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Posted Date: 25 February 2025

doi: 10.20944/preprints202502.2017.v1

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Article

The Effect of Technical Fouls on Momentum Change in Basketball: A Comparison of Regular Season vs. Playoffs in the NBA

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Abstract: Spanning two decades (2000–2021), this study delves into how TF-induced momentum shifts differ between regular season and playoff matchups, factoring in home-court advantage and team score status at the time of the call. Analyzing 4,196 cases of TFs called against coaches, we employ big data analytics to uncover distinct patterns in momentum shifts and their strategic implications. Using advanced statistical modeling, we identify how these effects vary across game contexts, demonstrating how big data enhances decision-making in competitive sports. Logistic regression revealed a significant season-by-location interaction ($p < .03$). The findings revealed that, in the regular season, TFs in home games were associated with a 44%-win rate, compared to 28% in away games. However, in the playoffs, this shifted to 50% at home and 23% away. These results provide valuable insights into the TF-momentum shift phenomenon. Leveraging game analytics to identify patterns in TF-related momentum shifts can help coaches make more informed decisions, including pinpointing the optimal moments for TFs and other strategic actions.

Keywords: momentum shift; basketball; coaches; technical fouls; playoffs

1. Introduction

The NBA playoffs attract millions of fans each year, as teams battle for the championship in a best-of-seven series that amplifies drama and excitement. The NBA playoffs are renowned for producing unforgettable plays, clutch performances, and defining moments in basketball history. While the regular season typically encompasses pre-planned and sometimes unexciting games involving all NBA teams, playoff contests feature sixteen teams competing for the title within intensified pressure from spectators and management. The intense excitement of the NBA playoffs often gives rise to the concept of “choking,” (Morgulev & Galily, 2018). As the culmination of the season, every playoff game carries immense significance, with the “win or go home” stakes creating intense drama that captivates audiences. During the 2023/24 season, NBA regular season games averaged 1.56 million viewers across ABC, ESPN, and TNT, while the 2024 NBA Finals drew an average of 11.3 million viewers in the United States (Statista, n.d.). In this high-pressure environment, it is unsurprising that coaches employ tailored strategies to optimize players’ contributions (José et al., 2021). One such strategy involves the pre-planned use of technical fouls (TFs) to influence game momentum. While TFs are often associated with penalizing inappropriate behavior, they also carry significant implications for the flow and progression of a game. Although commonly linked to the players’ confrontations on the court, TFs also occur when coaches express disrespect towards officials or violate game rules (Tenenbaum et al., 2023).

The TFs research addresses a critical lacuna in the existing literature by exploring the nuanced relationship between TFs and momentum shifts, with a focus on their differences between regular season and playoff matchups. While previous studies have often examined TFs in isolation or in general contexts, our study delves into how these events influence game dynamics under varying conditions, such as home versus away games and score status at the time of the foul. Thus, the aim

of this analysis is to elucidate the intricate process of momentum alteration during regular season and playoffs, particularly through the strategic deployment of TFs by coaches to redirect negative momentum toward a positive trajectory.

The study offers a comprehensive analysis which spans over two decades, from 2000 to 2021, enabling to delve into the multifaceted relationship between TFs and momentum shifts. We evaluate these shifts using statistical performance metrics, differentiating between regular and playoff seasons, home and away matchups, and exploring how these dynamics manifest when a team is leading or trailing throughout the four quarters which constitute the entire game. The application of statistical modeling to this extensive dataset allows us to extract meaningful insights that would be difficult to discern through smaller-scale studies, positioning our research within the broader discourse on the role of big data in sports analytics and decision-making.

