What factors are associated with 3-point shooting accuracy in the NBA?

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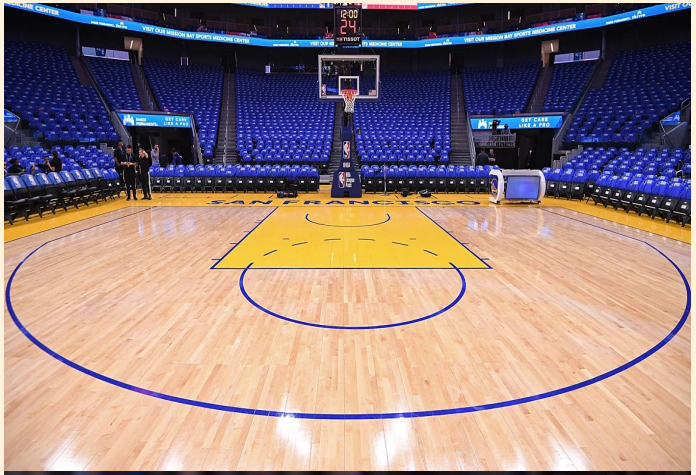
Motivation

- Strategic importance: Teams increasingly rely on 3-point shots for scoring efficiency
- Player evaluation: Understanding shooting accuracy helps teams identify valuable players and optimize lineups
- Game management: Coaches need data-driven insights on when, where, and who should take 3-point shots
- Analytics gap: While teams track shooting data, public understanding of what drives 3-point success remains limited
- Our goal: Identify which factors meaningfully affect 3-point shooting accuracy using shot-level data



Expected Findings

Player characteristics:

- More experienced players → Higher accuracy
- Guards → Higher accuracy than centers

Shot context:

- Closer distance → Higher accuracy
- Home games → Small accuracy boost
- Later quarters → Lower accuracy

Temporal trends:

- League-wide improvement over time

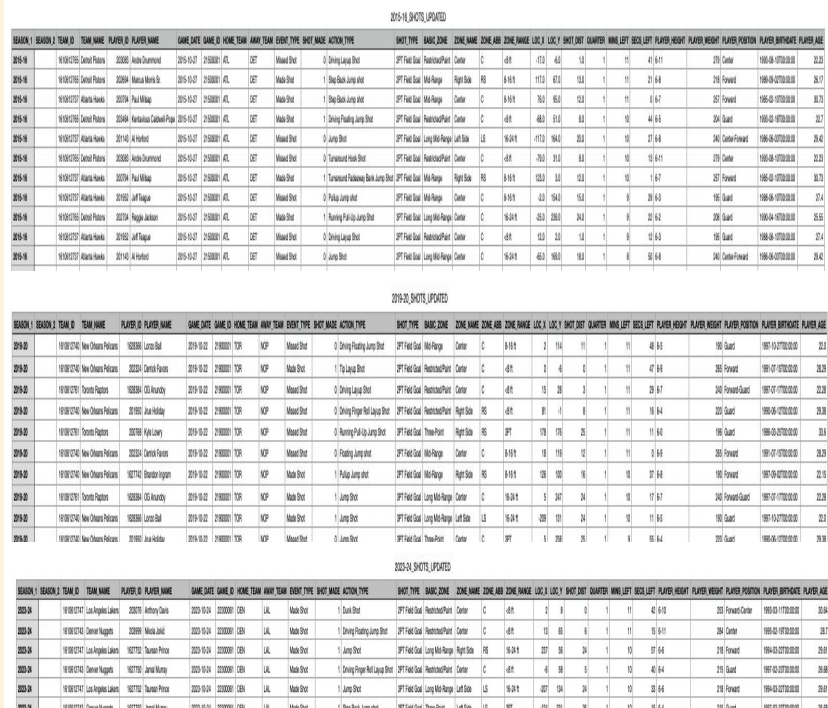
Data Sources

NBA Shot-Level Data from NBA Stats API
https://github.com/swar/nba_api
https://www.nba.com/stats

- Data was gathered using python. Code to replicate the data is saved as nba_scraper_replicable.py in “Code” folder. Running the code will result in 3 csv files.
- 3 seasons: 2015-16, 2019-20, 2023-24
- 213,900 3-point shot attempts
- 990 players across 30 teams
- Unit of analysis: One shot attempt.

