Research Papers on Momentum in NBA Basketball

Literature Review - Compiled on November 08, 2025

Project Context

This document presents a comprehensive review of academic research on momentum in NBA basketball. This literature review is part of the NBA Tactical Recommendations System project, which focuses on developing a machine learning model to predict optimal timeout timing based on momentum analysis.

1. Identifying Key Factors in Momentum in Basketball Games

Authors: Chen, T. & Fan, Q. (2018)

Source: PMC (PubMed Central) - Peer-reviewed

Link: https://pmc.ncbi.nlm.nih.gov/articles/PMC9041568/

Abstract

Momentum as elaborated under a recent novel definition has been shown quantitatively to have a significant impact on basketball game outcomes. This paper makes two contributions to the analytical literature on sports momentum: (1) two aspects of the new definition are operationalized so that its practicality becomes evident; and (2) through a dimension-reduction technique (elastic net), key factors associated with momentum are identified. Both technical variables such as field goals, assists, rebounds, etc. and environmental variables such as the spectator attendance rate and player salary dispersion are considered, and the potential for useful real-time analyzes is illustrated.

Key Definition

Mathematical Formula: Momentum occurs when one team outscores its opponent by a large margin (γ) in a relatively short period (s).

Parameters:
• s = time window (recommended: 90-360 seconds)
• γ = threshold value for momentum

Two Aspects:
• **Explosiveness:** The maximum slope of score difference change
• **Duration:** How long the momentum episode lasts

Key Findings

• **Three-point field goals** are the strongest momentum trigger
• **Attendance Rate (AR)** has major impact on momentum generation
• **Defensive rebounds** and **turnovers** play critical roles
• **Timeouts do NOT enhance or slow down momentum**
• Environmental variables (Gini coefficient, attendance) play a larger role than many technical variables
• From the explosiveness perspective: Three-point shots > Attendance Rate > Two-point shots
• From the duration perspective: Turnovers > Field goal misses > Rebounds

2. The Influence of 'Momentum' on the Game Outcome While Controlling for Game Types in Basketball

Authors: Qiu, M., Zhang, S., Yi, Q., Zhou, C., & Zhang, M. (2024)

Source: Frontiers in Psychology

Link: https://www.frontiersin.org/journals/psychology/articles/10.3389/fpsyg.2024.1412840/full

Abstract

In competitive sports, momentum encompasses positive or negative changes in cognition, physiology, emotions, and behavior caused by sudden or a series of continuous events. Momentum occurring during basketball games leads to significant performance variation regarding positive net points differences for a specific team within a certain period. This study designed a quantitative framework based on two performative dimensions (time constraints and point differentials) to accurately identify momentum in basketball games, and explored the role of momentum in games. We identified 2,083 momentum occurrences in 372 professional elite basketball games. The number of momentum occurrences for winning teams is significantly higher than for losing teams (1.78 ± 0.47 Difference Value, $p < 0.001$); the correlation between momentum and game outcomes decreased as each quarter progressed.

Key Definition (CBA Study)

Minimum Requirement: Net score difference of +6 points within 96 seconds

Rationale:
• At least 3 complete offensive/defensive possessions
• Average possession duration: ~32 seconds
• Average score per possession: 2.1 points
• Net score is used because momentum reflects the competition between both teams

Key Findings

• **2,083 momentum occurrences** identified in 372 games
• Winning teams had significantly more momentum occurrences (average 1.78 more)
• **First quarter momentum is most critical** - especially when weaker teams beat stronger teams
• Free throw scoring, opponent's two-point shots, and opponent's turnovers most important
• Correlation between momentum and game outcome **decreases each quarter**
• In evenly matched games, total number of momentum occurrences matters more than quarter-specific momentum
• Game type (evenly matched vs. quality difference) significantly affects momentum impact

3. Finally, Evidence for a Momentum Effect in the NBA

Authors: Arkes, J. & Martinez, J. (2011)

Source: Journal of Quantitative Analysis in Sports

Link: https://core.ac.uk/download/pdf/36735832.pdf

Key Contribution

This paper examines **game-to-game momentum** rather than within-game momentum. The authors found evidence for a positive momentum effect, in that stronger performance over the past 3 or 5 games is associated with a higher probability of winning the next game, with the estimated effect being stronger for home teams. Furthermore, the results are stronger when using more precise measures of team strengths, suggesting that not fully accounting for team strengths could contribute to a downward bias in the estimated momentum effect.

Key Findings

• **Game-to-game momentum exists** in the NBA
• Success in previous 3-5 games increases win probability in next game
• Each extra win in past 5 games increases win probability by **2.2-4.0 percentage points**
• Effect is **stronger for home teams**
• Betting houses exploit people's beliefs about momentum in point spread settings
• Marginal effects are fairly consistent across different values of momentum variables
• This was one of the first papers to find quantitative evidence for momentum in NBA

4. A Causal Approach for Detecting Team-Level Momentum in NBA Games

Authors: Weimer, L., Steinert-Threlkeld, Z., & Coltin, K. (2023)

Source: Journal of Sports Analytics

Link: https://journals.sagepub.com/doi/10.3233/JSA-220592

Key Innovation

This paper provides new evidence that team-level momentum exists in the National Basketball Association (NBA). The existence of momentum is one of the most prominent and longstanding questions in sports analytics. But for all its importance to announcers, coaches, and players, existing literature has found little evidence of momentum in professional basketball. This paper exploits a natural experiment in the flow of basketball games: television (TV) timeouts. Since TV timeouts occur at points exogenous to momentum, they enable the measurement of the effect of pauses in the game separate from the effect of strategy changes.