1.1. The Psychology of Momentum in Sports

Psychological momentum in sports refers to an athlete gaining a mental advantage, fostering a sense of superiority over their opponent (Iso-Ahola & Mobily, 1980). In the realm of sports, “momentum” takes on a colloquial meaning, referring to the psychological state and performance trajectory of a team or athlete. Momentum often manifests as a winning streak that provides a psychological advantage, frequently shifting during pivotal moments in games or competitions. These turning points can arise from key plays, successful scoring drives, defensive stops, or other decisive events that sway the game in favor of one side. Effective coaches and athletes are aware to the critical importance of managing momentum. Their strategies focus on maintaining composure during challenging phases, adhering to the game plan, and avoiding overconfidence when riding positive momentum (Tenenbaum et al., 2023). Conversely, losing momentum often leads to diminished performance, reduced confidence and frustration, requiring teams or athletes to regroup and regain control (Briki et al., 2012; Redwood-Brown et al., 2018). The dynamic of winning and losing streaks embodies the essence of momentum in sports, where teams or athletes on a winning streak feel nearly unstoppable, while those on a losing streak struggle to reverse their fortunes.

Moreover, team momentum, specifically, reflects the collective improvement or decline in a team’s performance over the course of a single game or across multiple games. This encompasses periods of extended success or consecutive losses (Arkes & Martinez, 2011; Weimer et al., 2023). Momentum can also shift within a competition, driven by sequences of actions that influence outcomes for both teams—often in opposing directions—highlighting its fluid and transformative nature.

1.2. The Strategic and Psychological Dynamics of Technical Fouls in Basketball

Relatively little attention has been given to the context and implications of technical fouls (TFs) in basketball. One notable study, Gomez et al. (2019) examined the immediate impact of TFs on both the team committing the foul and their opponents during Olympic Games, European Championships, and World Championships. The findings revealed that TFs assessed against coaches or bench personnel often disrupted the negative momentum of a losing team, suggesting that coaches may intentionally commit TFs to influence referees’ perceptions and shift game momentum. Similarly, Zitek and Jordan (2011) studied the role of instrumental aggressive behavior in the NBA, measured by the frequency of TFs. They found that players who received more TFs demonstrated higher success rates, scoring more points and achieving greater rebounds and blocks. These findings underscore a potential strategic element in the use of TFs to enhance individual and team performance. In a more recent study, Weimer et al. (2023) investigated team-level momentum in the NBA, with a particular focus on the effects of TV timeouts as natural interruptions. Their analysis revealed that TV timeouts led to an 11.2% decrease in the points scored by the team holding the momentum, an effect that persisted regardless of scoring streak length, player substitutions, or broader game context.

Building on this body of research, Tenenbaum et al. (2024) conducted a comprehensive analysis of 21 years of NBA games, specifically examining TFs called against coaches over immediate, short-term, and medium-term periods. The study provided compelling evidence of the psychological momentum shift phenomenon, identifying associated psychosocial factors. Notably, the likelihood of reversing negative momentum (e.g., a disadvantage) into positive momentum (e.g., gaining the lead) following a TF call decreased significantly from the first two quarters to the third and fourth quarters. This finding suggests that earlier TF calls are more effective in shifting momentum and improving the likelihood of winning. Furthermore, Tenenbaum et al. found that when a coach received a TF while their team was leading, the probability of winning the game increased significantly, regardless of the game's location or timing. Together, these studies highlight the multifaceted role of TFs in basketball, offering insights into their strategic use and broader impact on game dynamics.

1.3. Statistical Insights into Home Advantage

Home advantage, a well-documented phenomenon in sports, refers to the superior performance teams consistently demonstrate when competing on their home turf (Neave & Wolfson, 2003). Courneya and Carron (1992) refined this concept by defining home advantage as occurring when teams play more than 50% of their games at home and outperform their opponents in these contests. A key factor contributing to home advantage is the support of an enthusiastic home crowd, which has a significant capacity to generate momentum (Levental et al., 2022; Pollard & Gómez, 2009; Risser et al., 2018). Basketball players often draw emotional energy and encouragement from their enthusiastic fans, with the crowd's support amplifying their performance (Tenenbaum et al., 2024; Sors et al., 2023). For example, an analysis of 606 men's basketball league matches in Brazil (Junior, 2004) revealed significant statistical differences favoring home teams. Metrics such as points, three-pointers, assists, steals, blocks, and defensive rebounds demonstrated a consistent advantage for teams playing on their home court.

