
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.)

2015-16_SHOTS_UPDATED

SEASON	SEASON_ID	TEAM_ID	TEAM_NAME	PLAYER_ID	PLAYER_NAME	GAME_DATE	GAME_ID	HOME_TEAM	AWAY_TEAM	EVENT_TYPE	BST_MADE	ACTION_TYPE	SHOT_TYPE	BASIC_ZONE	ZONE_NAME	ZONE_AB2	ZONE_RANGE	LOC_X	LOC_Y	SHOT_DIST	QUARTER	MINN_LEFT	SECS_LEFT	PLAYER_HEIGHT	PLAYER_WEIGHT	PLAYER_POSITION	PLAYER_BIRTHDATE	PLAYER_AGE
2015-16	101013747	200000	Central Division	2015-037	2000001	ATL	CET	Moved Shot	O Driving Long Jump	SPFT Field Goal	PrecisionPoint	Center	C	4ft	-173	44	1	11	41	41	279	Center	100-03-17700000	23.23				
2015-16	101013747	200000	Central Division	2015-037	2000001	ATL	CET	Moved Shot	1 Step Back Jump shot	SPFT Field Goal	Mid-Range	Right Side	RS	4ft	-169	173	671	133	1	11	21	44	246	Forward	100-03-17700000	26.17		
2015-16	101013747	200000	Central Division	2015-037	2000001	ATL	CET	Moved Shot	1 Step Back Jump shot	SPFT Field Goal	Mid-Range	Center	C	4ft	-161	163	95	123	1	11	11	67	257	Forward	100-03-17700000	20.73		
2015-16	101013747	200000	Central Division	2015-037	2000001	ATL	CET	Moved Shot	1 Driving Floating Long Shot	SPFT Field Goal	PrecisionPoint	Center	C	4ft	-48	51	3	1	10	41	55	224	Guard	100-03-17700000	22.27			
2015-16	101013747	200000	Central Division	2015-037	2000001	ATL	CET	Moved Shot	O Jump Shot	SPFT Field Goal	Long Mid-Range	Left Side	LS	16-04	-173	164	233	1	10	37	44	240	Center/Forward	100-03-17700000	24.42			
2015-16	101013747	200000	Central Division	2015-037	2000001	ATL	CET	Moved Shot	O Turnaround Hook Shot	SPFT Field Goal	PrecisionPoint	Center	C	4ft	-76	31	83	1	10	15	61	279	Center	100-03-17700000	23.33			
2015-16	101013747	200000	Central Division	2015-037	2000001	ATL	CET	Moved Shot	1 Turnaround Followaway Bank Jump Shot	SPFT Field Goal	Mid-Range	Right Side	RS	4ft	-161	123	51	123	1	10	1	57	257	Forward	100-03-17700000	20.73		
2015-16	101013747	200000	Central Division	2015-037	2000001	ATL	CET	Moved Shot	O Pull Up Long Shot	SPFT Field Goal	Mid-Range	Center	C	4ft	-3	54	153	1	9	20	63	195	Guard	100-03-17700000	27.4			
2015-16	101013747	200000	Central Division	2015-037	2000001	ATL	CET	Moved Shot	1 Running Pull Up Long Shot	SPFT Field Goal	Long Mid-Range	Center	C	16-04	-65	286	243	1	10	22	63	224	Guard	100-03-17700000	25.55			
2015-16	101013747	200000	Central Division	2015-037	2000001	ATL	CET	Moved Shot	O Driving Long Jump Shot	SPFT Field Goal	PrecisionPoint	Center	C	4ft	-123	21	13	1	9	15	63	195	Guard	100-03-17700000	27.4			
2015-16	101013747	200000	Central Division	2015-037	2000001	ATL	CET	Moved Shot	O Jump Shot	SPFT Field Goal	Long Mid-Range	Center	C	16-04	-65	180	193	1	10	35	63	240	Center/Forward	100-03-17700000	24.42			

