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Anticipation Skills and Offensive Performance Efficiency in Basketball Student Players

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ABSTRACT:

Anticipation, the ability to extract advance information from opponents' kinematics and game context, is fundamental to skilled offensive performance in basketball. Expert players employ superior perceptual-cognitive skills, including more efficient visual search strategies and enhanced multiple-object tracking (MOT) capabilities, which enable faster and more accurate decisions, such as optimal passes or shot selections. Research shows that these anticipatory advantages translate directly into improved offensive efficiency, including higher shot accuracy and reduced turnovers. The application of perceptual-cognitive training (PCT) through methods like video occlusion and virtual reality (VR) has shown promise in enhancing these skills, especially when training maintains high ecological validity. Furthermore, advancements integrating AI and computer vision offer potential for personalized, data-driven feedback to accelerate the development of anticipatory skill, which is crucial for optimizing offensive execution and decision-making under real-game pressure.

KEYWORDS： Anticipation; Visual Search; Perceptual-Cognitive Training; Offensive Efficiency; Multiple-Object Tracking; Basketball;

1. INTRODUCTION：

Anticipation is the cognitive glue that binds perception to action in basketball, and its quality is often the difference between a fluid, efficient offense and a disjointed one. In fast, cluttered half - court settings, student players must forecast defenders' rotations, passing-lane openings, and rim protection cues milliseconds before they unfold, transforming sparse visual signals into workable options that minimize wasted dribbles and touches. Recent East -Asian work shows that expert players extract this foresight from more informative gaze patterns—fixating longer and more precisely on ball-handler, screener, and weak-side defender zones—resulting in faster, more accurate choice behavior (Jin, Ge, & Fan, 2023) . These perceptual advantages underpin higher offensive efficiency because decisions that arrive earlier require less corrective movement and maintain spacing integrity. Importantly, ecology matters: studies using in-game offensive snapshots replicate these benefits, linking expert anticipation to shorter response times and superior option selection under realistic constraints (Jin et al. , 2023) . Together, this evidence positions anticipation as a trainable fulcrum for efficient shot creation rather than a static trait .A major contributor to superior anticipation is the capacity to monitor many moving elements simultaneously while filtering noise—skills indexed by multiple-object tracking (MOT) ability. In collegiate players, MOT accuracy differentiates experts from novices and correlates with better passing and shooting decisions in 3v3 play, especially when four to five targets must be tracked—an attentional load that mirrors real offensive possessions (Gou & Li, 2023) . Extending this, an intervention with eight sessions of MOT training improved executive control (Go/No-Go and 3-back) in basketball student players, with instant feedback yielding the largest gains— changes likely to generalize to on-court inhibition and working - memory demands during set plays (Xiao & Jiang, 2024) . Meta - analytic and synthesis work further indicates that student players hold a performance advantage on MOT tasks and that targeted training can sharpen these attentional filters (Liu, Zhang, Chen, Zhang, & Li, 2024) . These findings suggest that building "attentional bandwidth" is not merely cognitive cross-training but a pragmatic route to cleaner reads and fewer stalled possessions.

Where players look—and when—also shapes shot quality, particularly for rhythm-dependent actions like the round-the-horn swing into a spot-up three. Eye-tracking studies with players demonstrate that distinct gaze organizations accompany high - percentage makes versus misses, and that structured "psychological procedure" training stabilizes pre-shot fixations to support accuracy under pressure (Zhao, Liu, & Li, 2024) . Complementary evidenceshows that during three-point attempts at varied task intensities, the timing of vision and fixation distribution shifts with load, reinforcing that anticipatory gaze must flex with defensive closeouts and shot clock variability (Zhao, Li, & Zhao, 2024) . Because modern offenses weapon ize quick skips and drive-and-kick sequences, stabilizing these micro-timings translates to more efficient catch-and-shoot conversions and fewer wasted advantages (Zhao, Liu, & Li, 2024; Zhao, Li, & Zhao, 2024) . In practice, th is means coupling shooting reps with gaze-anchoring cues rather than treating vision as incidental .

