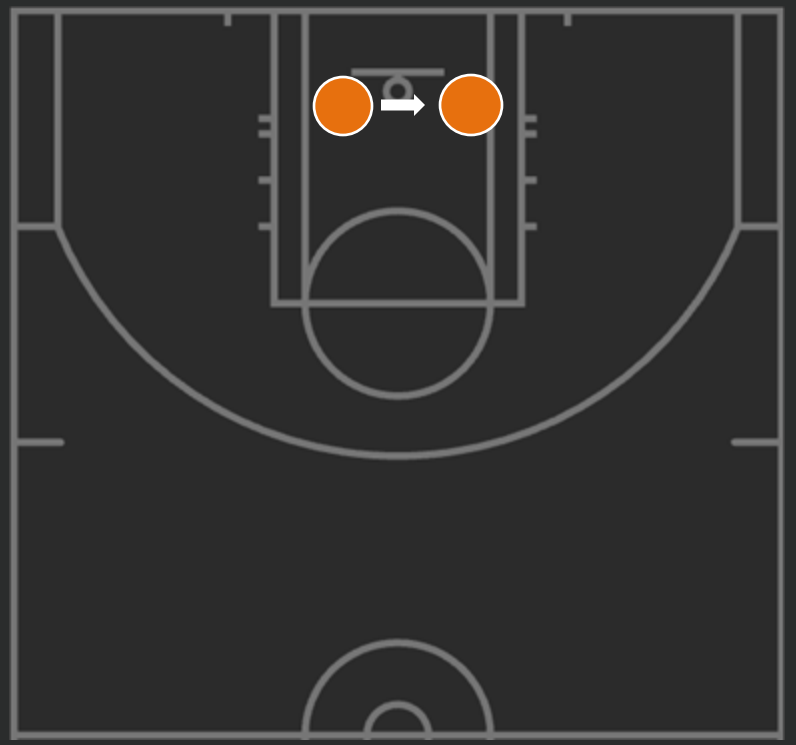
2022 season

50/80 = 63% shots made



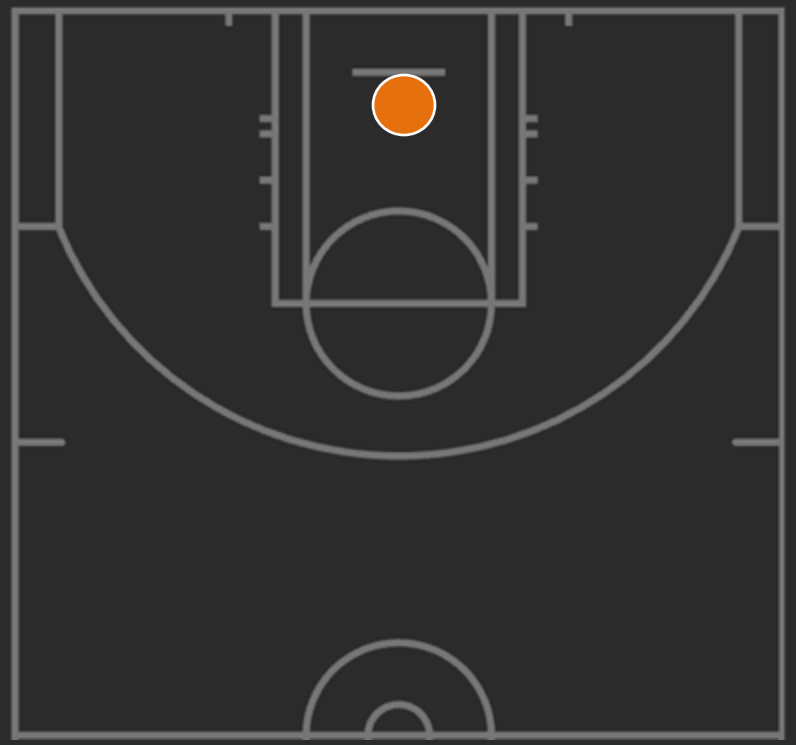
Differences

+10 FGA
-4% FG%



2023 season

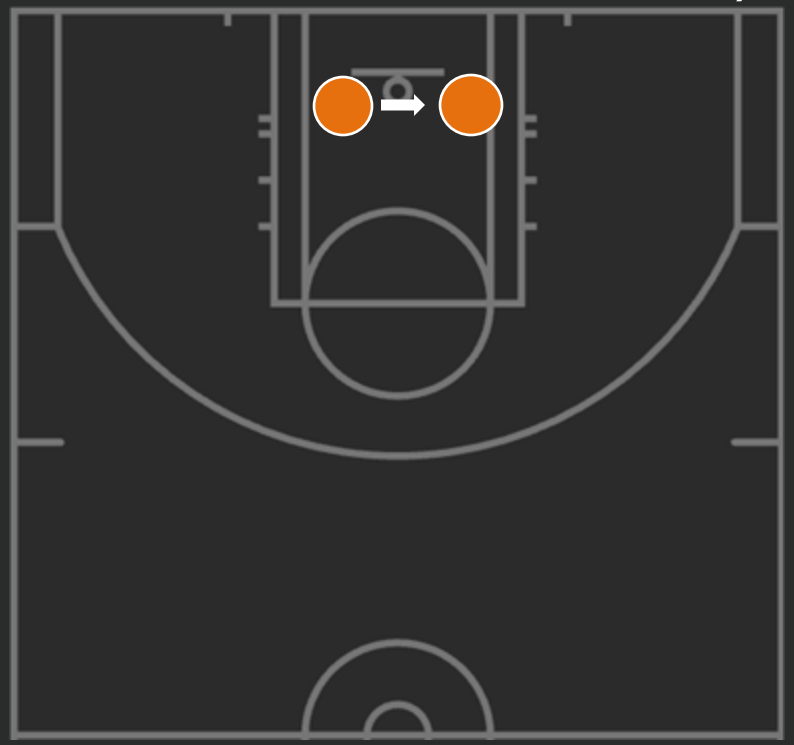
53/90 = 59% shots made



Differences

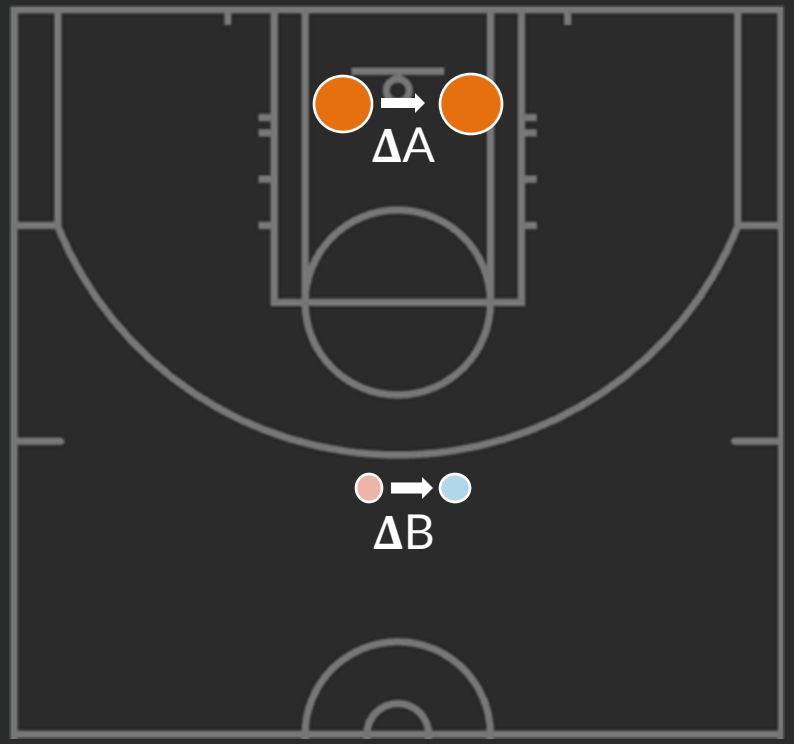
+10 FGA →Δ in Frequency

-4% FG% →Δ in Efficiency

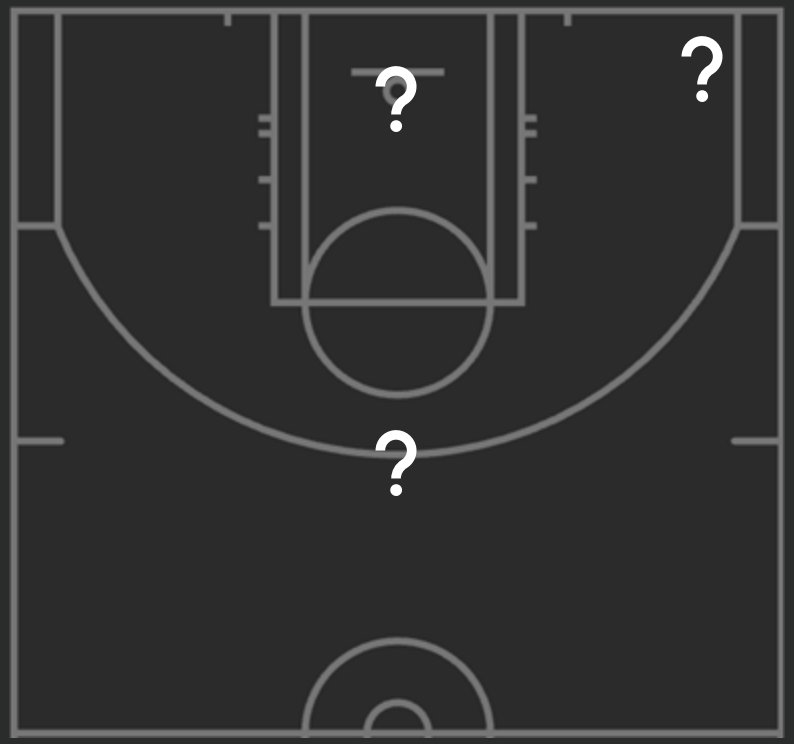


Values to show for each location

1. Δ in Frequency
2. Δ in Efficiency
3. Overall Frequency

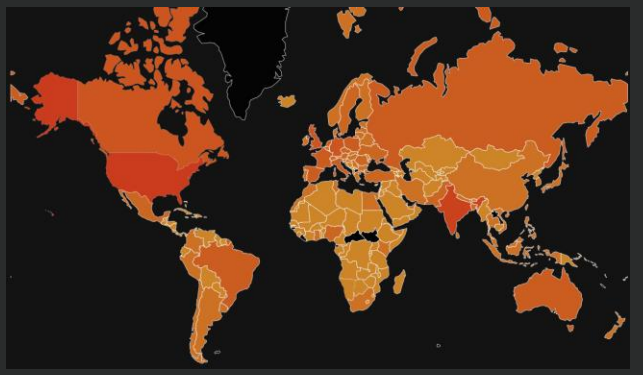