2019-20_SHOTS_UPDATED

SEASON	SEASON_ID	TEAM_ID	TEAM_NAME	PLAYER_ID	PLAYER_NAME	GAME_DATE	GAME_ID	HOME_TEAM	AWAY_TEAM	EVENT_TYPE	BST_MADE	ACTION_TYPE	SHOT_TYPE	BASIC_ZONE	ZONE_NAME	ZONE_AB2	ZONE_RANGE	LOC_X	LOC_Y	SHOT_DIST	QUARTER	MINN_LEFT	SECS_LEFT	PLAYER_HEIGHT	PLAYER_WEIGHT	PLAYER_POSITION	PLAYER_BIRTHDATE	PLAYER_AGE
2019-20	101013747	200000	New Orleans Pelicans	2019-012	2000001	TOR	NCP	Moved Shot	O Driving Floating Long Shot	SPFT Field Goal	Mid-Range	Center	C	6ft	-2	14	11	1	11	46	51	190	Guard	100-03-17700000	23.23			
2019-20	101013747	200000	New Orleans Pelicans	2019-012	2000001	TOR	NCP	Moved Shot	1 Long Shot	SPFT Field Goal	PrecisionPoint	Center	C	4ft	-1	4	0	1	1	47	48	265	Forward	100-03-17700000	22.28			
2019-20	101013747	200000	New Orleans Pelicans	2019-012	2000001	TOR	NCP	Moved Shot	O Driving Long Shot	SPFT Field Goal	PrecisionPoint	Center	C	4ft	-15	35	3	1	11	31	67	240	Forward	100-03-17700000	22.28			
2019-20	101013747	200000	New Orleans Pelicans	2019-012	2000001	TOR	NCP	Moved Shot	O Driving Finger On Loop Shot	SPFT Field Goal	PrecisionPoint	Right Side	RS	4ft	-81	1	8	1	11	16	64	220	Guard	100-03-17700000	23.28			
2019-20	101013747	200000	New Orleans Pelicans	2019-012	2000001	TOR	NCP	Moved Shot	O Running Pull Up Long Shot	SPFT Field Goal	Three Point	Right Side	RS	3ft	-173	176	25	1	11	14	58	190	Guard	100-03-17700000	21.14			
2019-20	101013747	200000	New Orleans Pelicans	2019-012	2000001	TOR	NCP	Moved Shot	O Floating Jump shot	SPFT Field Goal	Mid-Range	Center	C	6ft	-16	115	12	1	11	3	64	265	Forward	100-03-17700000	21.14			
2019-20	101013747	200000	New Orleans Pelicans	2019-012	2000001	TOR	NCP	Moved Shot	O Pull Up Long Shot	SPFT Field Goal	Mid-Range	Right Side	RS	6ft	-161	131	10	1	10	37	63	190	Forward	100-03-17700000	21.14			
2019-20	101013747	200000	New Orleans Pelicans	2019-012	2000001	TOR	NCP	Moved Shot	1 Long Shot	SPFT Field Goal	Long Mid-Range	Center	C	16-04	-5	24	24	1	10	17	67	240	Forward	100-03-17700000	22.28			
2019-20	101013747	200000	New Orleans Pelicans	2019-012	2000001	TOR	NCP	Moved Shot	1 Long Shot	SPFT Field Goal	Long Mid-Range	Left Side	LS	16-04	-209	131	24	1	10	11	65	190	Guard	100-03-17700000	22.23			
2019-20	101013747	200000	New Orleans Pelicans	2019-012	2000001	TOR	NCP	Moved Shot	O Long Shot	SPFT Field Goal	Three Point	Center	C	9ft	-6	290	25	1	10	91	64	279	Guard	100-03-17700000	20.38			

