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The influence of crowd noise and size on fouls and home court advantage in the WNBA

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ABSTRACT

Large and loud crowds add to the intensity of a sporting event and impact player performance. A rowdy crowd can cause players and coaches, particularly those from the visiting team, to make mistakes or become frustrated, leading to more flagrant and technical fouls in basketball games. This article examines how crowd size, along with other factors that influence the noise level in the arena, correlates with flagrant and technical fouls in the Women's National Basketball Association (WNBA). This article uses a fixed effects model with crowd size, as measured by the percentage of the arena that is full, as the variable of interest and fouls as the outcome variable. The model controls for the size of the arena and other game-specific characteristics. The results indicate that crowd size, and therefore crowd noise, is positively associated with flagrant fouls and technical fouls committed by coaches. This article also investigates how larger and louder crowds affect the home and away teams differently. The findings provide some evidence of a home court advantage in terms of technical fouls committed by coaches. This article contributes to the existing literature on how crowds can contribute to home court advantage but provides additional context by looking at fouls as an outcome variable.

Contribution/Originality: This article contributes to the existing literature about how crowds contribute to home-court advantage in two ways. First, the article uses unique data from the Women's National Basketball Association. Second, this article examines flagrant and technical fouls as outcome variables, which have not been previously explored.

1. INTRODUCTION

During any sporting event, fans and players feed off each other's energy. A loud and energetic crowd can contribute to home court advantage by boosting the morale of the home team or frustrating the away team. Following substantial empirical evidence that the crowd can impact the game outcome or player performance, we hypothesize that crowd size, which corresponds with crowd noise, could also influence player aggression. A crowded arena with loud fans may add to the intensity of the game, which could be reflected in the prevalence of flagrant and technical fouls in basketball. Conversely, in a nearly empty and quiet arena, players might be less likely to take risks or play aggressively. Coaches' behavior could also be influenced by crowd behavior. Perhaps a coach would be less willing to contest a call and confront a referee if no fans are booing or the arena is empty.

This article examines the relationship between crowd size and the prevalence of various types of fouls in the Women's National Basketball Association (WNBA). The outcome variables in this study are flagrant fouls, technical fouls by players, and technical fouls by coaches. We chose to examine the WNBA because of the considerable variation in crowd size and percentage of arena capacity filled in our data. This is advantageous because we believe we can

capture wide variation in crowd noise in a professional sports setting. This would not be as easy in the NBA, for example, where 71% of the games were sellouts and the arenas were filled to 98% of capacity during the 2023-24 season (NBA Communications, 2024).

We find evidence that crowd size and noise are positively associated with the likelihood of flagrant and technical fouls occurring in a game, and the prevalence of technical fouls by coaches. We argue that crowd size is another way to measure crowd noise, as larger crowds and more full arenas create a louder and more exciting environment for players and coaches.

The energy and noise from the crowd incentivize players and coaches to take on more risk and be more aggressive during games. We explore the differences in the effects between the home and away teams as well. Perhaps crowd size and noise disproportionately affect the two teams and could contribute to a home-court advantage if it is more common to have fouls called on the away team's players and coaches. We find evidence that in games played in larger crowds, the visiting team's coach is more likely to be charged with a technical foul.

2. RELATED LITERATURE

Academic research and numerous instances in sports history have demonstrated that crowds matter in sports (Mann, 2012). The influence of crowds on players, coaches, and referees is observed in nearly every sport, at amateur, collegiate, and professional levels. One of the most important ways in which fans have influence is through sound. While the graphics on the jumbo-tron at sporting events showing a decimal monitor and encouraging fans to get louder are not based on actual sound data, some researchers have collected decibel data to understand how crowd noise affects athlete performance.

Evidence suggests that crowd noise impacts the passing speed of German football players (Otte, Millar, & Klatt, 2020) and the accuracy of elite darts players (Greeve, Van Meurs, & Strauss, 2023). Crowd noise, of course, is directly tied to the presence and attitudes of the fans themselves. Larger crowds are most likely louder than smaller crowds. Therefore, crowd size is another way for researchers to capture the influence of fans in sports. There is evidence that crowd size and density are positively associated with aggression in ice hockey (Russell & Drewry, 1976; Russell, 1983).