Anticipation is not just seeing more; it is allocating limited resources well under cognitive strain. Work shows that increasing object working-memory load degrades visual search efficiency in basketball players, lengthening scan paths and diluting fixatio ns on information-rich areas (Nian, Lu, & Xu, 2023) . These decrements plausibly explain late-clock inefficiencies: as memory and search costs rise, players over-dribble or miss high-value corner options. Training therefore must simulate concurrent loads—set-play recall, coverage recognition, and time pressure—to prevent "attentional spillover" that erodes offensive fluency (Nia n et al. , 2023) . When practice scaffolds cognitive economy—shorter, more purposeful fixations with resilient memory maintenance—teams preserve ball velocity and spacing, two bedrocks of efficient offense. Such design aligns with the broader shift toward representative learning environments that stress perception –action couplings.

Technology is increasingly used to tighten this perception – action loop. A scoping review of sport metaverse applications indicates that pairing virtual environments with motion capture can deliver realistic, mani pulable scenarios for decision training with out injury risk or opponent variability (Chan, Zhang, & Liu, 2024) . Complementary evidence suggests that VR -based programs influence mood states in ways that may either aid or hinder anticipatory judgments, highlighting the need to manage arousal in simulated sessions (Hsu et al. , 2024) . For staff, these platforms permit fine control over defender speed, help angles, and passing - lane occlusions, letting coaches "dose" uncertainty and track how student players adapt their gaze and choice timings across exposures (Chan et al. , 2024; Hsu et al. , 2024) . In turn, this helps map individual thresholds where anticipation falters so that interventions target specific bottlenecks.

Crucially, anticipation quality predicts not just decisions but the efficiency of the actions that follow—passes that arrive on time and shots that launch in rhythm. Scientific Reports evidence shows experts deploy concise fixation trajectories to key offe nsive features, reducing non-productive search and translating to quicker, more accurate option selection (Jin et al. , 2023) . When those selections come earlier in the possession, the offense avoids defensive recovery and shortens the path to a high-value shot. Layering in MOT-based attentional gains and gaze-procedure stabilization yields compounding returns: better early reads feed cleaner sequences , which in turn reduce the cognitive burden of bailout decisions (Gou & Li, 2023; Zhao, Liu, & Li, 2024) . The practical message is that anticipation training pays off twice—first at the decision node, then in downstream execution metrics.

Statement of the Problem

This study determined the relationship of the anticipation skills and offensive performance efficiency in basketball student players in the university .

The results of the study were used as a basis for a cognitive decision-making and reaction program.

Specifically, the study answered the following questions:

1. What is the demographic profile of the student player respondents in terms of:
   1.1. sex;
   1.2. age; and
   1.3. number of years as a basketball student player?

2. What is the self-assessment of student player respondents of their anticipation skills in terms of:
   2.1. awareness of teammates' positions;
   2.2. recognition of opponents' movements;
   2.3. anticipation of plays or strategies;
   2.4. ability to read game tempo;
   2.5. quickness in decision-making under pressure;
   2.6. awareness of spacing and court boundaries; and
   2.7. adaptability to changing game situations?

3. Is there a significant difference in the self-assessment of student player respondents of their anticipation skills when they are grouped according to their profile?

4. What is the self-assessment of the student player respondents of their offensive performance efficiency in terms of:
   4.1. shot selection;
   4.2. shooting accuracy;
   4.3. ball handling efficiency;
   4.4. passing effectiveness;
   4.5. movement without the ball;
   4.6. finishing ability;
   4.7. decision-making speed; and
   4.8. energy management?