Design Comparison Visual Technique

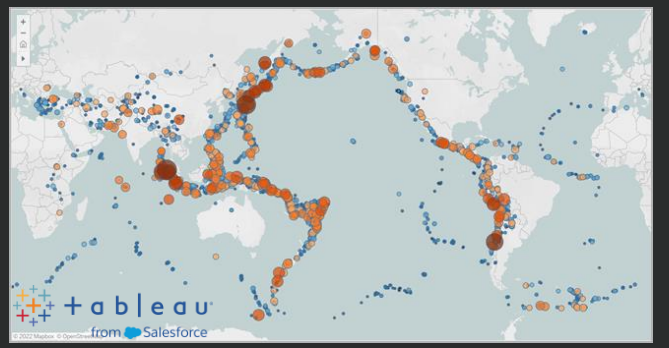


Goals:

- Visualize three variables in a geospatial context



1 variable

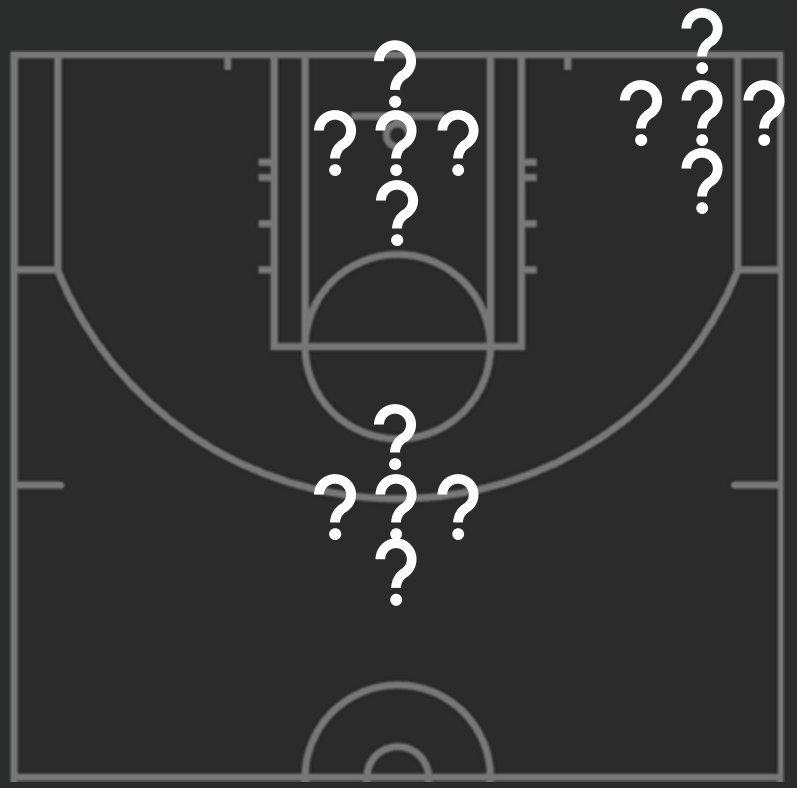


2 variables

?

3+ variables?

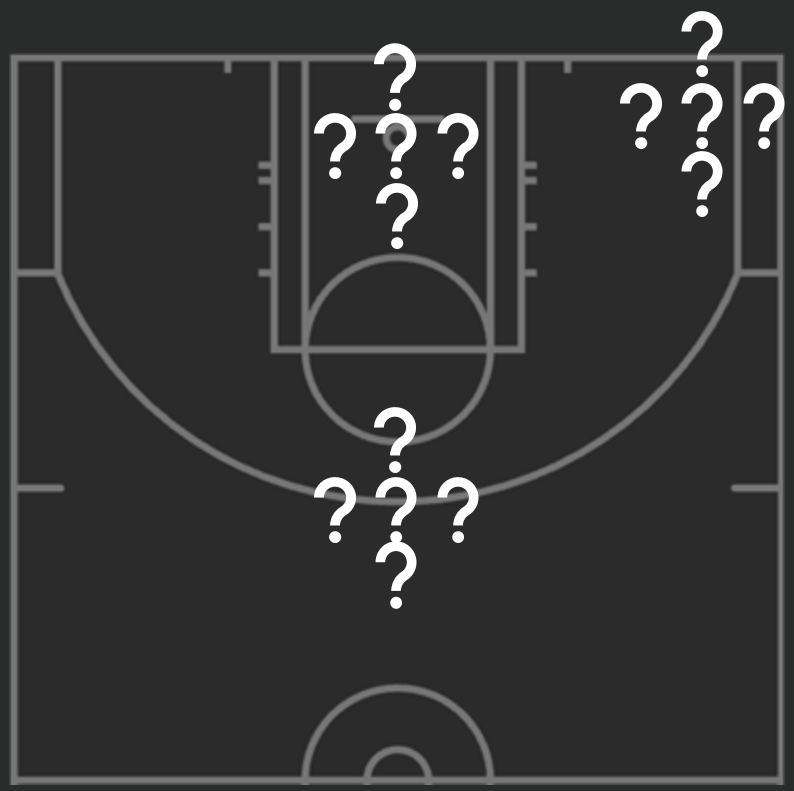
Design Comparison Visual Technique



Goals:

- Visualize multiple variables in a geospatial context
- Strike a balance between individual cell interpretability and group pattern

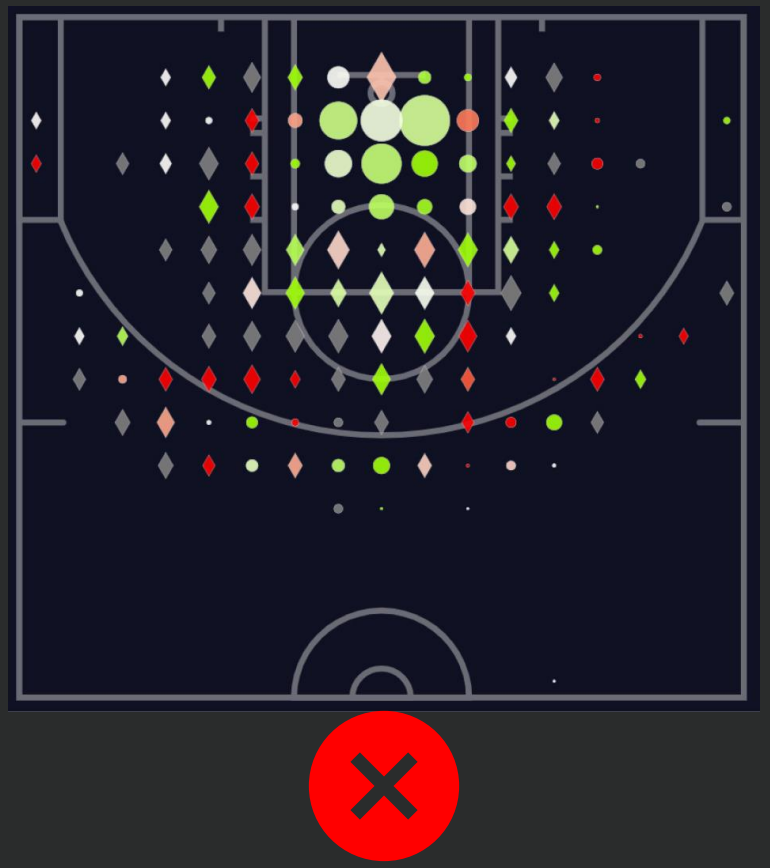
Design Comparison Visual Technique



Goals:

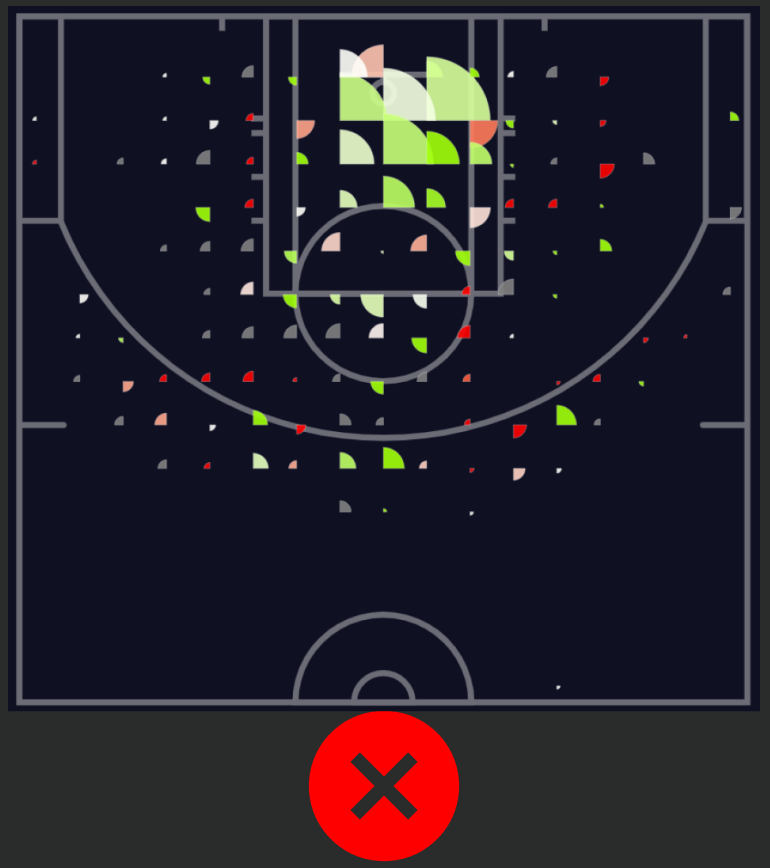
- Visualize multiple variables in a geospatial context
- Strike a balance between individual cell interpretability and group pattern
- Support pre-attentive processing of the most important domain insights

One single view designs



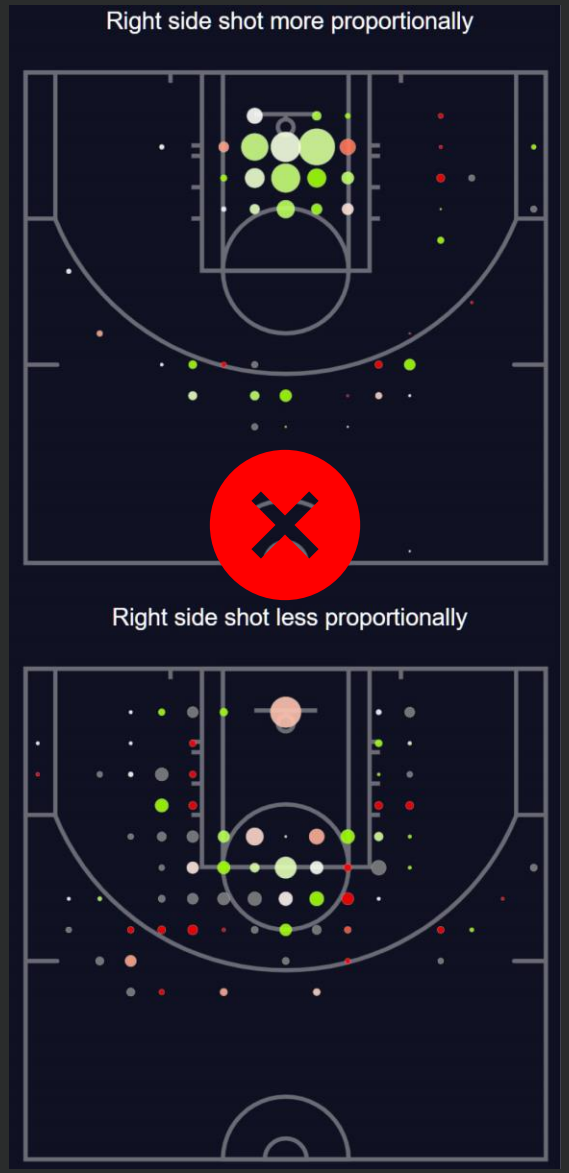
Alternative encodings we explored but did not choose

One single view designs



Alternative encodings we explored but did not choose

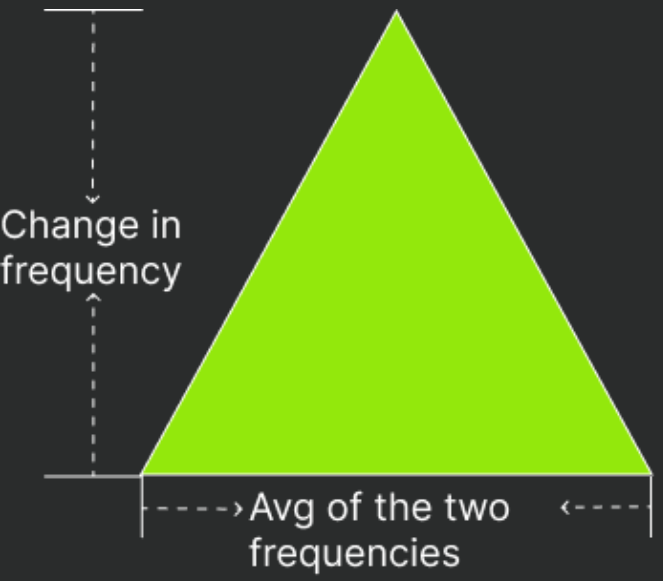
Two sub-views designs

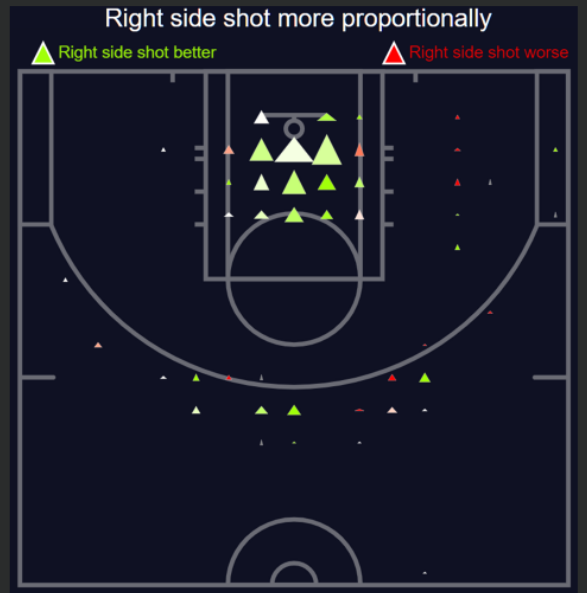


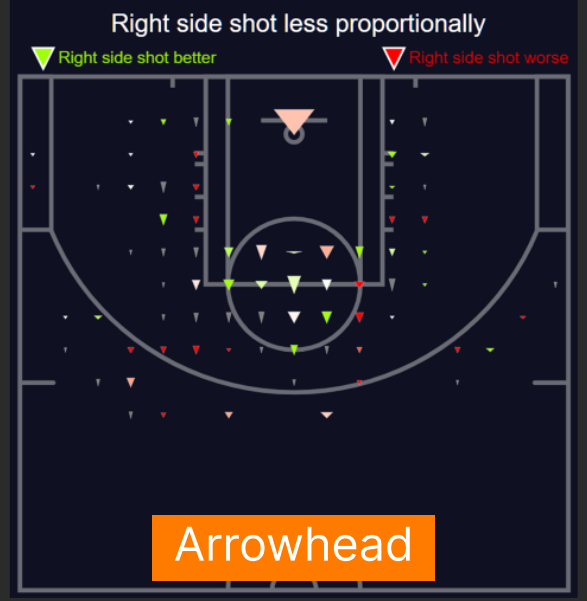
Alternative encodings we explored but did not choose