The literature has shown that the presence of fans, and the noise they create, can influence how athletes perform. For team sports, home fans could help the home team perform well and be loud and disruptive to the visiting team. Moreover, there is a common rhetoric in sports media that teams do not enjoy visiting certain stadiums or arenas because of the fans. Thus, crowd size and measures of fan noise have also been used to identify a home field or court advantage in sports.

Researchers at Penn State University collected decibel data during football games and found the crowd was 2 to 3 times louder when the visiting team was on offense compared to the home team, thus making it much more difficult for the visiting team to communicate (Barnard, Porter, TerBostron, Meulen, & Hambric, 2011). Another study examined the instances of false starts in the NFL during the COVID-19 pandemic, when crowds were either not allowed into the stadium or the number of fans was limited by law, and found that the absence of fans allowed quarterbacks to better manipulate opposing defenses via snap count (Farnell, 2023). These findings suggest that in American football, home fans are able to disrupt communication for the visiting team's offense, thus providing a home-field advantage to their team.

There is substantial evidence that crowd noise can influence the performance of athletes and can create advantages for the home teams. However, that is not the only aspect of the game in which fans have an influence. Numerous studies have shown that referees are also susceptible to pressure from crowd noise and behavior in association football (Downward & Jones, 2007; Nevill, Balmer, & Williams, 2002; Sors, Grassi, Agostini, & Murgia, 2020) and the National Football league (Lopez, 2016).

There is also evidence of fan influence on home-court advantage. Fans booing during basketball games was shown to motivate and positively influence the performance of home teams (Greer, 1983). Recent work studying home-court advantage in the NBA utilizes the "natural experiment" created by the COVID-19 pandemic to examine the impact of crowds on the home team's advantage. Leota et al. (2022) find evidence that the presence of fans increased the likelihood of the home team winning. Ehrlich and Potter (2022) and Gong (2022) both find that fan presence did not influence referee behavior in favor of the home team. Fischer and Haucap (2021) find similar results when examining German professional football during the COVID-19 pandemic. All three of these papers challenge the findings from the previous literature.

This article contributes to the existing literature by examining a different sports context, the WNBA, and including technical fouls committed by coaches, not just players, into the analysis. An additional advantage of our research is the ability to control for the officiating crew in each game, as it is possible that referees are not all influenced by fans in the same way. We also believe that the variation in arena size and attendance at WNBA games benefits our study, as it allows us to capture a wide range of crowd sizes over several seasons. We hypothesize that the presence of fans enhances the intensity of the game environment, which should correlate with an increase in flagrant and technical fouls. Our findings indicate a higher likelihood of technical and flagrant fouls when arenas are more crowded. Furthermore, we observe a positive relationship between crowd size and technical fouls committed by coaches. We argue that this is because fans' booing or cheering can encourage coaches to adopt more aggressive tactics or become frustrated. These results are primarily driven by the visiting team's coaches, who are more likely to be frustrated by the home fans.

3. DATA AND METHODS

Our data comes from Across the Timeline, which is an online data repository focused on women's basketball statistics. We obtain information about each individual game, attendance, referee officials assigned to the game, as well as the fouls committed in each game. We look at flagrant fouls (both flagrant 1 and flagrant 2 fouls combined), technical fouls committed by players, and technical fouls committed by coaches. We then use the arena information from the game details to determine the arena capacities and create a variable called 'Percent Full,' which is the game attendance divided by the maximum arena capacity. There is also an indicator variable for whether the game was at night (7 pm or later), a close game (final score difference was 6 points or less), and if there was any flagrant or technical foul in the game.

$$Any\ Fouls_g = \beta_0 + \beta_1 PercentFull_g + \beta_2 X_g + \epsilon_g \quad (1)$$

$$Flagrant\ Fouls_g = \beta_0 + \beta_1 PercentFull_g + \beta_2 X_g + \epsilon_g \quad (2)$$

$$Player\ Technical\ Fouls_g = \beta_0 + \beta_1 PercentFull_g + \beta_2 X_g + \epsilon_g \quad (3)$$

$$Coach\ Technical\ Fouls_g = \beta_0 + \beta_1 PercentFull_g + \beta_2 X_g + \epsilon_g \quad (4)$$