Moreover, coaches and players also employ strategic tactics to either disrupt the opponent's momentum or enhance their own. These tactics include well-timed use of timeouts, substitutions, and psychological strategies designed to undermine the focus and concentration of the opposing team (Gómez et al., 2019; Jones & Harwood, 2008; Weimer et al., 2023). Interestingly, even when home teams are of lower quality than their visiting counterparts, statistical data show that high-quality home teams still outperform lower-tier visiting teams playing away (Lago-Peñas & Lago-Ballesteros, 2011).

1.4. Contrasting NBA Seasons: Regular and Playoff Dynamics

A total of sixteen teams qualified for the basketball playoff each season, comprising the top eight from each conference—Eastern and Western. Teams with the best regular-season records often secure home-court advantage, a key factor in playoff success. In this context, home advantage assumes a significant role, with approximately 65% of games won by the home teams, impacting team strategies and performance (Morgado & Barreira, 2023).

Coaching strategies in basketball shift markedly from the regular season to the playoffs due to the higher stakes and intensified competition of the postseason. In this environment, coaches implement tailored strategies to optimize the players' contributions (José et al., 2021). For example, defense becomes more critical, prompting coaches to prioritize defensive ratings and effective field goal percentages as pathways to victory (Teramoto & Cross, 2010). Defensive rebounding is also crucial, frequently determining outcomes in closely contested playoff matchups (García et al., 2013). Moreover, players often vary their style of play, with guards and power forwards enhancing their three-point shooting, while the collective game is pronounced by guards providing assists, and centers contributing via rebounds and defensive intensity (José et al., 2021). In these high-pressure moments coaches commonly employ impression management tactics to maximize team performance under demanding conditions (Tenenbaum et al., 2023).

Considering the concept of momentum shift during a competition, and the research findings associated with it, we expect a stronger effect of momentum shift during the playoffs than during the regular season. Specifically, we expect that the TFs calls will result in higher percentage of momentum shifts (e.g., winning followed by a TF call) at home than away games while leading than trailing, and toward the end of the game (e.g., quarters 3 and 4) than the earlier stages of the game (e.g., quarters 1 and 2).

2. Method

TFs Sampling

During the regular season of the NBA (before the playoffs), each team plays eighty-two games (41 at home and 41 away), totaling 1,230 games in a regular season. The average number of TFs per game during the season is 0.5, thus the estimated total technical fouls in a regular season are around 615. During the playoff season, the number of games is smaller, and consequently the number of TFs calls is smaller as well. Specifically, 8 teams with the highest winning record in each of the geographic regions/conferences (i.e., eastern or western) qualify for the playoffs. Each of the playoff series consists of the "best of seven games" method. In the current study, we analyzed the data of 4,196 cases, which were used in Tenenbaum et al.'s (2024) study, where TFs were called against coaches during the years 2000-2021 in the regular season. During 21 years of regular-season games, we identified 3950 cases in which the coach committed a TF, while in the playoff periods, we identified 246 such cases. Statistical data on TFs by coaches in NBA games were extracted from the NBA play-by-play box-score on the official NBA website using a custom Python program. The software identifies the coaches against whom a TF was called, their team, the home or away team, the season (regular or playoff), and the game status (e.g., advantage vs. disadvantage at TF commencement).

The university's Institutional Review Board (IRB) approved the study. The IRB approval number for this study is P_2023011. **Transparency and openness:** We report how we determined our sample size, all manipulations, and all measures in the study.

3. Measures

Game Location: Playing at home stadium or at the away stadium of the opposing team.

Game's score position at the time of the technical foul: A dichotomous variable indicating either an advantage or disadvantage over the opposing team at the time the TF has been called.

Game's quarter: Four independent quarters lasting net 12 min each comprise the total game time.

Final score: A dichotomous variable indicating either a win or a loss by the team its coach has been called a TF.

Season: A dichotomous variable indicating either regular season or playoff season.

4. Statistical Analysis

To estimate the effects of the coaches' TF on shifting the games' momentum accounting for score status (advantage vs. disadvantage), game's location (home vs. away), season (regular vs. playoff), game's quarter (Q1 – Q4), and their interactions we conducted a logistic regression. The quarter was dummy coded in a manner that compares Q2 to Q1, Q3 to Q2, and Q4 to Q3. Given that inclusion of interaction terms may bias the interpretation of the main effects in logistic regression, we analyzed two models. The first model included only the main effects, and the second model included the main effects and the interaction terms. IBM SPSS 27 software was used for the data analysis.