Key variables:

- Outcome: Made/missed (binary)
- Shot characteristics: Distance (feet), court zone
- Player attributes: Age, height, weight, position
- Game context: Quarter, time remaining, home/away, season
- Shot details: Action type (catch-and-shoot, pull-up, etc.)



Data Procedures

1

Import & Append (604,392 total shots)

- Import three season CSV files separately
- Append into single combined dataset

2

Filter & Clean

- Keep only 3-point attempts → 213,900 shots
- Rename variables for clarity
- Drop observations missing key data

3

Variable Generation

- Season indicators (2016, 2020, 2024)
- Position dummies (guard, forward, center)
- Height conversion: "6-8" → 80 inches
- Home game indicator (team abbreviation matching)

4

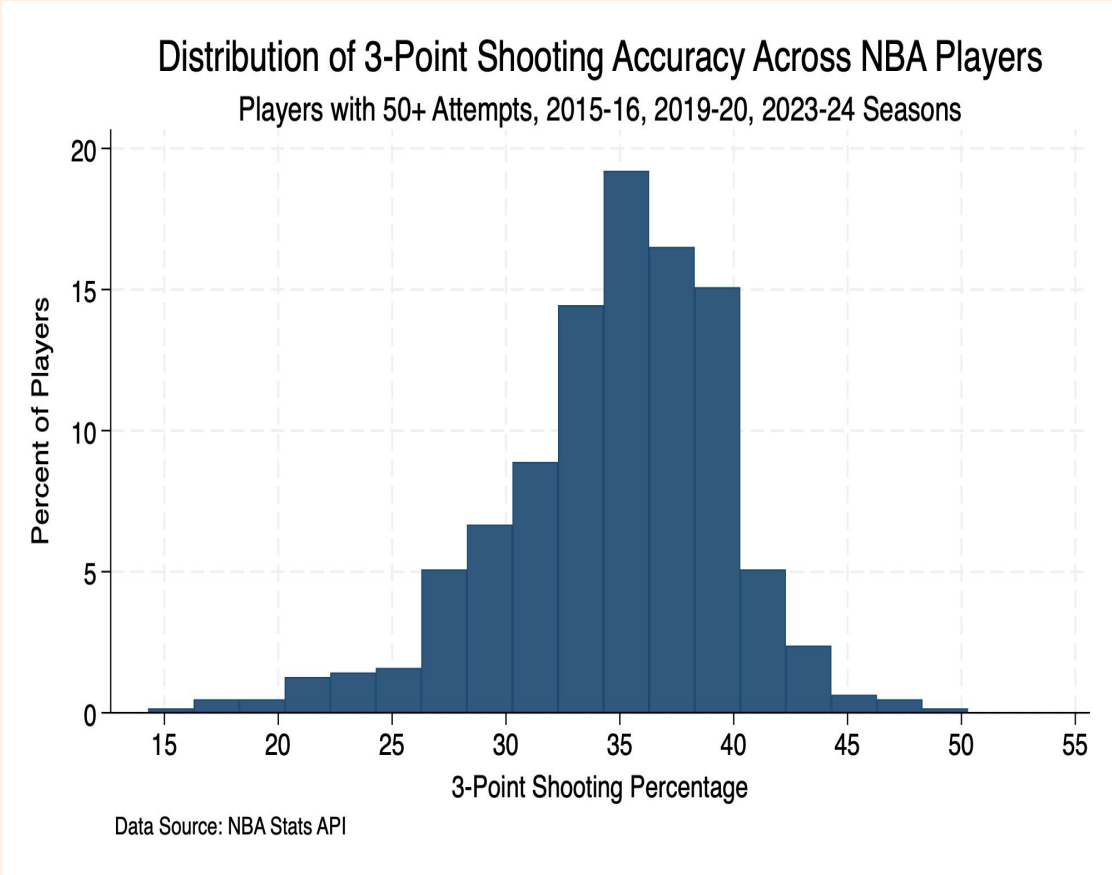
Final Sample

- 213,900 observations → 200,053 with complete data
- 93.5% retention rate

Descriptive Patterns: Distribution

Player Distribution:

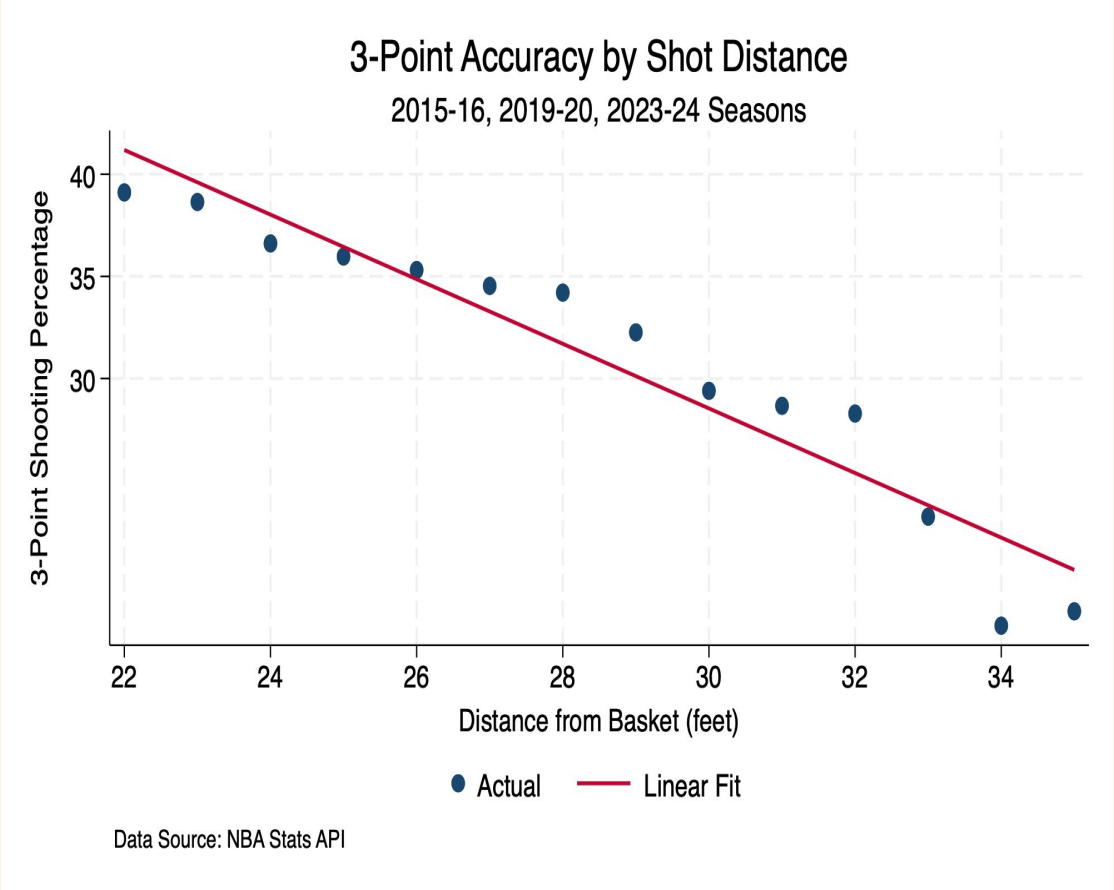
- Most NBA players cluster around 35% accuracy from three
- Accuracy varies a lot from 14% to 49% (substantial variation)
- True elite shooters (45%+) are rare (~5% of players)



Descriptive Patterns: Distance

Distance Effect:

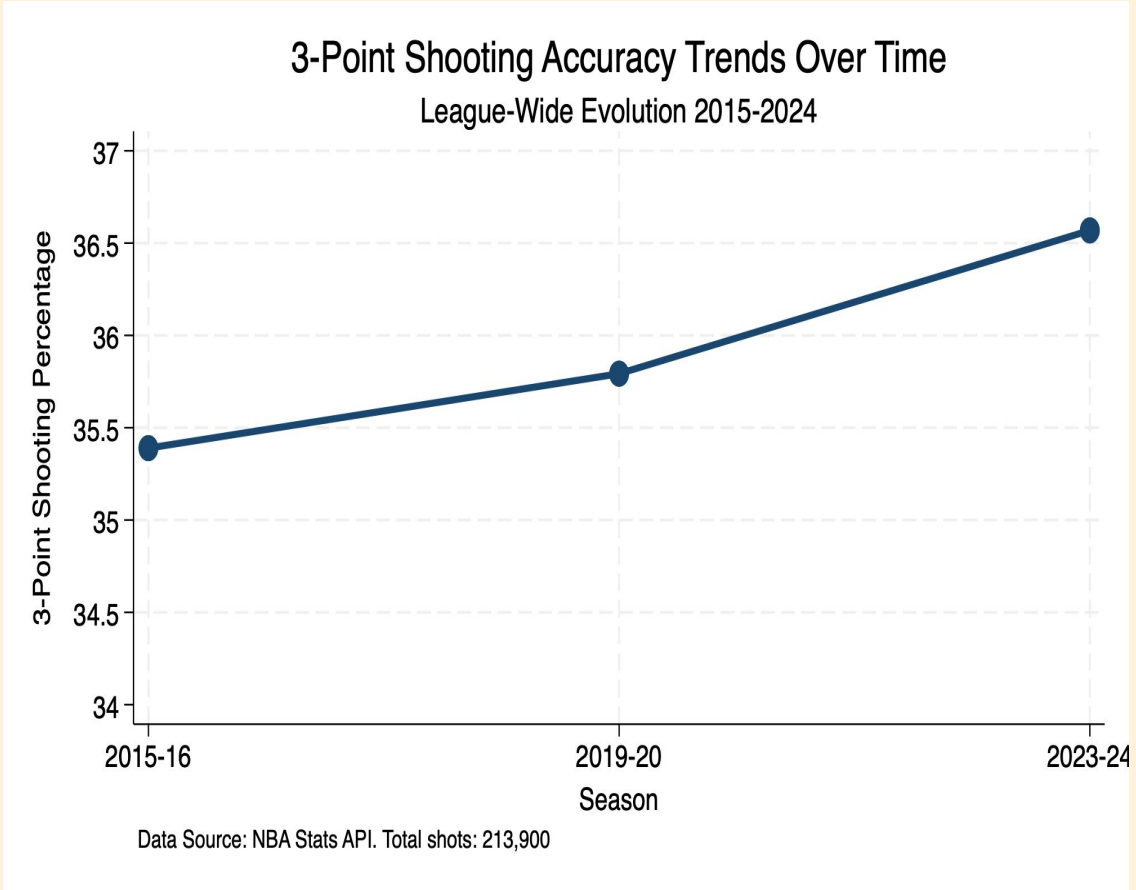
- There's a strong negative relationship between distance and accuracy
- Accuracy drops from 39% at 22 feet → 19% at 35 feet
- Each additional foot reduces accuracy by ~1 percentage point



Descriptive Patterns: Time

Temporal Trends:

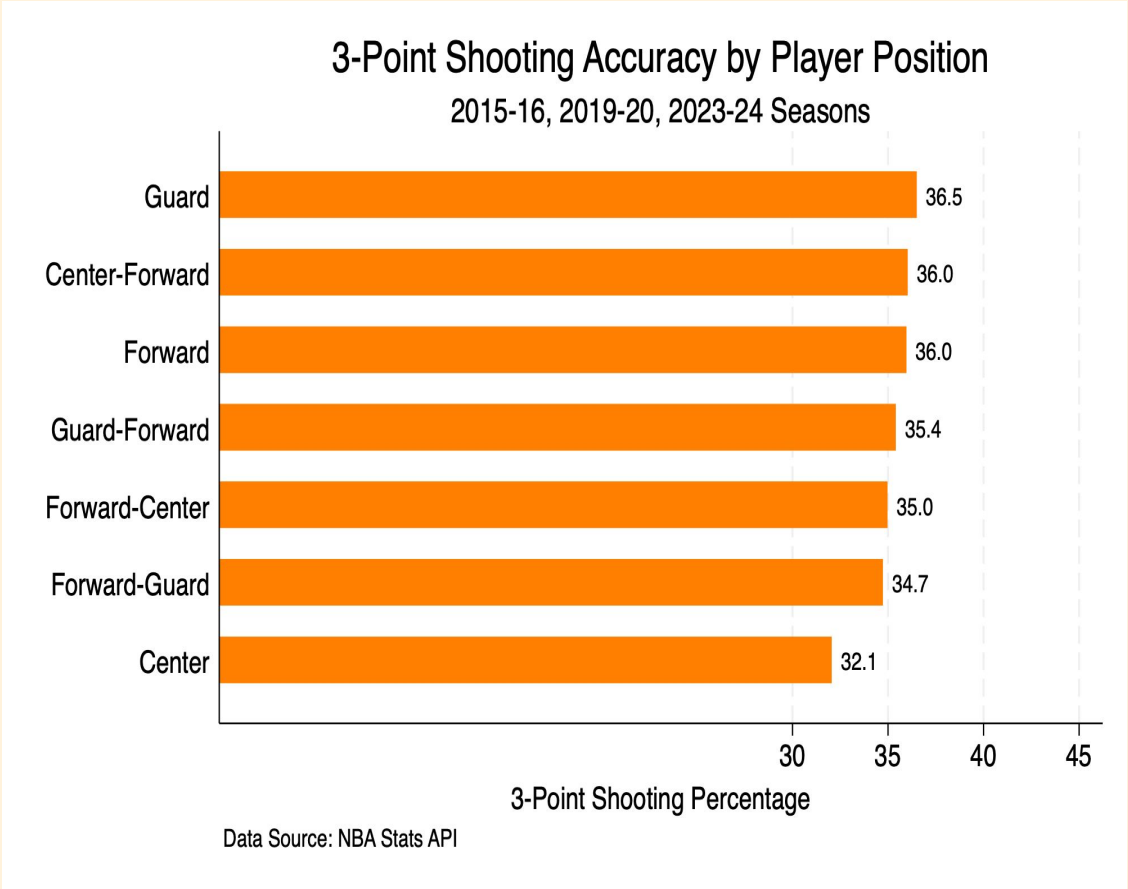
- League improving: 35.4% (2015-16) → 36.6% (2023-24)
- +1.2 percentage points over 9 years
- Consistent upward trajectory



Descriptive Patterns: Position

Position Differences:

- Guards shoot best: 36.5%
- Centers shoot worst: 32.1%
- Overall about a 4.4 percentage point gap



Regression Approach

MODEL	CONTROL	PURPOSE
(1) Shot Factors	Distance, quarter, home, season	Baseline shot context
(2) + Player	+Age, height, weight, position	Individual characteristics
(3) + Team FE	+30 team dummies	Team-specific effects
(4) Player FE	Within-player variation only	Control all fixed player traits

Statistical Approach:

- Standard errors clustered by player (accounts for repeated observations)
- All models use N = 200,053 observations
- Outcome: Made 3-pointer (0/1)

Note:

- Results represent associations not causal effects. Shot selection may be influenced by unobserved factors (shot difficulty, defense).

Regression Results

Shot distance: -0.011*** (highly significant, stable coefficient)

- Each additional foot results in 1.1 percentage points lower accuracy

Home game: +0.005**

- Playing at home results in 0.5 percentage points higher accuracy

Player age: +0.002***

- Each year older results in 0.2 percentage points higher accuracy

Quarter effects: 4th quarter and OT show significant accuracy drops

R^2 is low (0.5-0.6%): Normal for shot-level data, individual shots are inherently random