The motivation for this analysis is derived from and explained by Figures 1 and 2. Figure 1 shows the number of flagrant and technical fouls per game per WNBA season from 2010 to 2023. Figure 2 shows our attendance variable, the percentage of arena capacity full, per WNBA game over time. There is a noticeable drop in both fouls and attendance in 2020. The drop in attendance is, of course, due to the WNBA playing the entire season in the "Wubble," where the league played to empty stands. Also, the 2020 season was 12 games shorter than the normal WNBA season, which is why we look at fouls per game. We hypothesize that a possible explanation for why fouls per game dropped in 2020 is because the intensity of games also declined due to the lack of fans in the stands. Therefore, we want to analyze the relationship between crowd size and flagrant and technical fouls to better understand what we are seeing in Figures 1 and 2.

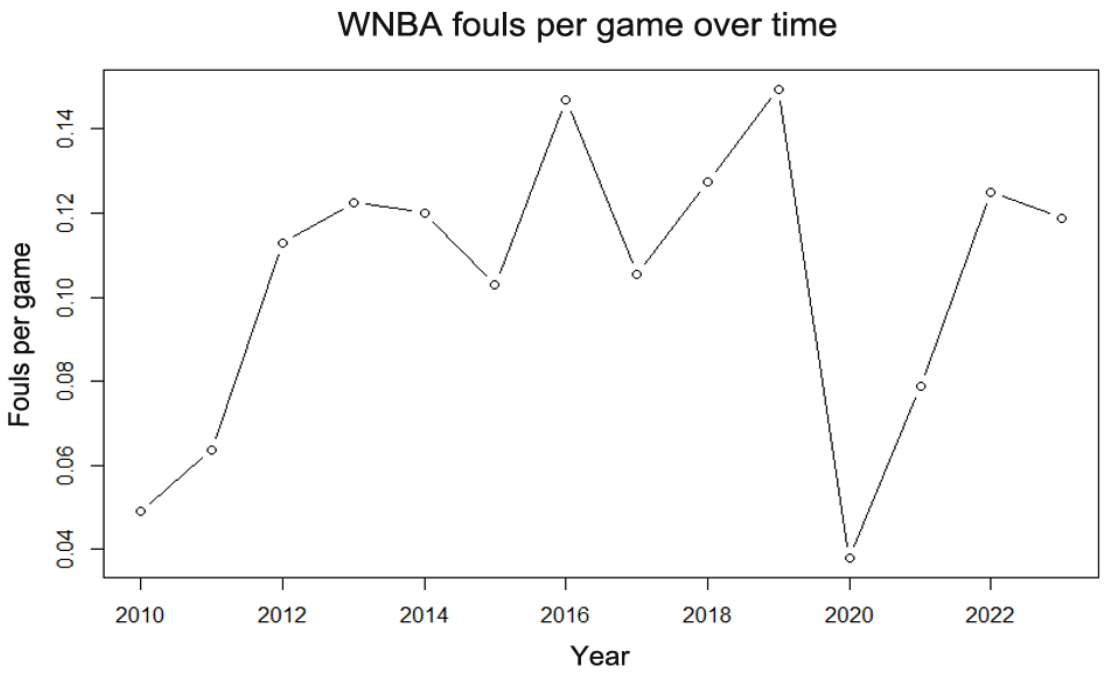

Figure 1. Average number of flagrant and technical fouls committed by players or coaches in a game by season from 2010 to 2022.