5. Results

The logistic regression results for the main effects model are presented in Table 1. Significant main effects for score status, game's location, and quarter emerged. Identical to the Tenenbaum et

al.'s (2024) findings, the chances of shifting momentum and winning were higher when the team was in advantage prior to the coach foul and when called in home games. Non-significant shift of momentum difference evident between Q1 and Q2, yet chances of winning significantly decreased when the coach was called a TF in Q3 and further declined when the TF was called in Q4. The analysis failed to obtain a main effect for season.

Insert here Table 1

Inspection of the interaction effect model presented in Table 1 indicates a significant ($p < .03$) season by game's location interaction. The interaction results are presented in Figure 1. In general, the coaches' TF call was more effective during the playoff season than during the regular season when the TF was called in home games, and the opposite in away games. Specifically, during the regular season, when the TF was called at home, the chances of winning in home vs away games was 44% vs. 28%, respectively ($d = 16\%$). In contrast, the difference in shifting momentum changed during the playoff season after a TF call. The chances of winning increased to 50% at home games and decreased to 23% in away games ($d = 27\%$). The season's period failed to interact with any of the other factors.

Insert Figure 1 here

6. Discussion

Through comprehensive analysis which spans over two decades (from 2000 to 2021) our study aimed to elucidate the intricate process of momentum alteration during regular season and playoffs, particularly through the strategic deployment of TFs by coaches to redirect negative momentum toward a positive trajectory. Moreover, our findings demonstrate the power of using big data for identifying subtle, yet significant, patterns in game momentum shifts, particularly in high-stakes environments such as the NBA playoffs.

Taking into consideration Tenenbaum et al.'s (2024) findings on the effect of coaches' TF calls on momentum shifts during the regular season, the findings show no differences between the playoffs and the regular season regarding metrics such as quarters and different game's score position (leading vs. trailing). Although we expected a stronger effect of momentum shifts during the playoffs in several aspects of the game due to increased pressure, such as heightened aggressiveness in defense (Teramoto & Cross, 2010) and more defensive rebounds (García et al., 2013), the findings counter our hypothesis. Nevertheless, the findings are in line with our second assumption in which we expected that TFs will result in a higher percentage of momentum shifts during playoffs at home rather than away games. Overall, this is the only predominant difference we have found between regular season and playoffs in terms of link between TF calls and momentum shifts.

Moreover, the findings revealed noticeable shifts in momentum and chances of winning, influenced by the season and game location (see Figure 1). Specifically, during the regular season, the chances of winning an NBA game are 44% when a TF is committed at home versus 28% when a TF is committed away. In the playoffs, the chances increase to 50% for winning a game at home, compared to only 23% for winning a game when a TF is committed away. Considering these conclusive findings, it is evident that in both the regular season and the playoffs, the home court provides a significant advantage in winning the game after a coach commits a TF. Nevertheless, the findings indicate a 6% increase in the chances of winning at home when a TF is committed during the playoffs. More specifically, the gap between home and away settings is significantly greater during the playoffs, with a 16% advantage at home during the regular season compared to a 27% advantage during the playoffs. Accordingly, during the playoffs, there is a 5% decrease in the chances of winning a game when a TF is committed away and a 6% increase in the chances of winning when a TF is committed at home.

All considered, the findings strongly echo prior research (Courneya & Carron, 1992; Tenenbaum et al., 2024; Sors, 2023), which has shown that home teams enjoy a noticeable advantage over visiting teams. While this pattern is evident in both the regular season and the playoffs, we suggest that the greater advantage during the playoffs derives from the tremendously high stakes, which ramp up