2020-21_SHOTS_UPDATED

SEASON	SEASON_ID	TEAM_ID	TEAM_NAME	PLAYER_ID	PLAYER_NAME	GAME_DATE	GAME_ID	HOME_TEAM	AWAY_TEAM	EVENT_TYPE	BST_MADE	ACTION_TYPE	SHOT_TYPE	BASIC_ZONE	ZONE_NAME	ZONE_AB2	ZONE_RANGE	LOC_X	LOC_Y	SHOT_DIST	QUARTER	MINN_LEFT	SECS_LEFT	PLAYER_HEIGHT	PLAYER_WEIGHT	PLAYER_POSITION	PLAYER_BIRTHDATE	PLAYER_AGE
2020-21	101013747	200000	Los Angeles Lakers	2020-014	2000001	CBW	UL	Moved Shot	1 Dark Shot	SPFT Field Goal	PrecisionPoint	Center	C	4ft	-2	8	0	1	11	42	610	220	Forward/Center	100-03-17700000	30.04			
2020-21	101013747	200000	Los Angeles Lakers	2020-014	2000001	CBW	UL	Moved Shot	1 Driving Floating Long Shot	SPFT Field Goal	PrecisionPoint	Center	C	4ft	-13	65	6	1	11	15	611	284	Center	100-03-17700000	28.37			
2020-21	101013747	200000	Los Angeles Lakers	2020-014	2000001	CBW	UL	Moved Shot	1 Long Shot	SPFT Field Goal	Mid-Range	Right Side	RS	16-04	-237	56	24	1	10	57	64	216	Forward	100-03-17700000	20.59			
2020-21	101013747	200000	Los Angeles Lakers	2020-014	2000001	CBW	UL	Moved Shot	1 Driving Finger On Loop Shot	SPFT Field Goal	Mid-Range	Left Side	LS	16-04	-41	58	5	1	10	40	64	214	Guard	100-03-17700000	28.08			
2020-21	101013747	200000	Los Angeles Lakers	2020-014	2000001	CBW	UL	Moved Shot	1 Long Shot	SPFT Field Goal	Long Mid-Range	Left Side	LS	16-04	-207	154	21	1	10	32	64	216	Forward	100-03-17700000	28.08			
2020-21	101013747	200000	Los Angeles Lakers	2020-014	2000001	CBW	UL	Moved Shot	1 Step Back Jump shot	SPFT Field Goal	Three Point	Left Side	LS	SP	-144	231	25	1	10	16	64	214	Guard	100-03-17700000	30.08			
2020-21	101013747	200000	Los Angeles Lakers	2020-014	2000001	CBW	UL	Moved Shot	1 Pull Up Long Shot	SPFT Field Goal	Long Mid-Range	Right Side	RS	16-04	-161	189	24	1	10	1	63	195	Guard	100-03-17700000	27.08			
2020-21	101013747	200000	Los Angeles Lakers	2020-014	2000001	CBW	UL	Moved Shot	1 Step Back Jump shot	SPFT Field Goal	Mid-Range	Right Side	RS	16-04	-109	147	19	1	9	40	610	220	Forward/Center	100-03-17700000	30.04			
2020-21	101013747	200000	Los Angeles Lakers	2020-014	2000001	CBW	UL	Moved Shot	1 Long Shot	SPFT Field Goal	PrecisionPoint	Center	C	4ft	-30	13	2	1	9	36	611	284	Center	100-03-17700000	28.37			
2020-21	101013747	200000	Los Angeles Lakers	2020-014	2000001	CBW	UL	Moved Shot	1 Reverse Finger Roll And Layup	SPFT Field Goal	PrecisionPoint	Center	C	4ft	-0	34	2	1	9	30	64	216	Forward	100-03-17700000	28.08			