regression_table

NBA 3-Point Shooting Accuracy Regressions				
	(1)	(2)	(3)	(4)
	(1) Shot Factors	(2) + Player	(3) + Team FE	(4) Player FE
shot_distance	-0.0108***	-0.0108***	-0.0109***	-0.0111***
	(0.0003)	(0.0003)	(0.0003)	(0.0003)
2.quarter	-0.0083***	-0.0088***	-0.0086***	-0.0089***
	(0.0032)	(0.0032)	(0.0032)	(0.0032)
3.quarter	-0.0042	-0.0045	-0.0044	-0.0044
	(0.0031)	(0.0031)	(0.0031)	(0.0031)
4.quarter	-0.0211***	-0.0216***	-0.0213***	-0.0189***
	(0.0032)	(0.0032)	(0.0032)	(0.0032)
5.quarter	-0.0610***	-0.0620***	-0.0624***	-0.0652***
	(0.0130)	(0.0128)	(0.0128)	(0.0128)
home_game	0.0054**	0.0055**	0.0055**	0.0051**
	(0.0022)	(0.0022)	(0.0022)	(0.0022)
age		0.0019***	0.0019***	
		(0.0004)	(0.0004)	
height_total_inches		-0.0009	-0.0007	
		(0.0008)	(0.0008)	
weight		-0.0003**	-0.0003**	
		(0.0001)	(0.0001)	
experience_proxy		0.0000	0.0000	
		(.)	(.)	
pos_guard		-0.0062	-0.0047	
		(0.0052)	(0.0050)	
pos_forward		-0.0043	-0.0035	
		(0.0044)	(0.0043)	
N	200053	200053	200053	200053
R-sq	0.005	0.006	0.006	0.005
adj. R-sq	0.005	0.006	0.006	0.005
Standard errors in parentheses				
* p<0.10	** p<0.05	*** p<0.01"		

What Matters for Shooting Accuracy?

Negative effects:

- Shot Distance: Largest effect, confidence interval clearly below zero - dominates all other factors

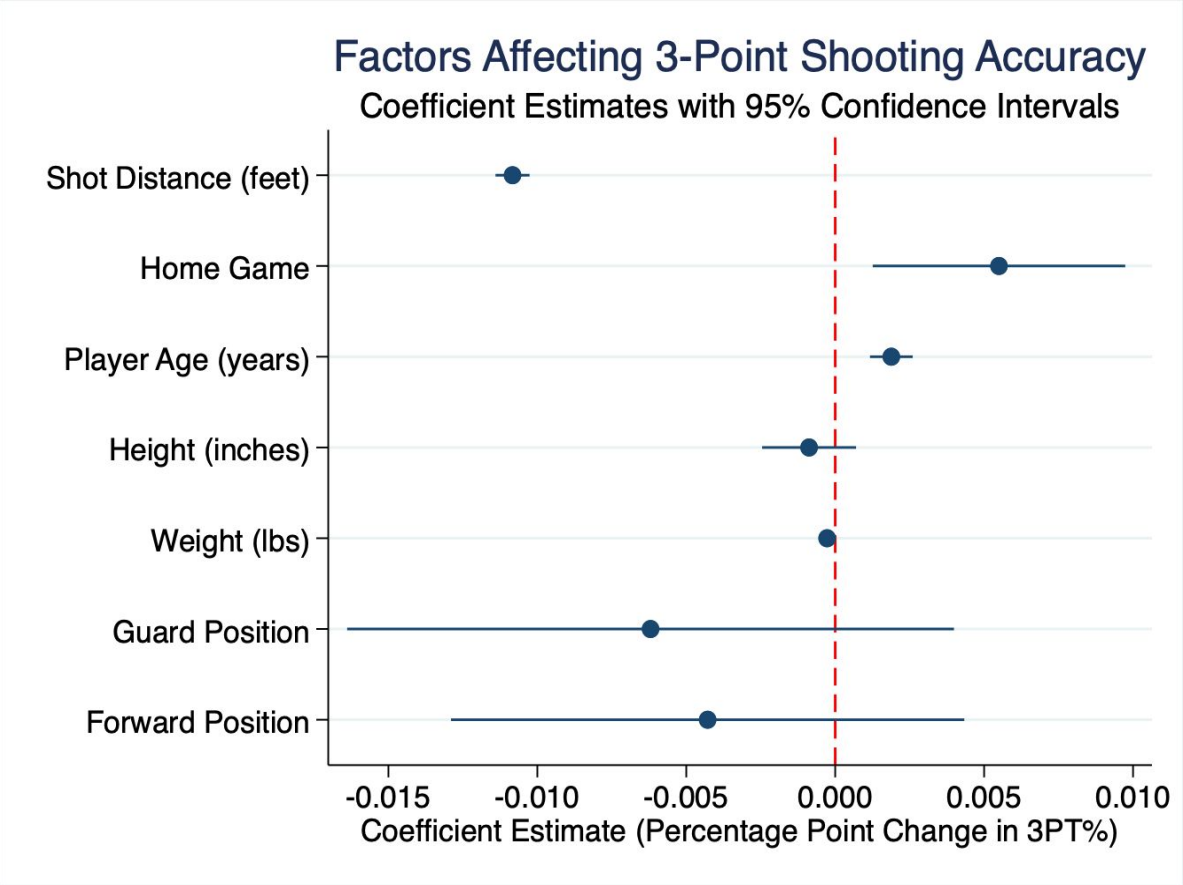
Positive effects:

- Home Game: Small but clear boost (confidence interval above zero)
- Player Age: Small positive effect (confidence interval above zero)

NOT significant (confidence intervals cross zero):

- Height: No effect on accuracy
- Guard Position: No advantage over other positions
- Forward Position: No advantage over centers
- Weight: Tiny negative effect, barely significant

Interpretation: After controlling for player characteristics, position doesn't matter—only distance, age, and home court do.



Experience and Distance Effects (Flexible Specification)

How Experience Moderates Distance Effects

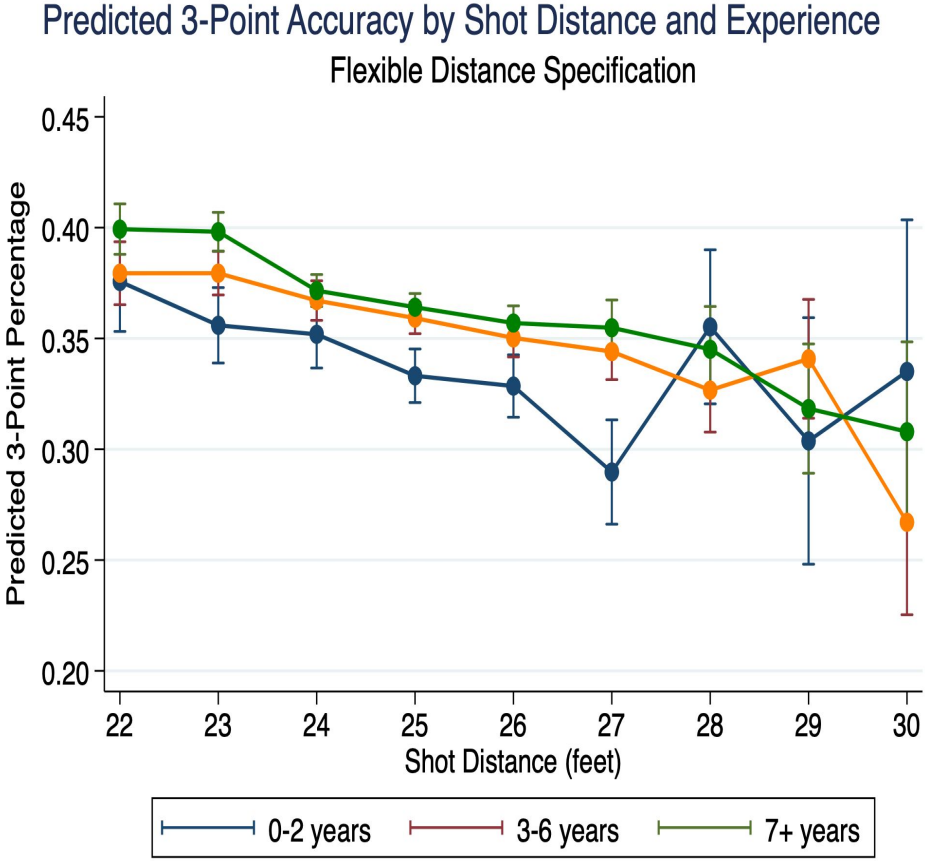
1. **Veterans maintain their accuracy advantage throughout the normal 3-point range (22-27 feet)**