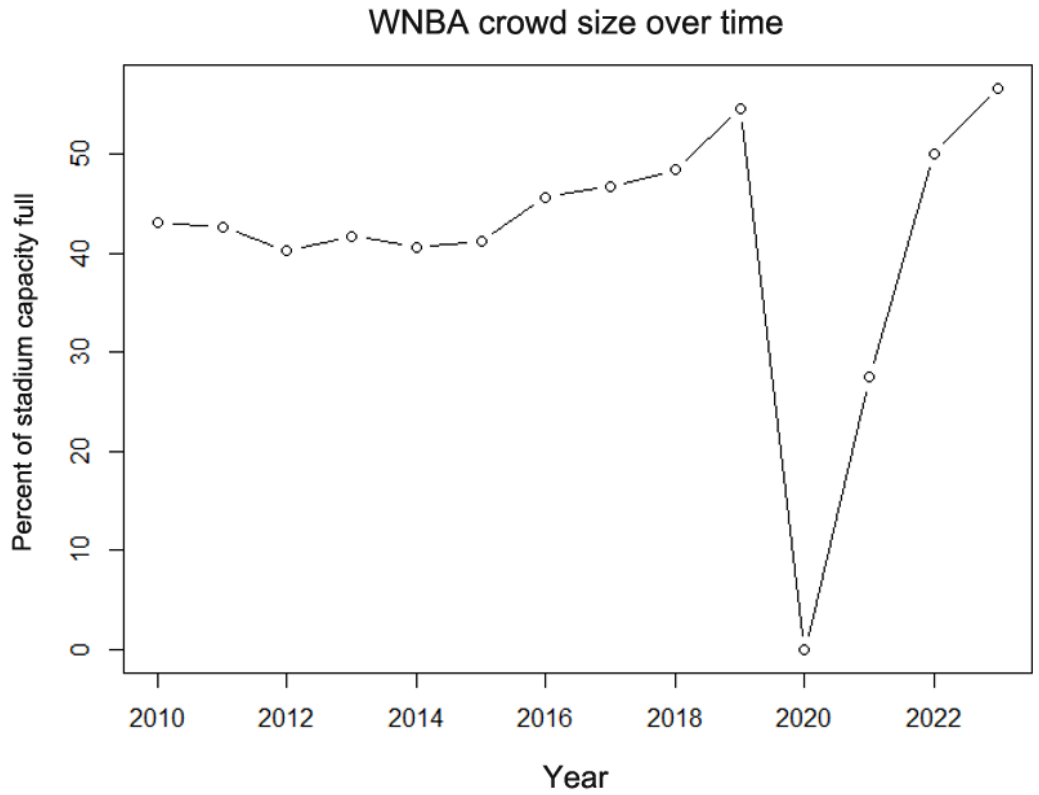

Figure 2. Average percentage of maximum capacity filled in a game by season from 2010-2022.

For our analysis, we examine the 2021, 2022, and 2023 seasons. This is for a few reasons. First, we are able to access more complete information about the games, such as the day of the week and the time the games were played. Also, we were only able to match the referee crews to the games they officiated during these seasons due to data availability. Additionally, there were no teams that moved cities, entered, or left the league during these seasons.

Table 1. Summary statistics: 2021-2023 data.

Variable	Mean	St. dev	Min.	Max.
Percent full	0.477	0.244	0.046	1.002
Attendance	5.197	2.982	301	18.100
Max capacity	12.376	5.882	1.050	20.173
Night game	0.740	0.439	0	1
Close game	0.312	0.464	0	1
Any foul in game	0.483	0.500	0	1
Flagrant fouls (Home team)	0.092	0.321	0	2
Flagrant fouls (Away team)	0.118	0.351	0	2
Flagrant fouls (Total)	0.210	0.479	0	3
Technical fouls by players (Home team)	0.229	0.506	0	3
Technical fouls by players (Away team)	0.209	0.459	0	3
Technical fouls by players (Total)	0.439	0.765	0	6
Technical fouls by coaches (Home team)	0.068	0.259	0	2
Technical fouls by coaches (Away team)	0.054	0.226	0	1
Technical fouls by coaches (Total)	0.123	0.338	0	2

Note: Observations = 682. Night Game, Close, Game, and Any Foul in Game are dummy variables.