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

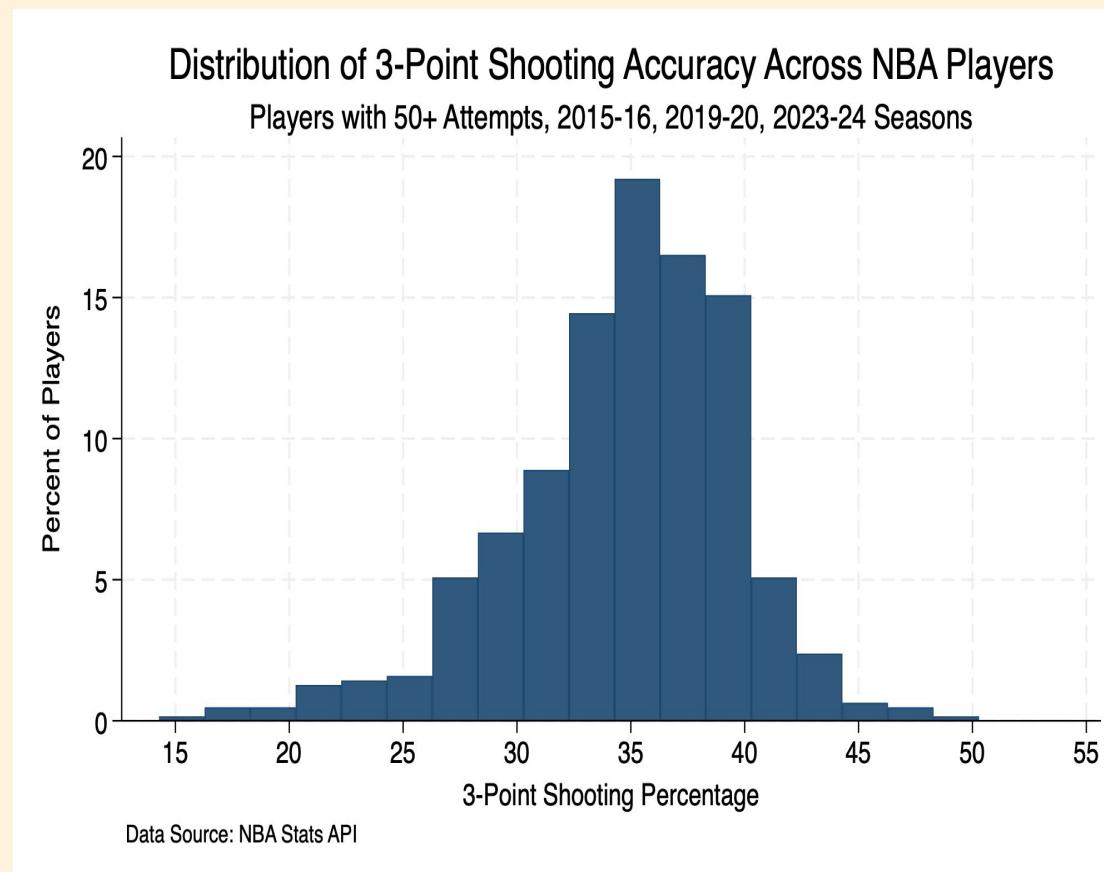
Final Sample

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

Descriptive Patterns: Distribution

Player Distribution:

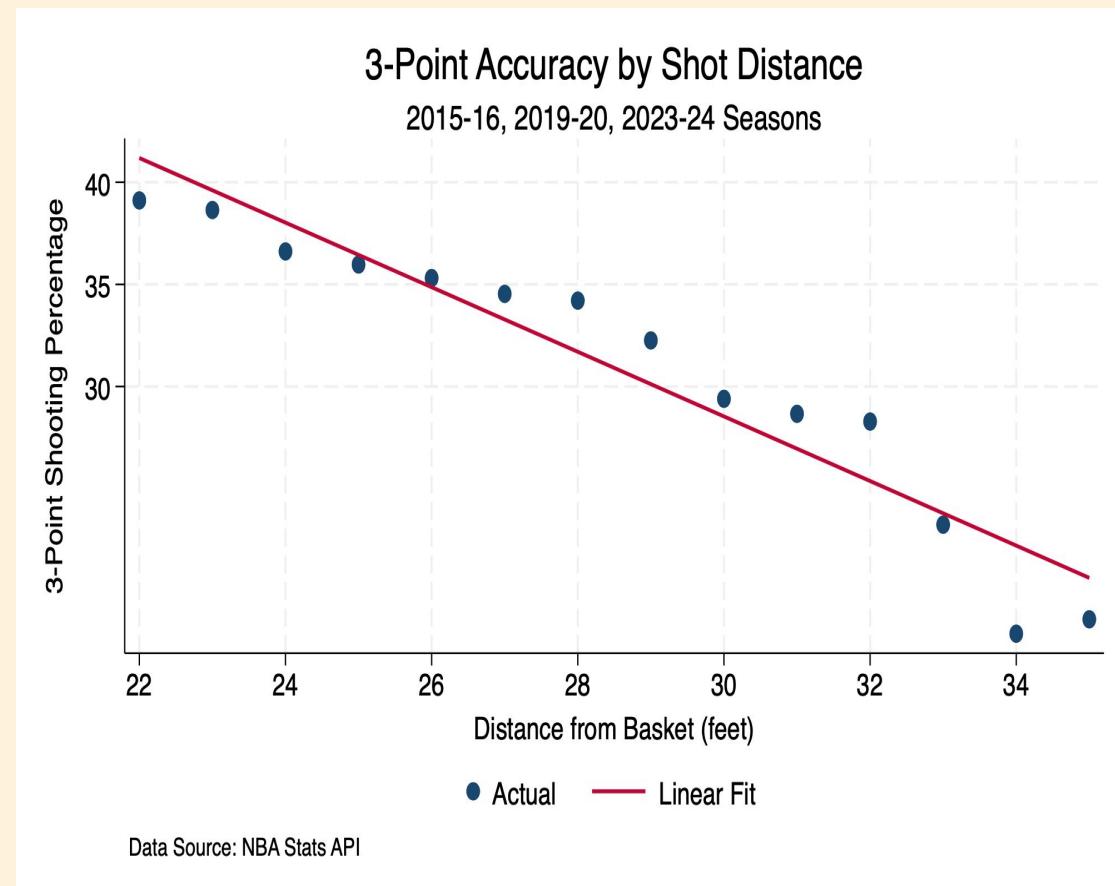
- Most NBA players cluster around 35% accuracy from three
- Accuracy varies a lot from 14% to 49% (substantial variation)
- True elite shooters (45%+) are rare (~5% of players)



Descriptive Patterns: Distance

Distance Effect:

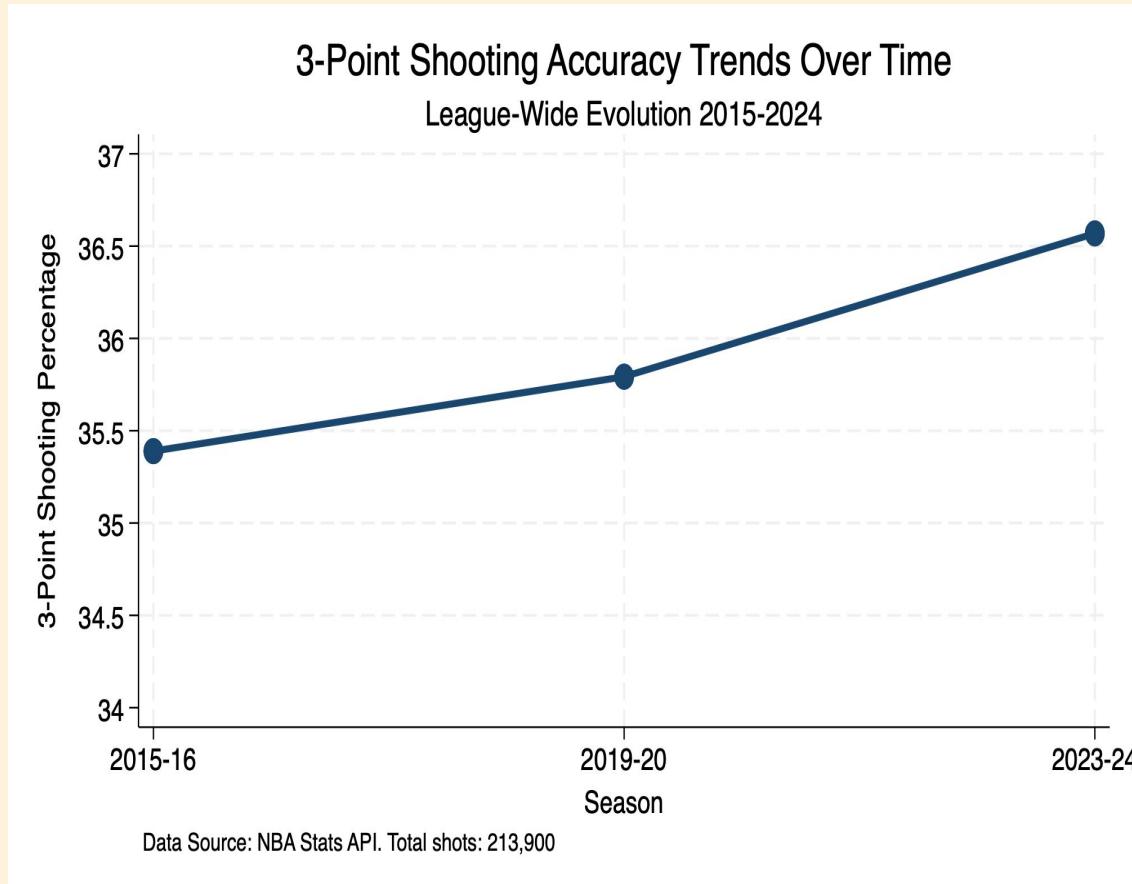
- There's a strong negative relationship between distance and accuracy
- Accuracy drops from 39% at 22 feet → 19% at 35 feet
- Each additional foot reduces accuracy by ~1 percentage point