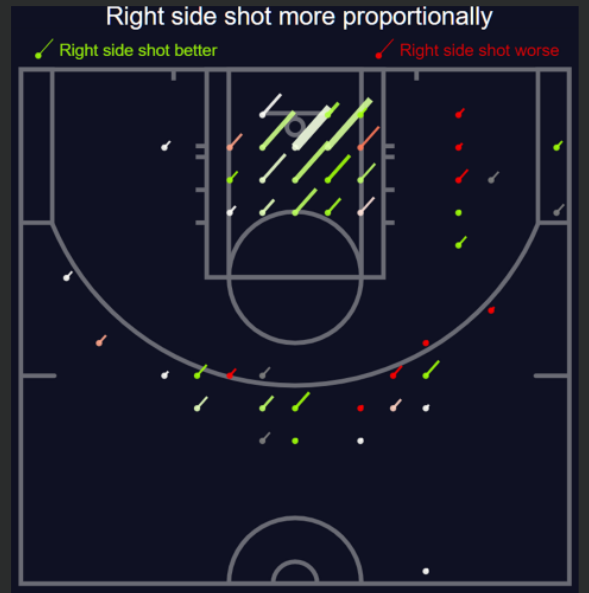
Two sub-views designs

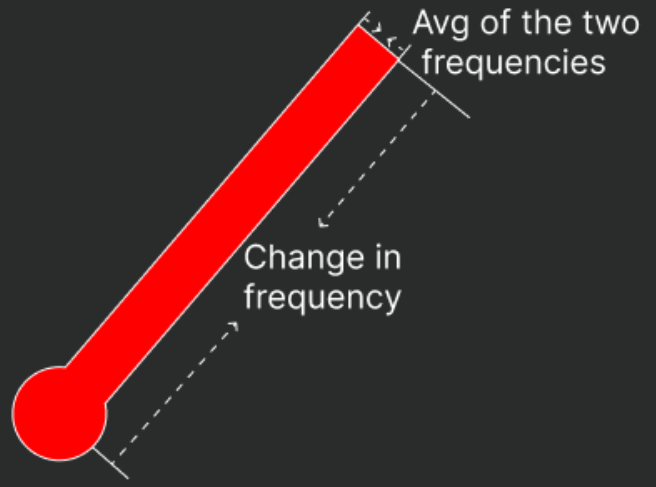
Alternative encodings we explored but did not choose