exponentially (Morgulev & Galily, 2018). The "tailwind" provided by the home crowd holds profound influence and value to the players through the support they feel while on "home turf." Notably, the presence of a supportive home crowd contributes to momentum generation (Levental et al., 2022; Risser et al., 2018). In this regard, while momentum is contagious, with exceptional individual performances inspiring the entire team to elevate their collective effort (Barsade, 2002; Zumeta et al., 2016), we suggest that during the playoffs season, players draw more emotional encouragement and energy from enthusiastic fans compared to the regular season, thereby boosting their game (Moskowitz & Wertheim, 2011; Sors, 2023). Thus, while our findings do not align with Belk et al. (2017), which show no disparities between the regular season and playoffs in the NBA, they are in line with Morgado and Barreira (2023), who demonstrate that home advantage assumes a significant role during the NBA playoffs season, impacting team strategies and performance. However, it must be stressed out that one should not belittle the so-called "lower" percentages as presented on Figure 1. We strongly argue that 23% can still trigger momentum shifts, positively influencing a team's trajectory. This can justify a coach committing a TF when their team is playing away during playoffs season.

Moreover, while NBA referees tend to be biased in favor of coaches following the commission of a TF (Tenenbaum et al., 2024), we suggest that the home crowd pressure following a TF call on a home team coach during the playoffs significantly influences referee bias in favor of that coach. After all, the well documented connection between home-court advantage and referee's bias in professional sports reveals that referees often exhibit a tendency to make decisions favoring the home team (Moskowitz & Wertheim, 2011; Sors, 2023). Hence, when a home team coach commits a TF, thus breaching the flow of the game, the home crowd tends to erupt with support for the coach, swaying the referee's demeanor towards the affected team.

In summary, this research delves into the impact of 4,196 TFs committed by coaches across two decades of NBA seasons, shedding light on the differences between regular season matchups and playoff encounters, considering factors such as home versus away games as well as examining how these dynamics unfold when a team is in a leading or trailing position. The implications of our findings extend to the practical realm for NBA coaches, particularly within the context of regular season vs. playoffs. Firstly, considering that TFs can potentially shift momentum, particularly at home, coaches might use TFs strategically to boost their team's energy and provoke the crowd during critical playoff moments. Additionally, recognizing the significant impact of home-court advantage during the playoffs, coaches should prioritize strategies that enhance crowd involvement and energy. It's also crucial for coaches to be mindful of potential biases and cultivate positive relationships with referees to minimize adverse effects. By understanding referee tendencies and maintaining professionalism, coaches can increase their chances of receiving favorable calls in high-stakes playoff situations. Finally, utilizing game analytics to discern patterns of momentum shifts related to TFs can help coaches in making informed decisions. This data can help pinpoint the optimal moments for TFs and other strategic actions.

7. Limitations

The strength of the current research lies in its quantitative approach, which provides valuable insights. However, it is limited in capturing additional events between the studied periods that could potentially influence the game trajectory. Additionally, the research has constraints in deeply exploring the psycho-social processes involved when a coach commits a TF due to its exclusive reliance on quantitative methods and the absence of qualitative methodology.

8. Future Research Directions

Continued exploration of the impact of TFs on professional basketball is recommended. Specifically, broadening the scope beyond male NBA players to include the Women's National Basketball Association (WNBA) is crucial for comprehensive comparative data, offering insights into

how TFs influence dynamics in women's basketball games. Additionally, given the differences in rules, such as the length of the game, exploring the impact of TFs in the Euro-League can also be interesting, especially as the diffusion of players and coaches increases annually. Finally, a qualitative analysis involving the observation of live games and the examination of immediate reactions to TF calls can illuminate the behavioral and contextual processes influenced by the execution of a TF.

9. Conclusion

This study examined the strategic use of technical fouls (TFs) by coaches and their impact on momentum shifts across two decades of NBA games, focusing on differences between regular season and playoff matchups. The findings accentuate the significant role of home-court advantage, particularly during playoffs, where TFs committed at home lead to higher win probabilities than those committed away. The results suggest that home crowd amplifies momentum shifts and justifies the notion of referee's bias in favor of home teams (Tenenbaum et al., 2024). These insights provide practical implications for coaches, highlighting the importance of strategically leveraging TFs, engaging the crowd, and describing momentum dynamics to optimize team performance during high-stakes playoff moments.

Data availability statement: The data that support the findings of this study are openly available at XXX

Funding: The author(s) reported there is no funding associated with the work featured in this article.

Disclosure of interest: No potential conflict of interest was reported by the author(s).

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