Descriptive Patterns: Time

Temporal Trends:

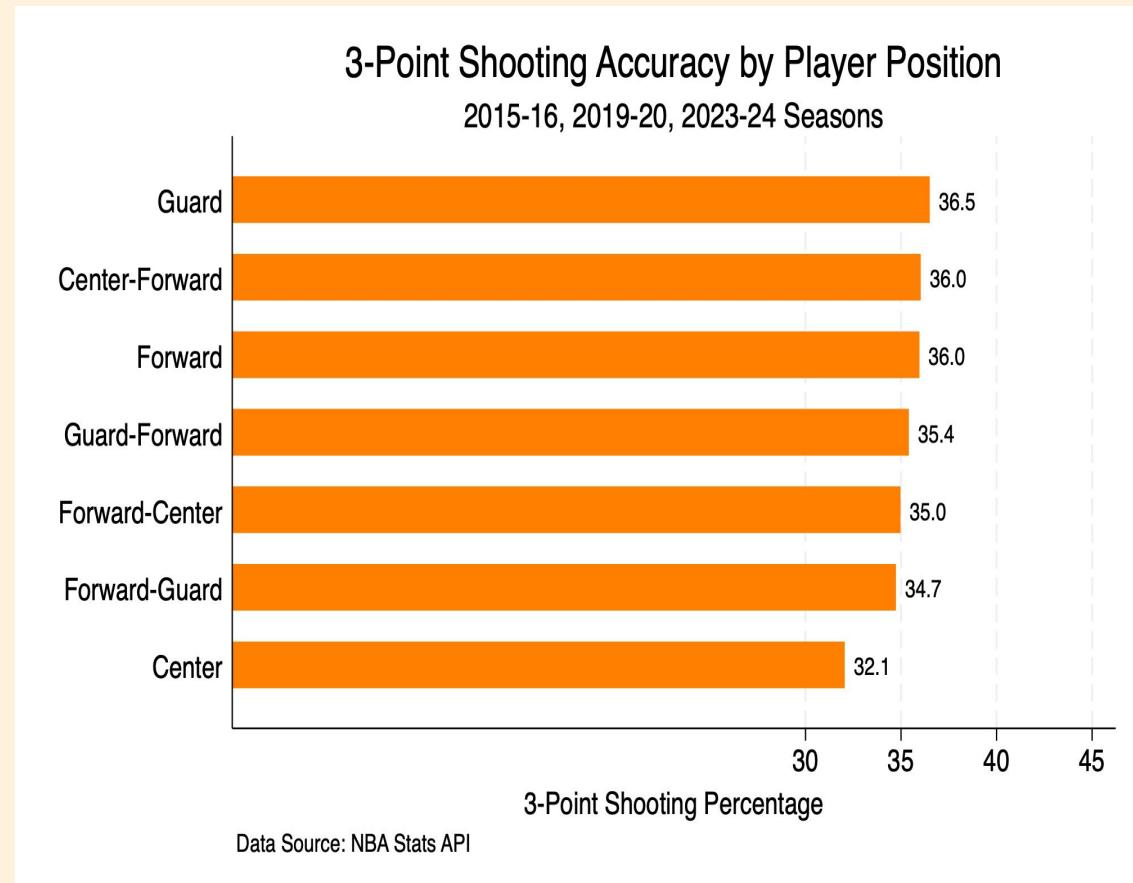
- League improving:
35.4% (2015-16) →
36.6% (2023-24)
- +1.2 percentage
points over 9 years
- Consistent upward
trajectory



