UNSUPERVISED LEARNING OF PLAYER ROLES AND LINEUP ARCHETYPES IN EUROLEAGUE BASKETBALL

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1 BACKGROUND & AIM

Basketball player evaluation is shifting from traditional position-based classifications to data-driven methods for identifying player functionalities. As players become more versatile and teams use positionless tactics, standard positional labels no longer fully describe players on the court. Although several studies have investigated player role identification, important limitations remain. Many approaches rely on box-score statistics, which may miss possession-level impact and contextual tactical information. Existing work also tends to emphasize offensive roles, while defensive archetypes are less frequently analyzed. In addition, most studies focus on the NBA, whereas European basketball has received less attention despite its different tactical systems, pace, player utilization, and game structure.

The aim of this study is to develop a model that describes players' functional responsibilities and create role-based lineup representations.

2 DATA & FEATURE ENGINEERING

EuroLeague
- Position
- Height
- Team metadata

Synergy Sports
- Possession-level events
- Play types
- Shot types

→ 2023–24 & 2024–25, Criteria: ≥100 possessions
Roles: ~230 observations (one player per season)
Lineups: 1,153 observations

Possession-adjusted statistics → Shooting profile → Play-type tendencies → Impact metrics → z-score standardization

3 ROLE IDENTIFICATION

Player profiles are generated from a mixture of K multivariate Gaussian distributions.

TRADITIONAL LABELS
- Point Guard
- Shooting Guard
- Small Forward
- Power Forward
- Center

→

FUNCTIONAL RESPONSIBILITIES
- Playmaking and offense organization
- Shot creation and high-usage scoring
- Spot-up / off-ball shooting
- Perimeter ball pressure and disruption
- Rim protection and interior defense



GAUSSIAN MIXTURE MODEL

$$p(x_i) = \Sigma_{k=1}^{K} \pi_k \mathcal{N}(x_i \mid \mu_k, \Sigma_k)$$

π_k = mixture weight
μ_k = centroid / mean feature vector
Σ_k = covariance matrix
K = number of latent roles

Parameters are estimated using Expectation–Maximization
OUTPUT Posterior role probabilities $P(z_i = k \mid x_i)$

OFFENSE

Guards	Creator	ShotCr	OffBall	BH	PnR	SpotUp	OffLoad	Usage%	FromPass	ISO	FTA	AST	TO
Combo (n=51)	17.22	0.40	0.03	0.39	0.54	0.22	19.95	19.43	0.12	0.09	3.66	6.14	3.17
Playmaker (n=17)	56.03	0.53	0.01	0.53	0.71	0.13	31.55	20.39	0.08	0.06	4.24	10.48	4.54
Scorer (n=10)	15.51	0.59	0.01	0.37	0.55	0.15	39.88	28.02	0.07	0.14	8.38	6.25	3.84
Shooter (n=8)	4.08	0.06	0.10	0.16	0.26	0.44	12.70	17.61	0.23	0.04	3.27	3.86	2.51

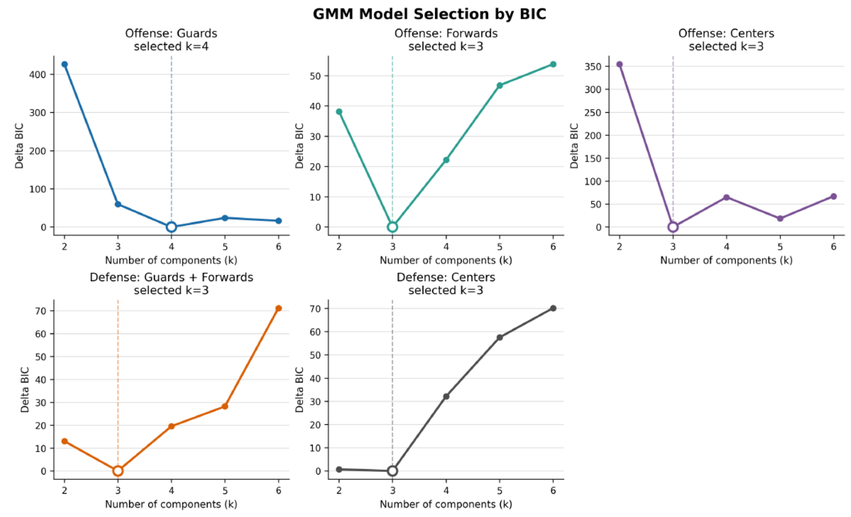
Wings	OffLoad	Usage%	FTA	Jumper	OffDrib3PT	ShotDist	AtRim	RollMan
SpotUp Wing (n=48)	8.45	14.67	2.88	0.38	0.06	287.11	0.37	0.48
Primary Wing (n=5)	21.36	21.81	6.74	0.14	0.12	129.61	0.72	0.52
Scoring Wing (n=11)	19.58	22.95	4.75	0.39	0.16	283.54	0.34	0.14