Table 1 presents the summary statistics for the full data sample. The table includes our variable of interest in our empirical analysis, "Percent Full" which is the attendance for a game divided by the maximum capacity in the arena. In our sample, the average WNBA game was 47.7% full. There is considerable variation as well, with one game at 4.5% of the arena capacity, and another over the seated capacity at 100.2%. Table 1 also contains the summary statistics for our control variables, dummy variables indicating if the game was a night game or a close game. And finally, the table includes the summary statistics for the various outcome variables considered in our analysis. First, a dummy variable indicates if any flagrant or technical foul occurred in the game, as well as counts of the flagrant fouls (Flagrant 1 and Flagrant 2 fouls combined) and the technical fouls committed by players or coaches. We present the foul statistics by home team and away team, as well as the total per game.

Table 2 presents attendance and arena capacity information across the three seasons in our analysis for each of the WNBA teams. The columns for each year indicate the average percentage of seating capacity filled per game for each of the teams. For nearly every team, the attendance-to-capacity ratio increased over time, indicating that WNBA teams are playing in fuller arenas. This is consistent with the growing popularity of the league over this same period. However, there is still considerable variation across teams, with some teams playing in mostly full arenas and others in mostly empty arenas. The percentage of arena full variable is also affected by the seating capacity of the arena. We also observe significant variation across teams in this aspect as well. Some teams are playing in the same arenas as their local NBA counterparts, while others are in smaller arenas and gymnasiums. While we are trying to capture the percentage of the arena that is full in a game to proxy for sound, a small arena that is mostly full will feel different than a large arena that is half full. There may be more people in the less full large arena, resulting in a louder crowd. Furthermore, several WNBA teams do not always play home games in the same location or have changed home arenas during our sample period, so any home team controls will not necessarily account for this. Therefore, we control for the maximum seating capacity, called "Max Capacity" in our specifications as well.

Table 2. Percent full and max capacity by team over time.

Team	2021	2022	2023	Average % full	Average max capacity
Atlanta Dream	0.385	0.759	0.859	0.684	3,500
Chicago Sky	0.307	0.689	0.708	0.588	10,387
Connecticut Sun	0.293	0.571	0.624	0.508	10,000
Dallas Wings	0.300	0.541	0.663	0.515	7,000
Indiana Fever	NA	0.201	0.221	0.212	14,496
Los Angeles Sparks	0.442	0.298	0.362	0.362	15,376
Las Vegas Aces	0.260	0.467	0.767	0.517	12,148
Minnesota Lynx	0.139	0.384	0.402	0.318	19,356

Team	2021	2022	2023	Average % full	Average max capacity
New York Liberty	0.106	0.300	0.439	0.297	17,732
Phoenix Mercury	0.318	0.433	0.499	0.423	18,422
Seattle Storm	0.261	0.587	0.493	0.456	15,700
Washington Mystics	0.499	0.870	0.909	0.780	4,802

Note: Attendance data not available for Indiana Fever in 2021 Season.

Table 3. Crowd size and probability of a flagrant or technical foul in a game.

	(1)	(2)	(3)	(4)
Percent full	0.304***	0.413***	0.422***	0.432***
	(0.110)	(0.145)	(0.147)	(0.147)
Max capacity	0.000	0.000*	0.000*	0.000*
	(0.000)	(0.000)	(0.000)	(0.000)
Night game	--	--	0.039	0.048
			(0.080)	(0.081)
Close game	--	--	--	0.073
				(0.049)
Home team	✓	✓	✓	✓
Away team	✓	✓	✓	✓
Referees FE	–	✓	✓	✓
Day of week FE	✓	✓	✓	✓
Season FE	✓	✓	✓	✓
Observations	628	628	628	628
Adjusted R-Squared	0.016	0.042	0.040	0.042

Note: Standard errors in parentheses. Statistical significance denoted as * p-value < 0.1; *** p-value < 0.01.

4. RESULTS

To measure the association between crowd size and various types of fouls during games, we estimated Equations (1) - (4). The results are presented in Tables 3 - 6. Our findings do not suggest any causal relationship between crowd size and fouls, but merely show a statistical relationship, or lack thereof. We discuss the magnitude of our results but do not place much importance on the coefficients themselves; rather, we focus on the direction and significance of the correlations. In this section, as well as the conclusion, we explore possible explanations for our results.