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

R² 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) (1) Shot Factors	(2) (2) + Player	(3) (3) + Team FE	(4) (4) Player FE
shot_distance	-0.0108*** (0.0003)	-0.0108*** (0.0003)	-0.0109*** (0.0003)	-0.0111*** (0.0003)
2.quarter	-0.0083*** (0.0032)	-0.0088*** (0.0032)	-0.0086*** (0.0032)	-0.0089*** (0.0032)
3.quarter	-0.0042 (0.0031)	-0.0045 (0.0031)	-0.0044 (0.0031)	-0.0044 (0.0031)
4.quarter	-0.0211*** (0.0032)	-0.0216*** (0.0032)	-0.0213*** (0.0032)	-0.0189*** (0.0032)
5.quarter	-0.0610*** (0.0130)	-0.0620*** (0.0128)	-0.0624*** (0.0128)	-0.0652*** (0.0128)
home_game	0.0054** (0.0022)	0.0055** (0.0022)	0.0055** (0.0022)	0.0051** (0.0022)
age		0.0019*** (0.0004)	0.0019*** (0.0004)	
height_total_inches		-0.0009 (0.0008)	-0.0007 (0.0008)	
weight		-0.0003** (0.0001)	-0.0003** (0.0001)	
experience_proxy		0.0000 (.)	0.0000 (.)	
pos_guard		-0.0062 (0.0052)	-0.0047 (0.0050)	
pos_forward		-0.0043 (0.0044)	-0.0035 (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)

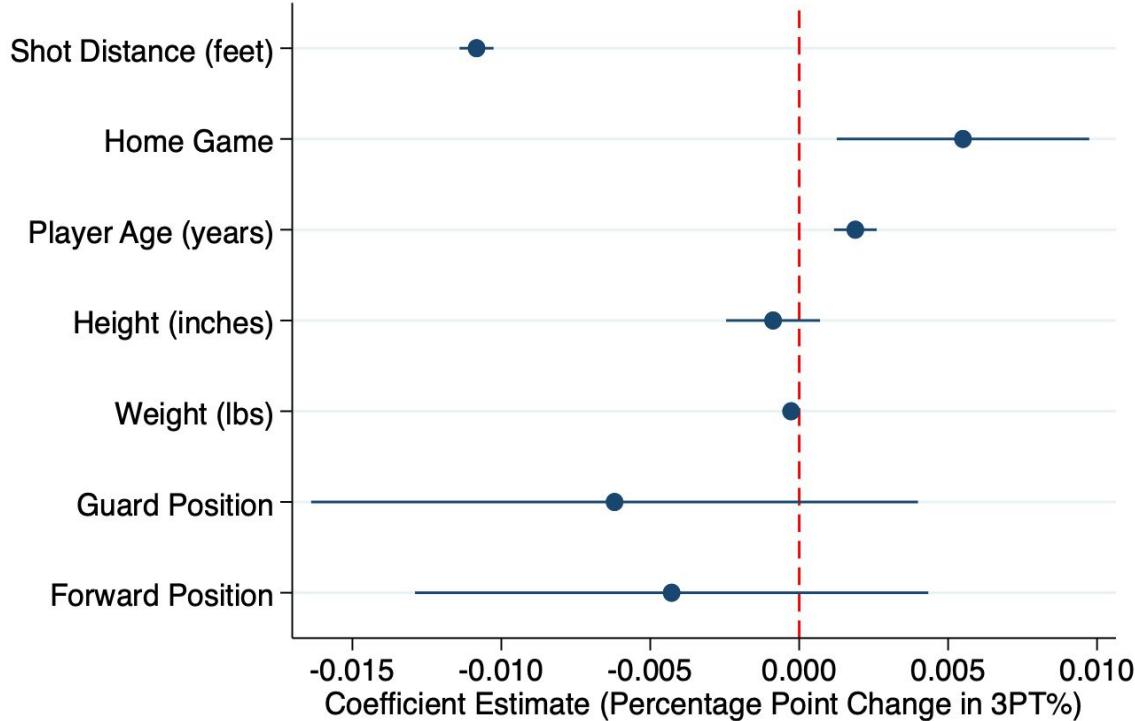
NOT significant (confidence intervals cross zero):