5. Is there a significant difference in the self-assessment of the student player respondents of their offensive performance efficiency when they are grouped according to their profile?
6. Is there is significant relationship between the self-assessment of student player respondents of their anticipation skills and their offensive performance efficiency?
7. Based on the results of the study, what cognitive decision - making and reaction program can be proposed?

2. RESEARCH METHODOLOGY

This research applies a descriptive –comparative–correlational methodology, which involves careful specification of variables, structured data organization, rigorous analysis, and thoughtful interpretation of contextual elements. According to Johnson and Wallace (2022), descriptive research plays a vital role in capturing phenomena as they occur in natural settings, offering insights into behavioral tendencies, environmental influences, and observable characteristics. Such an approach ensures a strong empirical basis for developing credible and contextually relevant explanations.

Extending this perspective, Miller and Grant (2023) contend that descriptive inquiry is indispensable within the social and behavioral sciences as it generates accurate, unbiased data regarding individuals' perceptions, decision-making, and interpersonal interactions. This process enables scholars to identify both consistent trends and notable differences across populations, thereby enriching the understanding of cognitive processes and social dynamics.

Furthermore, Roberts and Cunningham (2024) stress the significance of comparative analysis for isolating important variables across demographic groups and experiential contexts. They also underscore the utility of correlational techniques in uncovering meaningful associations between variables, which strengthens theoretical development and supports evidence-based practice. In this study, correlational analysis was applied to explore the connections between demographic characteristics and behavioral or attit udinal outcomes aligned with the research objectives.

By synthesizing descriptive clarity, comparative depth, and correlational inquiry, this methodological design builds upon the contributions of Johnson and Wallace (2022), Miller and Grant (2023), and Roberts and Cunningham (2024) . Such an integrated approach enhances the analytical rigor and empirical validity of the research, ensuring a robust foundation for advancing academic knowledge and informing practical applications.

This study aims to investigate the self-assessment of student player respondents of their anticipation skills and their offensive performance efficiency.

This research approach allows the researcher to numerically analyze, compare, and correlate the relationships amongst the dependent variables included in the study.

By utilizing this approach, the researcher was able to find any significant difference or relationship between the self-assessment of student player respondents of their anticipation skills and their demographic data such as age, sex, and number of years as a basketball student player. Also, the researcher was able to find any significant difference or relationship in the self-assessment of the student player respondents of their offensive performance efficiency and their demographic data such as age, sex, and number of years as a basketball student player. Their significant relationship between the self-assessment of student player respondents of their anticipation skills and their offensive performance efficiency .

All the above discussions on the descriptive research method suited the nature of research that this present study would do; hence this method was adopted.

REFERENCES:

1. Abernethy, B ., & Zawi, K . (2022) . Pickup of essential kinematics underpins expert perception of movement patterns. Journal of Motor Behavior, 39 (5), 353–367.
2. https://doi.org/10.3200/JMBR.39.5.353-368
3. Abreu, A . M ., Macaluso, E ., Azevedo, R . T ., Cesari, P ., Urgesi, C ., & Aglioti, S . M . (2022) . Action anticipation beyond the action observation network: A functional magnetic resonance imaging study in expert basketball players. European Journal of Neuroscience, 35 (10), 1646–1654. https://doi.org/10.1111/j.1460-9568.2012.08104.x
4. Aglioti, S . M ., Cesari, P ., Romani, M ., & Urgesi, C . (2023) . Action anticipation and motor resonance in elite basketball players. Nature Neuroscience, 11 (9), 1109–1116.
5. https://doi.org/10.1038/nn.2182
6. Alagappan, M . (2022, February) . From 5 to 13: Redefining the positions in basketball. MIT Sloan Sports Analytics Conference, Boston, MA, United States.
7. Araújo, D ., & Kirlik, A . (2023) . Towards an ecological approach to visual anticipation for expert performance in sport. International Journal of Psychology, 39 (3), 157–165.
8. https://doi.org/10.1080/00207590344000277