Table 4. Crowd size and number of flagrant fouls in a game.

	(1)	(2)	(3)	(4)
Percent full	0.248**	0.208	0.233	0.238*
	(0.106)	(0.141)	(0.143)	(0.143)
Max capacity	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Night game	--	--	0.100	0.105
			(0.078)	(0.078)
Close game	--	--	--	0.041
				(0.048)
Home team	✓	✓	✓	✓
Away team	✓	✓	✓	✓
Referees FE	–	✓	✓	✓
Day of week FE	✓	✓	✓	✓
Season FE	✓	✓	✓	✓
Observations	628	628	628	628
Adjusted R-Squared	0.001	0.014	0.016	0.015

Note: Standard errors in parentheses. Statistical significance denoted as * p-value < 0.1; ** p-value < 0.05.

Table 5. Crowd size and number of technical fouls by players in a game.

	(1)	(2)	(3)	(4)
Percent full	0.018 (0.232)	-0.107 (0.272)	-0.096 (0.273)	-0.082 (0.274)
Max capacity	0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)
Night game	--	--	0.068 (0.125)	0.078 (0.125)
Close game	--	--	--	0.090 (0.076)
Home team	✓	✓	✓	✓
Away team	✓	✓	✓	✓
Referees FE	–	✓	✓	✓
Day of Week FE	✓	✓	✓	✓
Season FE	✓	✓	✓	✓
Observations	628	628	628	628
Adjusted R-Squared	0.045	0.015	0.014	0.014

We find a positive and significant relationship between our measure of crowd size, the percent of the arena that is full, and our indicator variable "any foul," which captures if any flagrant or technical foul occurs in a game. Therefore, we show that games with fuller arenas, and likely louder crowds, are more likely to have flagrant or technical fouls occur.

Further, we find a positive and significant relationship between the percentage of the arena that is full and the number of flagrant fouls in a game. While the estimated coefficient is consistent in magnitude and sign, we do not observe a statistically significant relationship in all four specifications. We can interpret the coefficient as if the arena went from completely empty (0% full) to at capacity (100% full); this corresponds with approximately 0.2 more flagrant fouls per game, which is slightly less than half a standard deviation change. This may not seem like a large effect, but flagrant fouls are not very common. The average number of flagrant fouls per game is 0.21.

Looking at technical fouls committed by players in a game, we do not find any evidence of a relationship between crowd size and the number of technical fouls by players in a game. Finally, we examine technical fouls committed by coaches in a game. Here, we find a positive and significant relationship between crowd size and technical fouls by coaches in a game. These results are consistent across our specifications. Interpreting these coefficients, we find that if the arena went from empty to full, this would correspond with approximately 0.19 to 0.27 more technical fouls committed by coaches in a game. This is a fairly large effect, as technical fouls by coaches are not very common. About 0.123 technical fouls by coaches occurred per game in our sample. We posit that crowd noise is correlated with crowd size. Without good measures of crowd noise, we argue that the increased intensity due to the crowd's presence and noise contributes to the association between crowd size and fouls. Our results provide evidence that increased fan noise or more crowded arenas could frustrate players and coaches, resulting in more flagrant and technical fouls. The results are strongest for technical fouls by coaches, which could be because coaches need to raise their voices to be heard over the large crowd or are feeding off the crowd's intensity.

4.1. Home Court Advantage?

Next, we investigate the presence of a home court advantage. That is, if crowd size and noise impact the frequency of flagrant and technical fouls for the away team more than the home team, then we could conclude that louder and fuller arenas can contribute to a home-court advantage. We estimated Equations (2) - (4) again, but separated the outcome variables by home and away team. The results are presented in Tables 7- 9.

We do not find any evidence that the home or away team is affected differently by increased crowd size in terms of flagrant fouls or technical fouls by players. However, we find that for technical fouls by coaches, there is a relationship between crowd size and the away team's coaches, but not the home team. In other words, our results in

Table 6 are largely driven by technical fouls by the away team's coach. This is further evidence that larger and louder crowds can influence the mind of the visiting team's coach, resulting in frustration and reactions that warrant a technical foul.