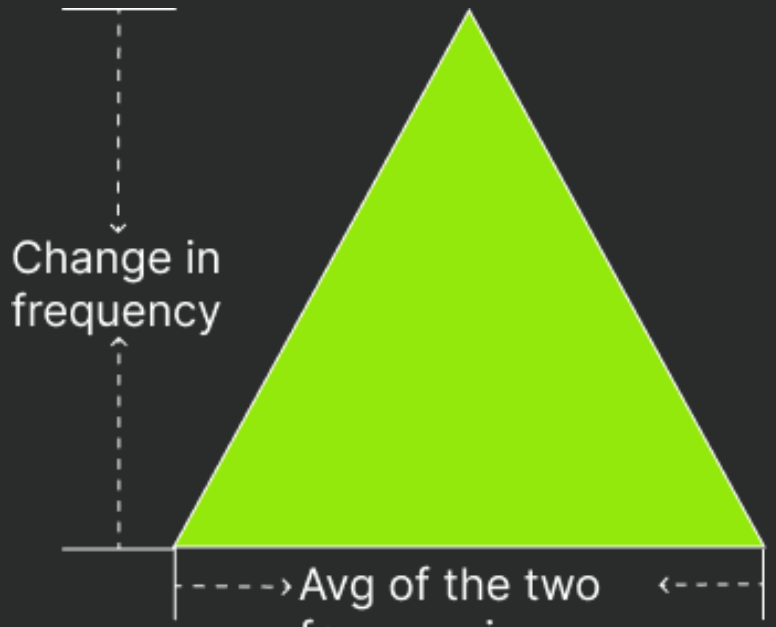


Two chosen designs

Arrowhead Encoding

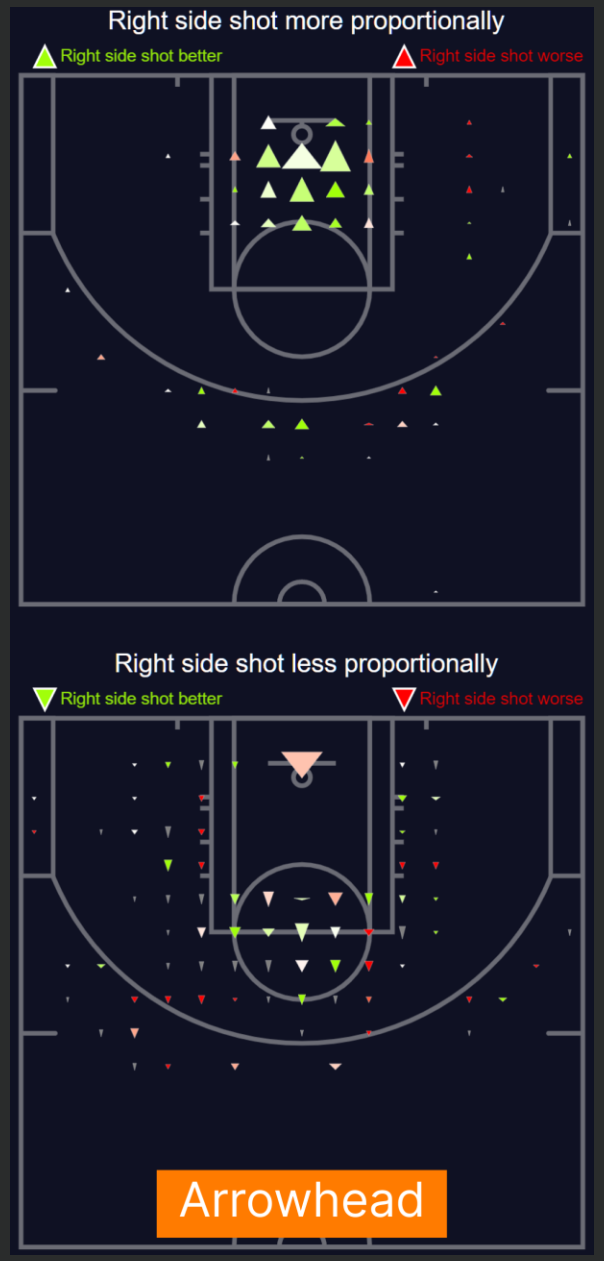
more change

less change

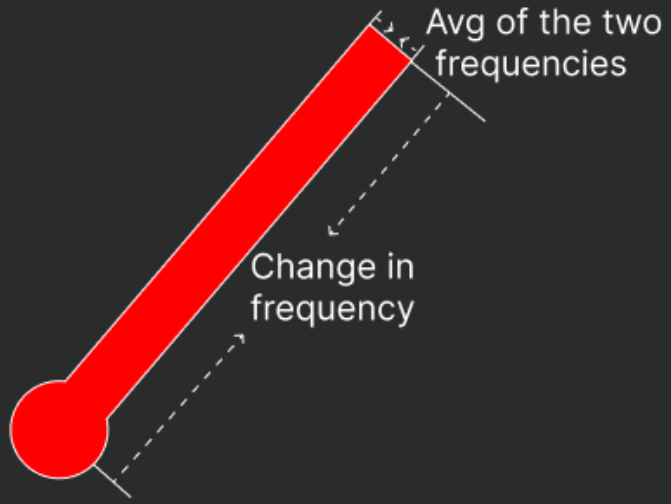


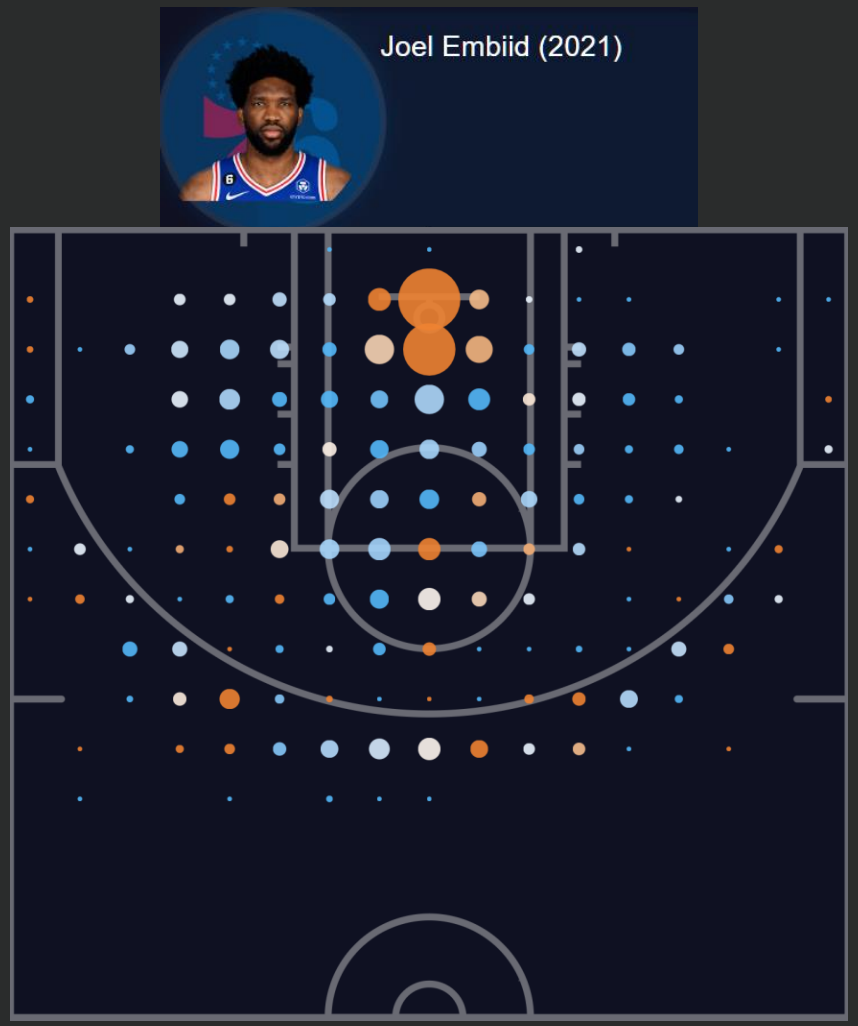
more overall

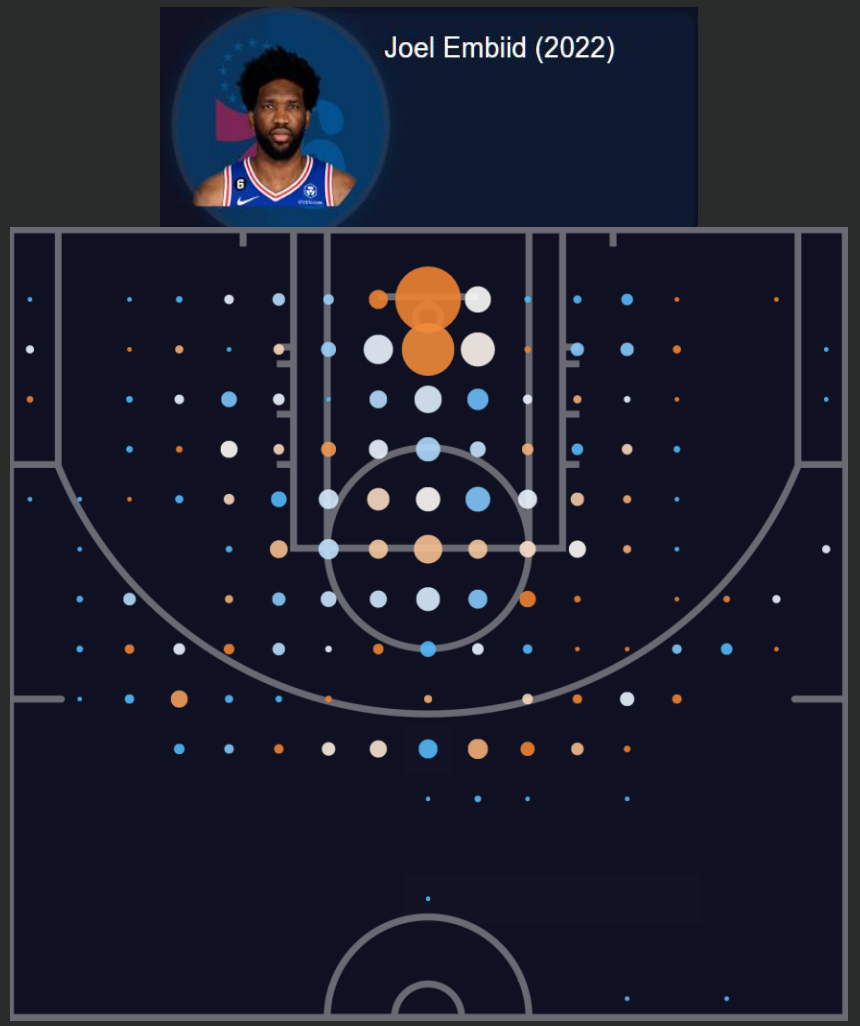
less overall

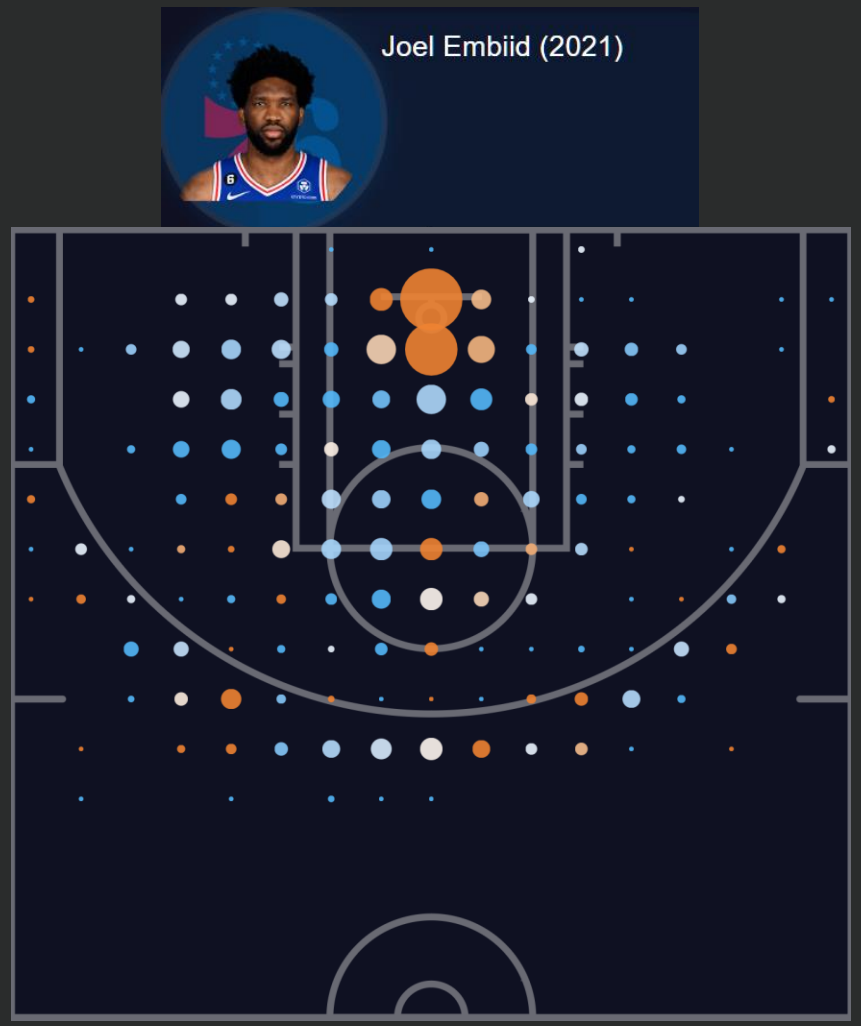


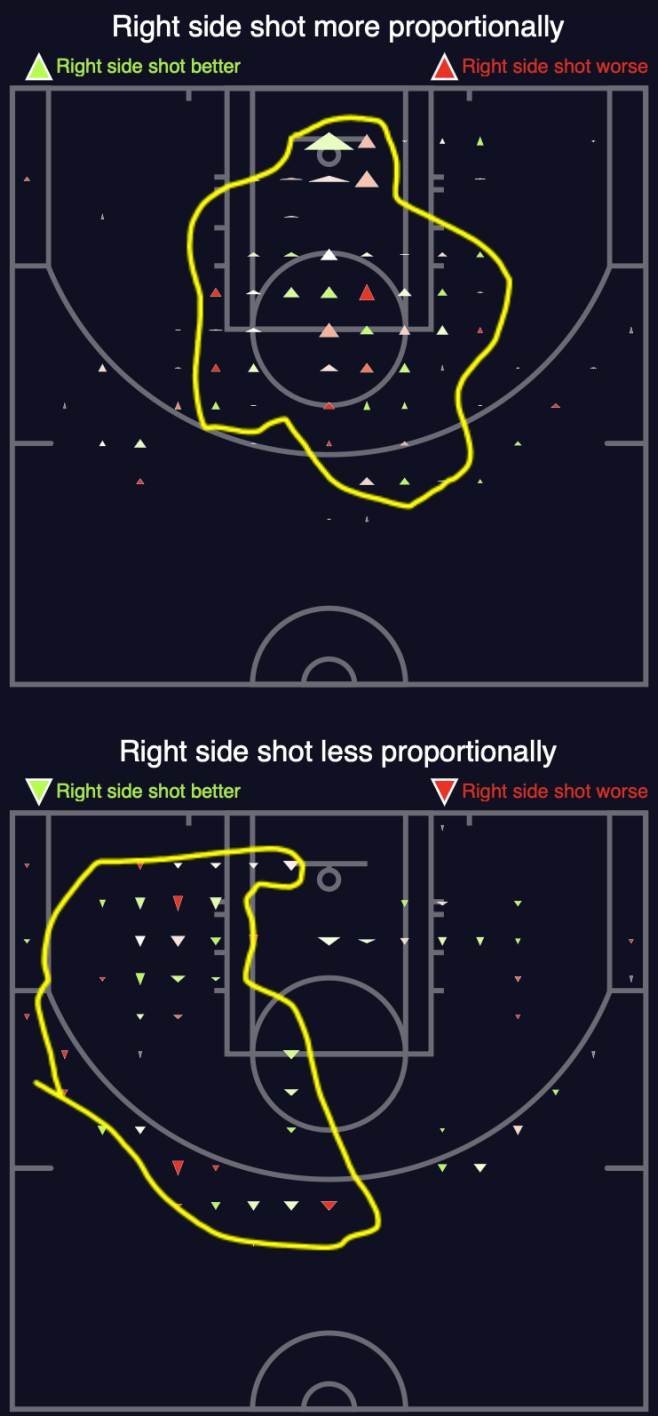