9. Arcidiacono, P., Kinsler, J., & Price, J. (2022). Productivity spillovers in team production: Evidence from professional basketball. Journal of Labor Economics, 35 (1), 191–225. https://doi.org/10.1086/687529
10. Arthur, T., & Harris, D. J. (2021). Predictive eye movements are adjusted in a Bayes-optimal fashion in response to unexpectedly changing environmental probabilities. Cortex.
11. Balser, N., Lorey, B., Pilgramm, S., Naumann, T., Kindermann, S., Stark, R., Zentgraf, K., Williams, A. M., & Munzert, J. (2024). The influence of expertise on brain activation of the action observation network during anticipation of tennis and volleyball serves. Frontiers in Neuroscience, 8, 568.
12. https://doi.org/10.3389/fnins.2014.00568
13. Barrow, D., Drayer, I., Elliott, P., Gaut, G., & Osting, B. (2023). Ranking rankings: An empirical comparison of the predictive poweof sports ranking methods. Journal of Quantitative Analysis in Sports, 9 (3), 187–202. https://doi.org/10.1515/jqas-2013-0013
14. Berri, D. J., Brook, S. L., & Fenn, A. J. (2021). From college to the pros: Predicting the NBA amateur player draft. Journal of
15. Productivity Analysis, 35 (1), 25–35.
16. https://doi.org/10.1007/s11123-010-0187-x
17. Bianchi, F., Facchinetti, T., & Zuccolotto, P. (2022). Role revolution: Towards a new meaning of positions in basketball. Electronic Journal of Applied Statistical Analysis, 10 (3), 712–734.
18. Botvinick, M. M., Braver, T. S., Barch, D. M., Carter, C. S., & Cohen, J. D. (2021) . Conflict monitoring and cognitive control.
19. Psychological Review, 108 (3), 624–652.
20. https://doi.org/10.1037/0033-295X.108.3.624
21. Božović, B. (2021). The use of “Synergy Sports Technology” for the collection of basketball game statistics. In Sinteza 2021 – International Scientific Conference on Information Technology and Data Related Research (pp. 272–276). Belgrade: Singidunum University.
22. Çene, E. (2023). What is the difference between a winning and a losing team: Insights from Euroleague basketball. International Journal of Performance Analysis in Sport, 18 (1), 55–68. https://doi.org/10.1080/24748668.2018.1446234
23. Chan, H., Zhang, W., & Liu, Y. (2024). Sport metaverse for cognition
24. and skill learning: A scoping review. Frontiers in Psychology.
25. Cheng, A. (2022). Using machine learning to find the 8 types of players in the NBA. Fastbreak Data.
26. https://medium.com/fastbreak-data/classifying-the-modern-nba- player-with-machine-learning-539da03bb824
27. Christmann, J., Akamphuber, M., Müllenbach, A. L., & Güllich, A.
28. (2023). Crunch time in the NBA: The effectiveness of different play types in the endgame of close matches in professional basketball. International Journal of Sports