- 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.

Factors Affecting 3-Point Shooting Accuracy

Coefficient Estimates with 95% Confidence Intervals



Experience and Distance Effects (Flexible Specification)

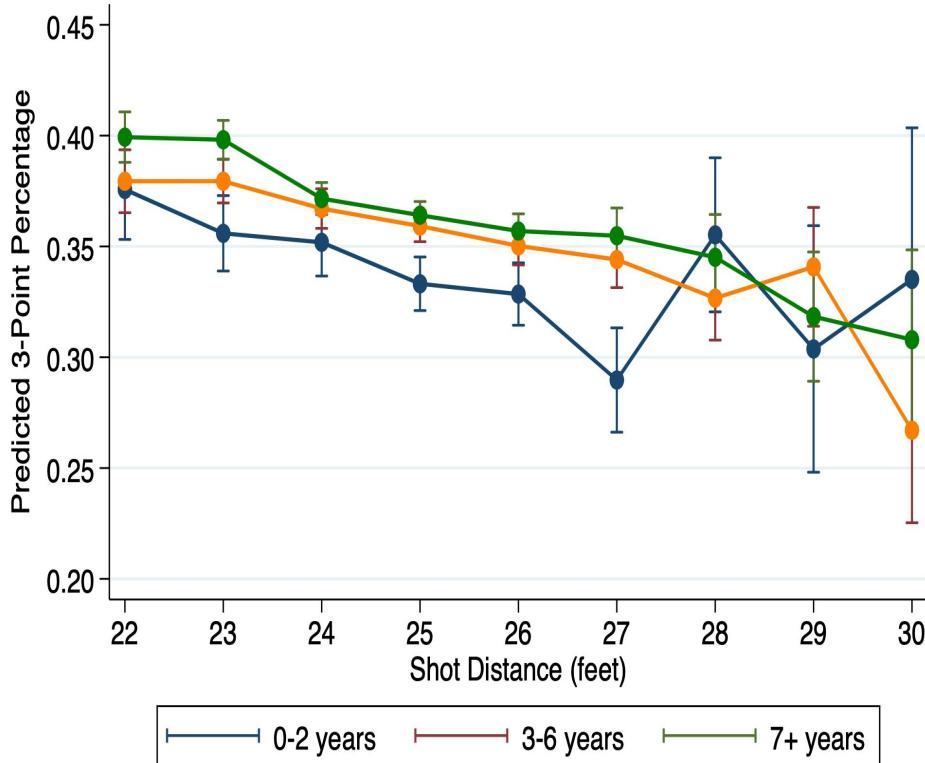
How Experience Moderates Distance Effects

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

Predicted 3-Point Accuracy by Shot Distance and Experience
Flexible Distance Specification



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