Needle Encoding

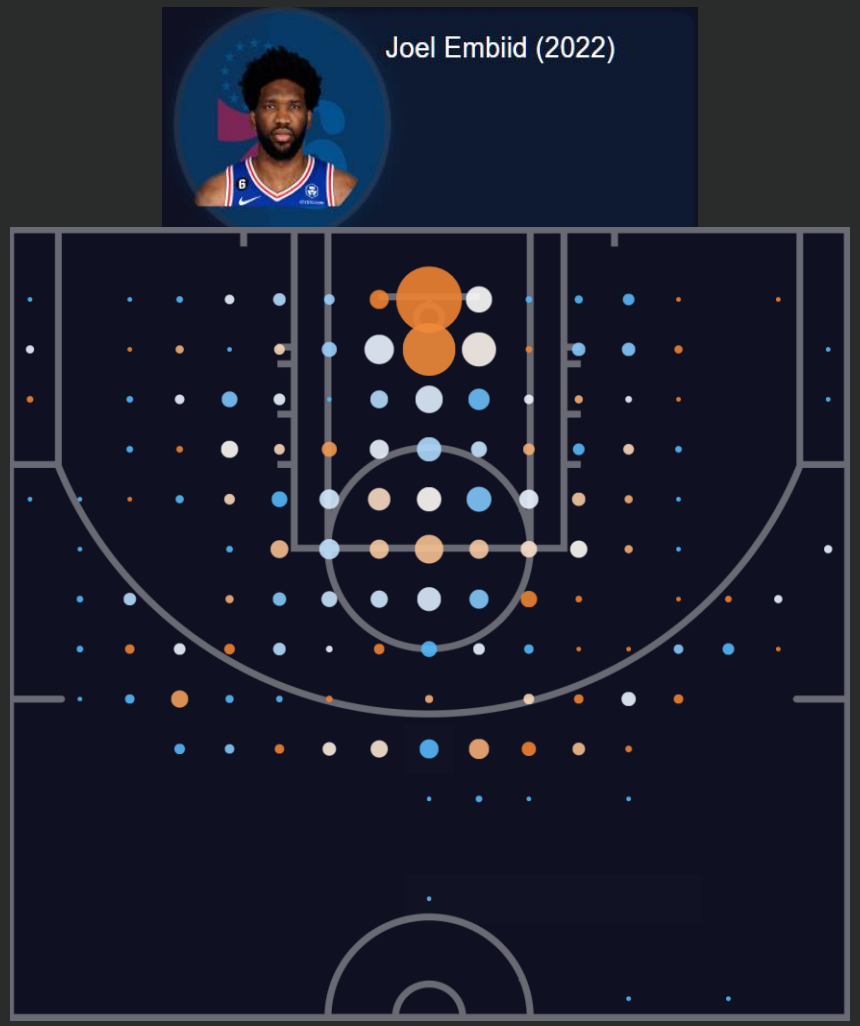



Joel Embiid (2021)


Joel Embiid (2022)

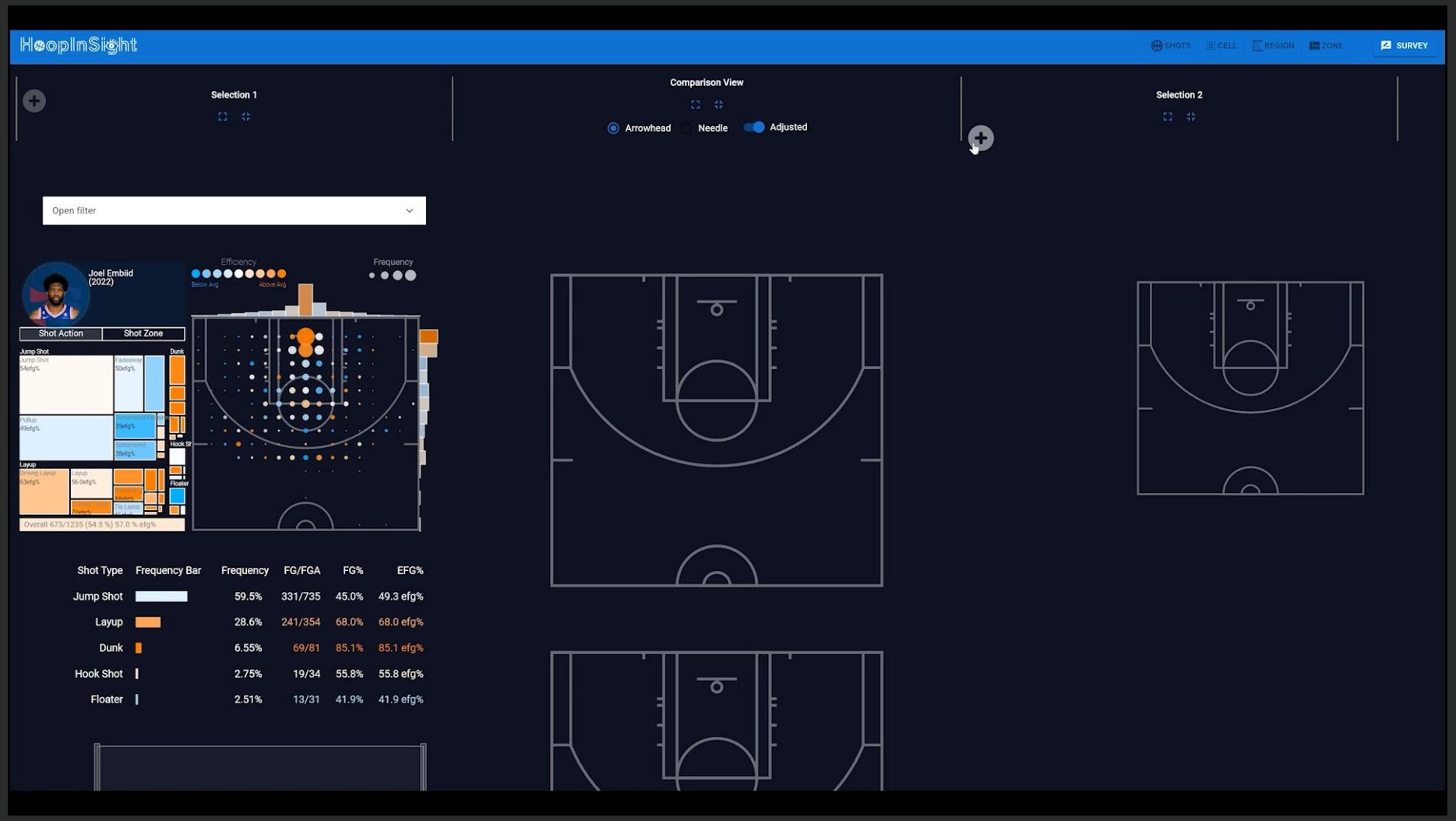

Joel Embiid (2021)


Right side shot more proportionally
Right side shot better
Right side shot worse
Right side shot less proportionally
Right side shot better
Right side shot worse


Joel Embiid (2022)