- 7+ year veterans shoot ~4-6 percentage points better than rookies
- The roughly parallel lines validate our linear specification

2. **At extreme distances (28-30 feet), the veteran advantage diminishes**

- All experience groups converge to similar accuracy (~30%)
- Even elite veterans struggle equally on desperation shots

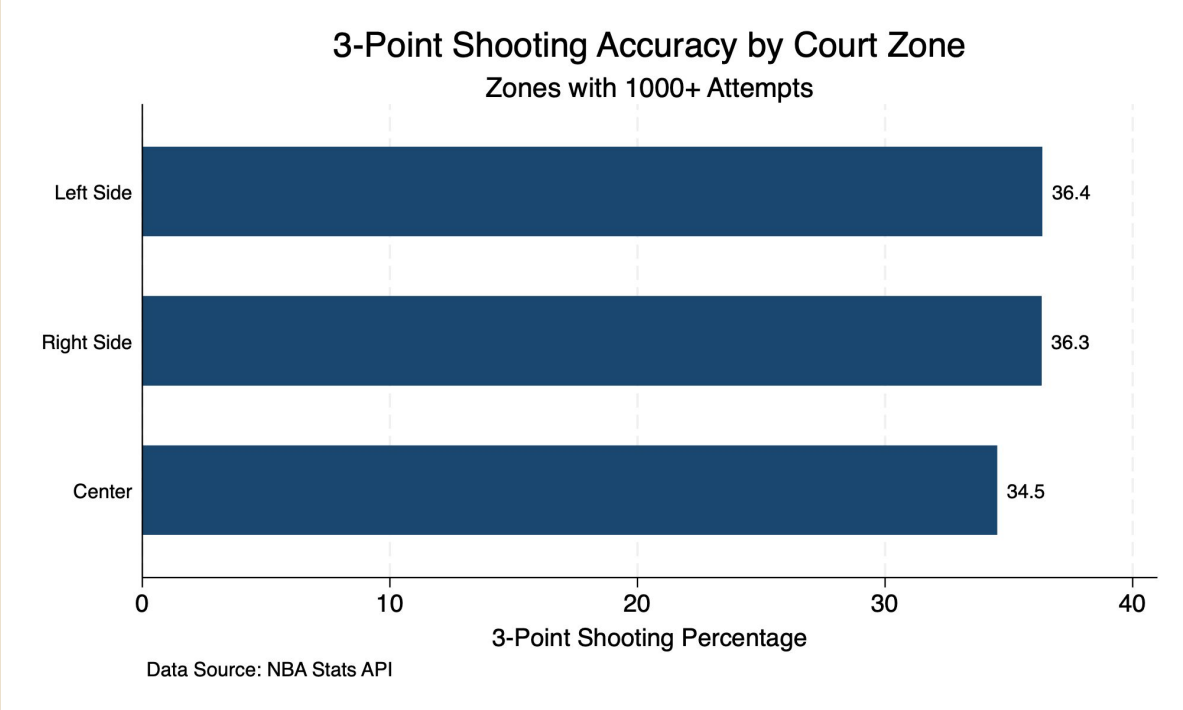
Key insight: Experience provides consistent benefits for standard shots, but can't overcome the difficulty of half-court attempts



Conclusions

1. Distance is everything: -1.1% per foot (consistent, dominant effect)
2. Experience helps: Veterans shoot 4-6% better across the board
3. Home court advantage: +0.5% (matters in close games)
4. Clutch is hard: 4th quarter -2.1%, overtime -6.1%
5. Experience helps differently by distance: Veterans maintain their edge at normal range (22-27 ft) but everyone struggles equally on desperation shots (28-30 ft)

Bonus


3-Point Shooting Accuracy by Court Zone
Zones with 1000+ Attempts
Left Side
Right Side
Center
36.4
36.3
34.5
0
10
20
30
40
3-Point Shooting Percentage
Data Source: NBA Stats API