Table 6. Crowd size and number of technical fouls by coaches in a game.

	(1)	(2)	(3)	(4)
Percent full	0.190*	0.263**	0.271**	0.271**
	(0.105)	(0.116)	(0.116)	(0.116)
Max capacity	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Night game	—	—	0.049	0.049
			(0.053)	(0.053)
Close game	—	—	—	-0.001
				(0.032)
Home team	✓	✓	✓	✓
Away team	✓	✓	✓	✓
Referees FE	—	✓	✓	✓
Day of Week FE	✓	✓	✓	✓
Season FE	✓	✓	✓	✓
Observations	628	628	628	628
Adjusted R-Squared	0.001	0.091	0.091	0.089

Note: Standard errors in parentheses. Statistical significance denoted as * p-value < 0.1; ** p-value < 0.05.

Table 7. Crowd size and number of flagrant fouls in a game.

	Home team			Away team		
Percent Full	0.061	0.066	0.066	0.001	0.018	0.026
	(0.116)	(0.116)	(0.116)	(0.132)	(0.132)	(0.132)
Max Capacity	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Night Game	—	0.025	0.025	—	0.084	0.089
		(0.052)	(0.052)		(0.059)	(0.059)
Close Game	—	—	-0.004	—	—	0.043
			(0.032)			(0.036)
Home Team	✓	✓	✓	✓	✓	✓
Away Team	✓	✓	✓	✓	✓	✓
Referees FE	✓	✓	✓	✓	✓	✓
Day of Week FE	✓	✓	✓	✓	✓	✓
Season FE	✓	✓	✓	✓	✓	✓
Observations	629	629	629	629	629	629
Adjusted R-Squared	0.047	0.046	0.044	0.036	0.034	0.033

Table 8. Crowd size and number of technical fouls by players in a game.

	Home team			Away team		
Percent full	-0.051	-0.044	-0.043	-0.062	-0.055	-0.040
	(0.183)	(0.184)	(0.184)	(0.168)	(0.169)	(0.168)
Max capacity	-0.000	-0.000	-0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Night game	—	0.034	0.035	—	0.033	0.043
		(0.082)	(0.082)		(0.075)	(0.075)
Close game	—	—	0.008	—	—	0.080*
			(0.050)			(0.046)
Home team	✓	✓	✓	✓	✓	✓
Away team	✓	✓	✓	✓	✓	✓
Referees FE	✓	✓	✓	✓	✓	✓
Day of week FE	✓	✓	✓	✓	✓	✓
Season FE	✓	✓	✓	✓	✓	✓
Observations	629	629	629	629	629	629
Adjusted R-Squared	0.044	0.043	0.041	0.020	0.018	0.022

Note: Standard errors in parentheses. Statistical significance denoted as * p-value < 0.1.

One explanation stems from the existing research that demonstrates how fans can influence referees to make biased calls that favor the home team. If referees are also influenced by crowds and are calling more fouls on the away team, the technical fouls by coaches could be influenced by this as well. To account for this, we control for the officiating crew in our specifications in Table 9. Furthermore, in Table 10, the specifications also control for the number of personal fouls committed by the away team, the difference in personal fouls on the home versus away team, and the total number of personal fouls called. There is evidence from NCAA basketball that referees are more likely to call fouls on the visiting team and on the team that is in the lead (Anderson & Pierce, 2009). The first column in Table 10 is the same as the final column in Table 9, for easier comparison. Our results are consistent, suggesting that visiting coaches are likely affected by larger and louder crowds, even while controlling for how the game is being called.

Table 9. Crowd size and the number of technical fouls by coaches in a game.