HoopInSight Interactions

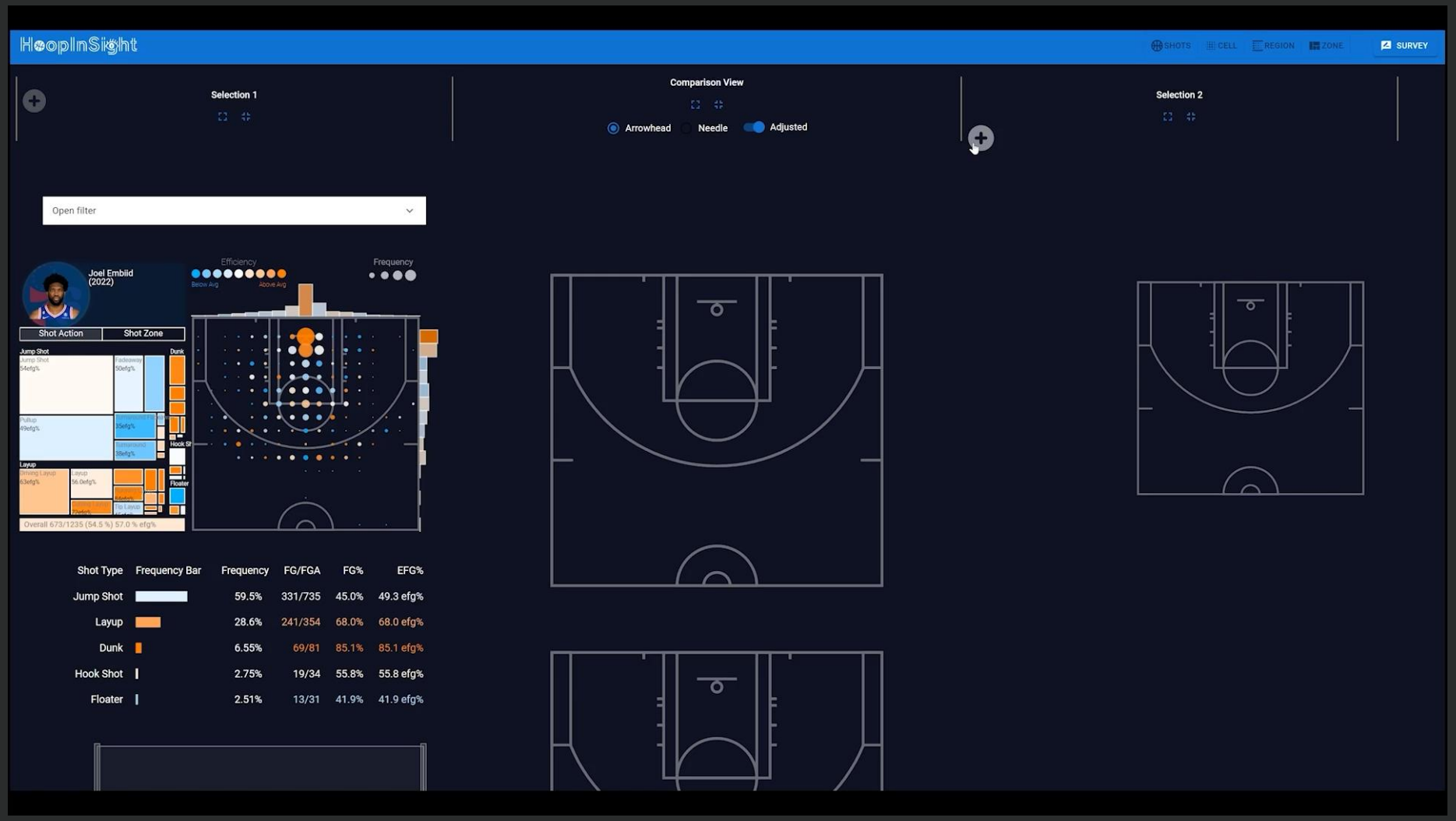
Different Entity Selection



HoopInSight Interactions

Different Entity Selection

Temporal Filtering

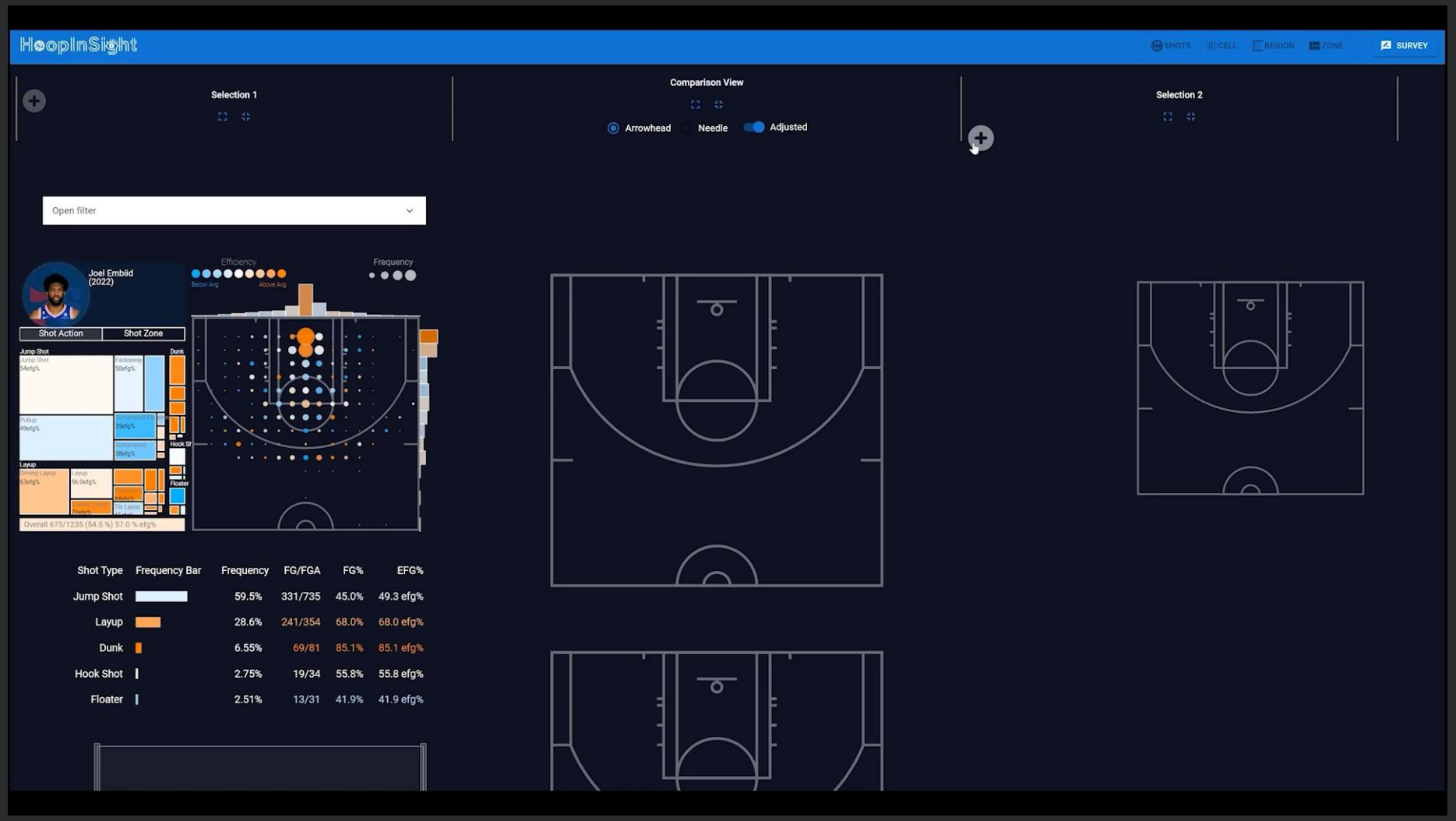


HoopInSight Interactions

Different Entity Selection

Temporal Filtering

Categorical Filtering



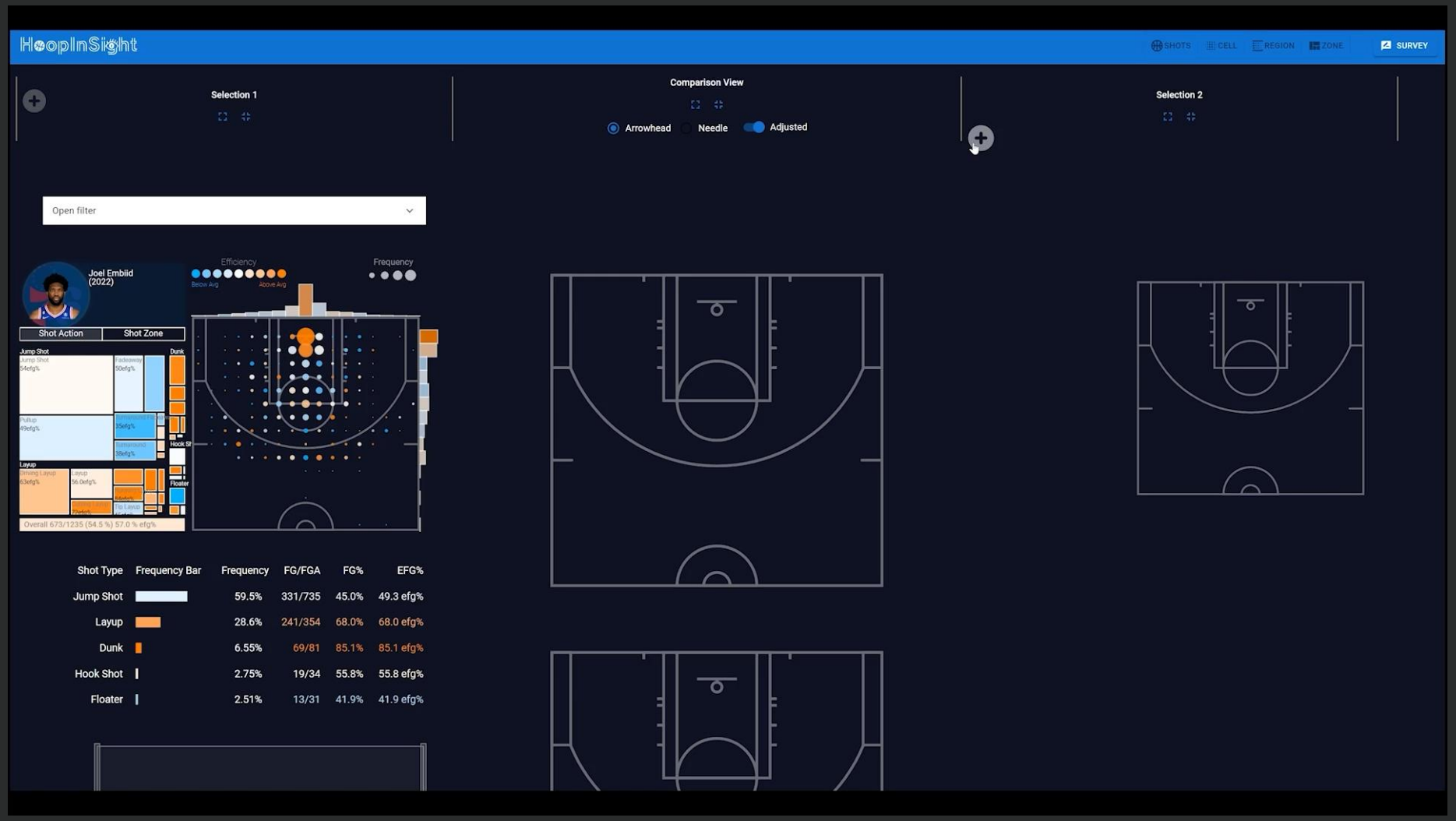
HoopInSight Interactions

Different Entity Selection

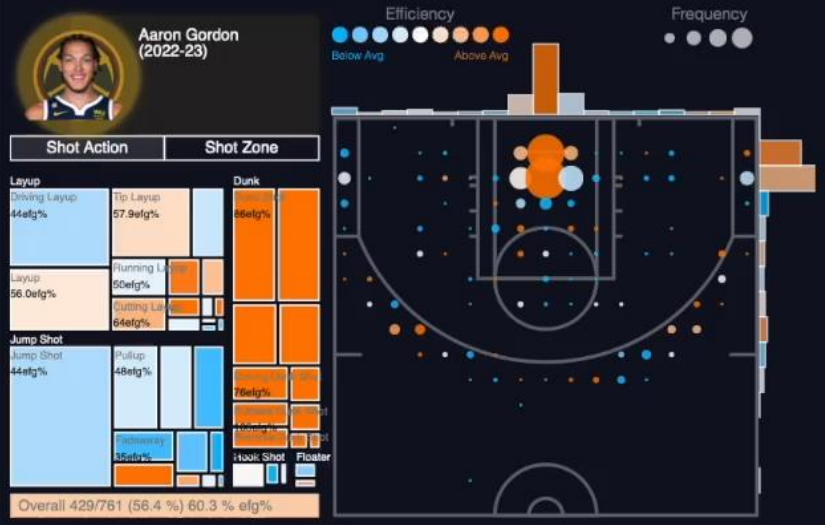
Temporal Filtering

Categorical Filtering

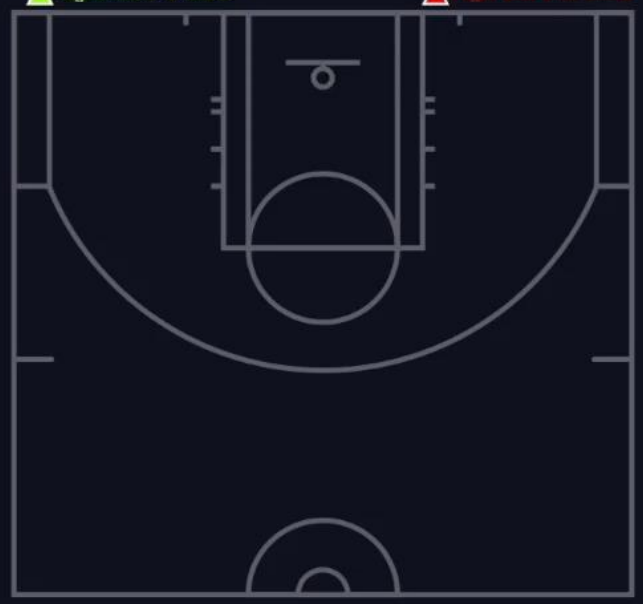
Freehand Selection



Open filter

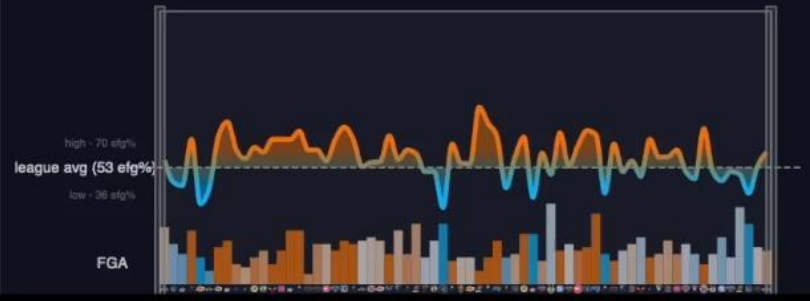


Right side shot more proportionally



Right side shot less proportionally

Shot Type	Frequency Bar	Frequency	FG/FGA	FG%	EFG%
Layup		35.0%	145/267	54.3%	54.3 efg%
Jump Shot		34.8%	89/265	33.5%	44.9 efg%
Dunk		26.4%	181/201	90.0%	90.0 efg%
Hook Shot		2.36%	8/18	44.4%	44.4 efg%
Floater		1.31%	6/10	60%	60 efg%



Open filter

Aaron Gordon
(2022-23)
Efficiency
Below Avg
Above Avg
Frequency
Shot Action
Shot Zone
Overall 429/761 (56.4 %) 60.3 % efg%

Shot Type	Frequency Bar	Frequency	FG/FGA	FG%	EFG%
Layup		35.0%	145/267	54.3%	54.3 efg%
Jump Shot		34.8%	89/265	33.5%	44.9 efg%
Dunk		26.4%	181/201	90.0%	90.0 efg%