Centers	Creator	SpotUp	OffLoad	ShotDist	AtRim	RollMan	CnS3PT	Drive
Postup Big (n=14)	0.05	0.22	12.34	126.28	0.76	0.17	0.18	0.06
Rim Roller (n=28)	0.00	0.07	7.40	55.49	0.96	1.00	0.01	0.02
Stretch Big (n=26)	0.05	0.48	11.98	219.27	0.48	0.95	0.40	0.09

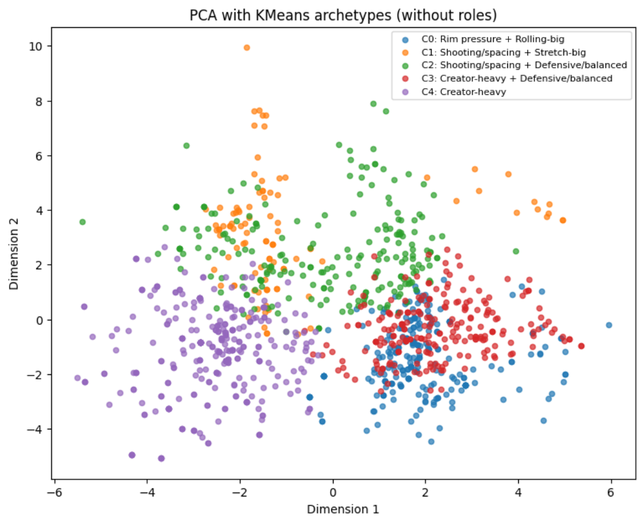
DEFENSE

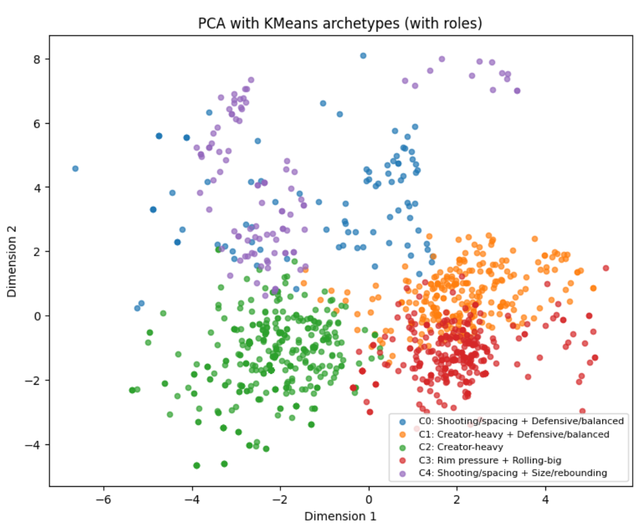
Guards & Wings	BLK	STL	DRB	dISO	dPerDrive	Height	dPnR-BH	DRAPM	DefRtg	DRBRtg
Disruptor (n=21)	0.40	2.83	5.09	0.03	0.13	1.96	0.18	-0.02	109.72	70.32
On Ball Defender (n=79)	0.17	1.60	3.76	0.03	0.11	1.91	0.20	-0.09	110.87	69.71
Physical Defender (n=61)	0.59	1.48	6.19	0.06	0.14	2.01	0.11	0.19	109.55	71.17

Centers	BLK	STL	DRB	dAtRim	dRollMan	dISO	dPerDrive	dPostAction	Height
Non-Anchor Big (n=12)	2.23	1.72	7.15	0.33	0.11	0.14	0.16	0.04	2.11
Rim Protector (n=10)	1.63	1.23	7.74	0.17	0.17	0.08	0.11	0.01	2.12
Versatile Big (n=46)	1.23	1.67	6.97	0.24	0.07	0.13	0.14	0.02	2.07