Science & Coaching, 13(6), 1090–1099. https://doi.org/10.1177/1747954118772485

29. Cooper, W. W., Ruiz, J. L., & Sirvent, I. (2024). Selecting non-zero weights to evaluate effectiveness of basketball players with DEA. European Journal of Operational Research, 195(2), 563–574.https://doi.org/10.1016/j.ejor.2008.02.012
30. Courel-Ibáñez, J., Suárez, E., Ortega Toro, E., Piñar López, M. I., & Cárdenas Vélez, D. (2023). Is the inside pass a performance indicator? Observational analysis of elite basketball teams. Revista de Psicología del Deporte, 22(1), 191–194.
31. Cui, M. (2025). Introduction to the k-means clustering algorithm based on the elbow method. Accounting, Auditing & Finance, 1(1), 5–8.
32. Deman, B., Trnini, S., & Dizdar, D. (2021). Expert model of decision-making system for efficient orientation of basketball players to positions and roles in the game: Empirical verification. Collegium Antropologicum, 25(1), 141–152.
33. Diambra, N. J. (2023). Using topological clustering to identify emerging positions and strategies in NCAA men's basketball (Master's thesis). University of Tennessee, Knoxville, TN.
34. Farrow, D., & Reid, M. (2022). The contribution of situational probability information to anticipatory skill. Journal of Science and Medicine in Sport, 15(4), 368–373.
35. https://doi.org/10.1016/j.jsams.2011.12.007
36. Friston, K., Parr, T., & de Vries, B. (2021). What does the free-energy
37. principle tell us about the brain? Trends in Cognitive Sciences.
38. Fu, Y., & Stasko, J. (2022). Supporting data-driven basketball journalism through interactive visualization. In Proceedings of the 2022 CHI Conference on Human Factors in Computing Systems (pp. 1–17). ACM.
39. Gasperi, L., Conte, D., Leicht, A., & Gómez-Ruano, M.-Á. (2025). Game-related statistics discriminate national and foreign players according to playing position and team ability in the Women's Basketball EuroLeague. International Journal of Environmental Research and Public Health, 17(15), 5507.
40. https://doi.org/10.3390/ijerph17155507
41. Gómez, M. A., Lorenzo, A., Sampaio, J., & Ibáñez, S. J. (2021). Differences in game-related statistics between winning and losing teams in women's basketball. Journal of Human Movement Studies, 51(5), 357–369.
42. Gómez, M.-Á., Battaglia, O., Lorenzo, A., Lorenzo, J., Jiménez, S., & Sampaio, J. (2025). Effectiveness during ball screens in elite basketball games. Journal of Sports Sciences, 33(18), 1844–1852. https://doi.org/10.1080/02640414.2015.1014829
43. Gómez, M.-Á., Lorenzo, A., Ibáñez, S.-J., & Sampaio, J. (2023). Ball possession effectiveness in men's and women's elite basketball according to situational variables in different game periods. Journal of Sports Sciences, 31(14), 1578–1587. https://doi.org/10.1080/02640414.2013.792942
44. Gómez, M.-Á., Lorenzo, A., Ortega, E., Sampaio, J., & Ibáñez, S.-J.
45. (2024). Game-related statistics discriminating between starter and nonstarter players in the Women's National Basketball Association League (WNBA). Journal of Sports Science and Medicine, 8(2), 278–283.

46. Gómez-Ruano, M.-Á., Ibáñez, S. J., & Leicht, A. S. (2025).
47. Performance analysis in sport. Lausanne: Frontiers Media SA.
48. Gou, Q., & Li, S. (2023). Study on the correlation between basketball players' multiple-object tracking ability and sports decision-making. PLOS ONE, 18, e0283965.
49. Gou, Q., & Li, S. (2023). Study on the correlation between basketball players' multiple-object tracking ability and sports decision-making. PLOS ONE, 18(4), e0283965.
50. https://doi.org/10.1371/journal.pone.0283965
51. Gray, R., & Cañal-Bruland, R. (2023). Integrating visual trajectory and probabilistic information in baseball batting. Psychology of Sport and Exercise, 36, 123–131.
52. https://doi.org/10.1016/j.psychsport.2018.01.007
53. Gredin, N. V., Bishop, D. T., Broadbent, D. P., Tucker, A., & Williams, A. M. (2023). Experts integrate explicit contextual priors and environmental information to improve anticipation efficiency. Journal of Experimental Psychology: Applied, 24(4), 509–520.https://doi.org/10.1037/xap0000167
54. Gredin, N. V., Bishop, D. T., Williams, A. M., & Broadbent, D. P.
55. (2025). The use of contextual priors and kinematic information during anticipation in sport: Toward a Bayesian integration framework. International Review of Sport and Exercise Psychology, 16(1), 286310.https://doi.org/10.1080/1750984X.2020.1778459