	Home team			Away team		
Percent full	0.096 (0.092)	0.099 (0.092)	0.095 (0.092)	0.175** (0.080)	0.182** (0.080)	0.186** (0.080)
Max capacity	-0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
Night game	--	0.016 (0.041)	0.013 (0.041)	--	0.035 (0.036)	0.037 (0.036)
Close game	--	--	-0.020 (0.025)	--	--	0.019 (0.022)
Home team	✓	✓	✓	✓	✓	✓
Away team	✓	✓	✓	✓	✓	✓
Referees FE	✓	✓	✓	✓	✓	✓
Day of Week FE	✓	✓	✓	✓	✓	✓
Season FE	✓	✓	✓	✓	✓	✓
Observations	629	629	629	629	629	629
Adjusted R-Squared	0.077	0.075	0.075	0.092	0.092	0.092

Note: Standard errors in parentheses. Statistical significance denoted as ** p-value < 0.05.

Table 10. Crowd size and the number of technical fouls by away team coaches in a game.

	Away team			
Percent full	0.186** (0.080)	0.197** (0.081)	0.186** (0.080)	0.209** (0.081)
Max capacity	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
Night game	0.037 (0.036)	0.036 (0.036)	0.037 (0.036)	0.034 (0.036)
Close game	0.019 (0.022)	0.017 (0.022)	0.018 (0.022)	0.013 (0.022)
Personal fouls (Away)	--	0.003 (0.003)	--	--
Difference in personal fouls (Home-Away)	--	--	0.001 (0.002)	--
Personal fouls (Total)	--	--	--	0.003* (0.002)
Home team	✓	✓	✓	✓
Away team	✓	✓	✓	✓
Referees FE	✓	✓	✓	✓
Day of week FE	✓	✓	✓	✓
Season FE	✓	✓	✓	✓
Observations	629	629	629	629
Adjusted R-Squared	0.092	0.092	0.090	0.096

Note: Standard errors in parentheses. Statistical significance denoted as * p-value < 0.1; ** p-value < 0.05.

This study has some limitations. We proxy crowd noise with a simple measure of how full the arena is. There may have been larger crowds that were quieter than smaller crowds, but we cannot account for this. Our control variables for night games and close games are our best attempt at accounting for other factors that would influence crowd noise. There is also a concern that games with bigger crowds and a higher percentage of capacity filled may be bigger or higher-stakes games to begin with, and we may just be capturing that more exciting or interesting games have a greater likelihood of flagrant or technical fouls. We control for the time of day, day of the week, and how close the game was to try to account for this, assuming that scheduling is a good predictor of fan interest in games.

5. CONCLUSION

This article contributes to the literature by examining a different sports context, women's professional basketball, and how fans can influence the prevalence of fouls called in a game. Additionally, this article adds to the existing research on how fans can influence home-court advantage. The current literature shows that fans can influence referee decisions in favor of the home team and can help the home team perform better while the away team performs worse.

This article examines the relationship between crowd size and the prevalence of flagrant and technical fouls in the WNBA and looks at the differences between fouls called against the home and away teams. Previous literature has established that fans can influence player performance and referee decisions. Fans could influence the number of flagrant and technical fouls in a game through several channels. First, fans could be influencing referees to call more fouls in general. Alternatively, referees could be biased towards the home team, calling more fouls on the visiting team, which may result in frustration by the visiting team's coach in particular. The literature finds mixed results regarding whether fans can influence referee behavior, and when controlling for personal foul calls, it is still observed that the away team's coach receives more technical fouls. Additionally, fans could frustrate players and coaches, causing them to play more aggressively or engage with the crowd, resulting in a technical foul. Finally, a fuller arena adds to the intensity of the game itself, raising the perceived stakes for players and coaches, which could be reflected in more aggressive and riskier behavior. Our most consistent results suggest that coaches are affected by crowd size more than players. This could be strategic, as there is evidence that coaches use technical fouls to trigger a momentum change in the game, resulting in their team rallying around them (Tenenbaum, Ben-Zion, & Lev, 2024; Tenenbaum, Vigodsky, & Lev, 2023).

As the WNBA continues to grow in popularity, this will certainly add to the intensity of the games' environment. Our research suggests that more full arenas are more likely to see flagrant or technical fouls in a game. In terms of the presence of home-court advantage, it is important to note the disparities in arena capacity across the league. These differences could be exacerbated as some teams move to larger arenas to accommodate larger crowds, while others cannot or do not.

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