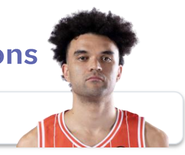
LINEUPS

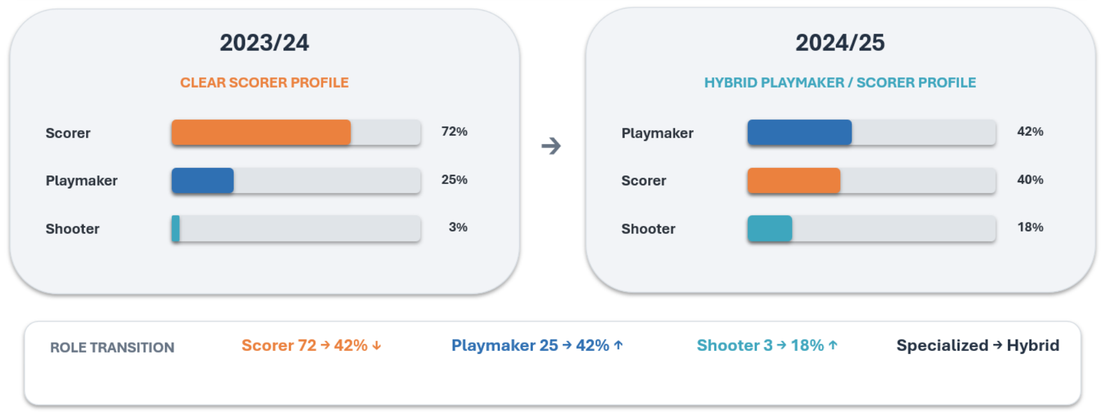




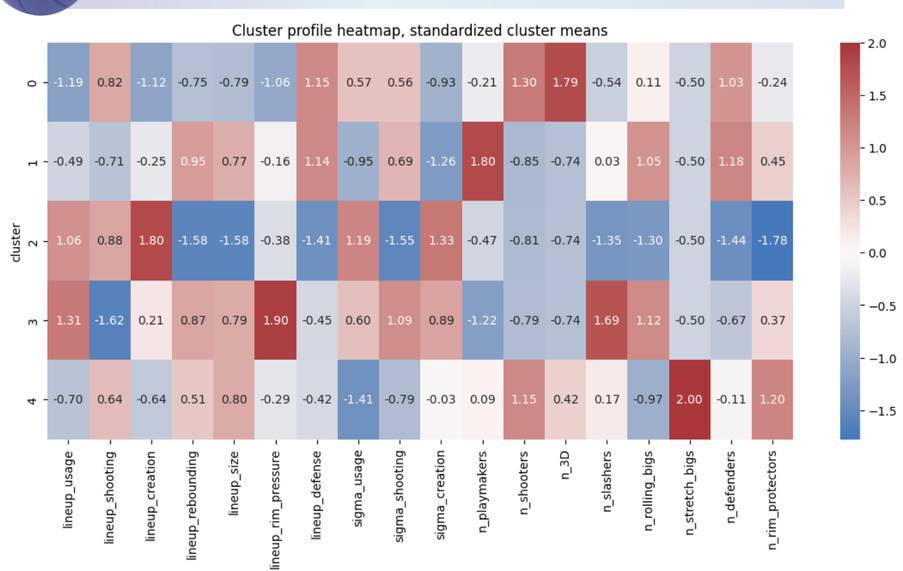
Why probabilities matter: role evolution across seasons

ELIJAH BRYANT — same player · same team · different season · different functional profile





4 LINEUP ARCHETYPES





5 CONCLUSIONS

Positions are too rigid

Modern EuroLeague players combine tactical responsibilities.

GMM captures hybridity

Soft assignments preserve overlapping offensive and defensive roles.

Richer data enhances interpretability

Role-based lineup representations produce more stable and interpretable archetypes than using the full feature set alone.

6 FUTURE PLANS

Evaluate lineup archetype performance

Analyze matchup interactions

Develop a lineup recommendation model

Integrate real-time decision support

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