Hook Shot		2.36%	8/18	44.4%	44.4 efg%
Floater		1.31%	6/10	60%	60 efg%

high - 70 efg%
league avg (53 efg%)
low - 36 efg%
FGA

Shot Type	Frequency Bar	Frequency	FG/FGA	FG%	EFG%
Jump Shot		43.0%	23/65	35.3%	45.3 efg%
Layup		36.4%	28/55	50.9%	50.9 efg%
Dunk		15.2%	19/23	82.6%	82.6 efg%
Hook Shot		3.97%	3/6	50%	50 efg%
Floater		1.32%	1/2	50%	50 efg%

Shot Type	Frequency Bar	Frequency	FG/FGA	FG%	EFG%
Layup		34.7%	117/212	55.1%	55.1 efg%
Jump Shot		32.7%	66/200	33%	44.7 efg%
Dunk		29.1%	162/178	91.0%	91.0 efg%
Hook Shot		1.96%	5/12	41.6%	41.6 efg%
Floater		1.31%	5/8	62.5%	62.5 efg%

Reflection and Discussion

- Design Considerations for Spatial Comparison

Reflection and Discussion

- Design Considerations for Spatial Comparison
- Scalability and Transferability

Reflection and Discussion

- Design Considerations for Spatial Comparison
- Scalability and Transferability
- Designing as Domain Experts (DaDE)

Benefits
- More manageable process
- Focusing on novel solutions
- Synergy of domain knowledge and visualization expertise

Pitfalls
- Narrow domain perspectives
- Prioritizing experts over casual users
- Task/data explosion

Thank you!

HoopInSight

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Paper