Key Findings

• **TV timeouts cause an 11.2% decline** in the number of points that the team with momentum subsequently scores
• Used TV timeouts as **natural experiment** (exogenous to game flow and strategy)
• First major evidence of team-level in-game momentum in NBA using **causal inference** methods
• Effect is **robust** to run size, substitutions, and game context
• Provides empirical evidence that momentum is not just a psychological belief but a measurable phenomenon
• Challenges previous research that found no evidence of momentum
• Methodology can be applied to other sports and contexts

5. All About Momentum: Investigating High-Pressure Situations in the NBA Through Scoring Probability

Authors: Mihályi, B., Biczók, G., & Toka, L. (2025)

Source: Sage Journals

Link: https://journals.sagepub.com/doi/10.1177/17479541251333956

Key Contribution

One of the defining characteristics of real basketball stars, and even great role players, is how well they perform under immense mental pressure. This paper presents a method to identify high-pressure situations during a basketball game through shooting success. The analysis incorporates a novel feature set that emphasizes both player-level and team-level momentum, including scoring streaks. Using six seasons of NBA data, the study finds that shotmaking is mainly impacted by momentum, i.e., when a team outscores their opponent significantly over a short period of time.

Key Findings

- Focus on **high-pressure situations** and their relationship to momentum
- Analyzes both **player-level** and **team-level momentum**
- **Scoring streaks** serve as momentum indicators
- Six seasons of NBA data analyzed with deep learning clustering techniques
- Shotmaking significantly affected by momentum conditions
- Redefines player roles using clustering-based approach
- Demonstrates relationship between pressure, momentum, and performance

Summary of Key Definitions Across Studies

The following table summarizes the various definitions and operationalizations of momentum across the reviewed studies:

Study	Time Window	Score Threshold	Key Metric
Chen & Fan (2018)	90-360 seconds	γ (variable)	Explosiveness & Duration
Qiu et al. (2024)	96 seconds	+6 points	Net score difference
Arkes & Martinez (2011)	3-5 games	Win/Loss	Game-to-game success
Weimer et al. (2023)	Scoring runs	Variable	Points scored during run
Mihályi et al. (2025)	Short periods	Significant outscore	Scoring probability

Common Elements Across All Studies

Despite different methodologies and definitions, all studies share several common elements in their understanding of momentum:

1. Time Constraint: Momentum occurs over a relatively short period (seconds to minutes for in-game momentum, games for game-to-game momentum)

2. Score Differential: A significant scoring advantage or performance improvement in that time period

3. Behavioral Impact: Momentum affects subsequent performance, decisions, and outcomes

4. Psychological Component: Involves changes in cognition, emotion, motivation, and confidence

5. Measurable Effect: Can be quantified and shown to have statistical significance

Implications for NBA Timeout Prediction Project

Based on this literature review, the following insights are relevant for the NBA Tactical Recommendations System project:

1. Momentum Definition for the Project:
The Chen & Fan (2018) definition provides the most suitable framework: a team outscoring its opponent by γ points within s seconds (90-360 seconds recommended). This aligns well with timeout decision-making timescales.

2. Key Variables to Track:
• Three-point field goals (strongest momentum trigger)
• Defensive rebounds
• Turnovers
• Score runs (consecutive scoring sequences)
• Game quarter (first quarter momentum most impactful)

3. Timeout Effectiveness:
• Chen & Fan found timeouts do NOT stop momentum
• However, Weimer et al. found TV timeouts reduce momentum by 11.2%
• This suggests timing and type of timeout may matter

4. Feature Engineering:
• Calculate momentum score using time-weighted runs
• Track explosiveness (rate of score change) and duration
• Consider first quarter momentum separately
• Account for game type (evenly matched vs. quality difference)

5. Model Training Approach:
• Define "successful timeout" based on momentum change after timeout
• Use retrospective analysis: did timeouts called during high opponent momentum stop the run?
• Consider both immediate effect and longer-term game impact

6. Research Gap:
The relationship between timeout timing relative to momentum state remains understudied. This project can contribute new knowledge by systematically examining when timeouts are most effective in the context of momentum.

Conclusion

This literature review has identified five major academic papers that provide rigorous, peer-reviewed definitions and measurements of momentum in NBA basketball. The papers span from 2011 to 2025, showing the evolution of momentum research from initial skepticism to empirical validation.

The most important finding for the project is that momentum is now accepted as a real, measurable phenomenon with quantifiable impact on game outcomes. The Chen & Fan (2018) mathematical definition provides a solid foundation for feature engineering, while the Qiu et al. (2024) findings about first-quarter momentum and Weimer et al. (2023) causal evidence provide valuable insights for model development.

The next steps in the project should include:
• Implementing the Chen & Fan momentum calculation algorithm
• Extracting Play-by-Play data from NBA API
• Calculating momentum scores for historical games
• Identifying timeout events and their temporal context relative to momentum
• Defining success criteria for timeouts based on momentum changes

This solid theoretical foundation positions the project to make an original contribution to sports analytics by examining the specific relationship between timeout timing and momentum effectiveness.

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