

Analyzing the Effects of the NBA COVID Bubble on the NBA Playoffs

A Case Study for Home-Court Advantage

Michael Price

michael.price@uconn.edu

Department of Statistics, University of Connecticut

Dr. Jun Yan

jun.yan@uconn.edu

Department of Statistics, University of Connecticut

27, October, 2020

Abstract: The 2020 NBA playoffs were played inside of a bubble in Disney World because of the COVID-19 pandemic. This meant that there would be no fans in attendance, games played on neutral courts and no traveling for teams which in theory removes home-court advantage from the games. This idea was a hot topic of discussion as analysts and fans debated the possible effects it may have on the outcome of games. Home-court advantage has historically played a huge role in NBA playoff series outcomes. Thus, to study the effects of the bubble, and home-court advantage, the 2020 season is compared to the 2017, 2018, and 2019 playoffs. While many factors contribute to the outcome of games, points scored is the deciding factor of who wins games so scoring will be the primary focus of this study. The specific measures of interest are team scoring totals and team shooting percentage on two pointers, three pointers, and free throws. Comparing these measures for home teams and away teams in 2020 vs. 2017-2019 shows how the 2020 playoffs favored away teams more than normal, particularly with two point shooting and total scoring.

I. Introduction

Home-court advantage is often discussed in sports circles as a contributing factor to the outcome of games. It is well-known that the home team typically benefits from some competitive edge from playing at their home-court, resulting in a better chance of winning. Thus, the NBA playing the 2020 playoffs in a bubble brought a great deal of concern for fans, teams, journalists, and others. Steve Aschburner (Aschburner 2020) discusses details about anticipated effects in his article “How Orlando’s Neutral Site Will Impact Teams, Referees and Games”. Aschburner shares concerns from former players, coaches and other experts about the potential effects of removing home-court advantage. Aschburner notes that the NBA did make attempts to recreate the effects by putting the “home” team logo on the court and allowing the “home” team to play crowd noise and music, but most people doubted these small attempts would recreate a true playoff atmosphere. During the 2020 NBA playoffs, home teams only won about 48.2% of the games. This is lower than normal, which Aschburner claims usually floats around 60%. This shift in the home team winning percentage surely indicates the opportunity for thorough investigation.

So, what happened? Did the home teams fail to perform up to normal standards without the help of home-court advantage? Were away teams able to rise to the occasion and perform better not having to deal with the headache of going on the road? This paper seeks to answer that using scoring totals and shooting percentages as indicators of team performance. This will deepen understanding of how home-court advantage affects home and away teams in the NBA.

This study is quite different from earlier NBA home-court advantage studies. By using the neutral site games of 2020 we will get to compare home and away performance to a control. Typically, studies just compare home vs away performance. These studies don’t separate the effects of home-court advantage into the specific effect on the home team and the specific effect on the away team. They show that home teams outperform away teams, but not if this is a result of home teams overperforming or away teams underperforming because of home-court advantage. Some of these studies are reviewed in greater detail in Section II Literature Review.

This study will compare home team performance in 2020 at a neutral site

with no fans vs. 2017-19 playoffs with fans. Likewise, away team performance in 2020 at a neutral site with no fans vs. 2017-19 playoffs with fans. By comparing home teams in 2020 to home teams in 2017-19 and away teams in 2020 to away teams in 2017-19, I can add a new perspective to the field of research. This will allow for a more accurate understanding of the effects of home-court advantage on home and away teams in the NBA. We won't just see that home-court advantage helps home teams outperform away teams, but this study will actually clearly separate the effects of home-court advantage on home teams and away teams performance individually.

9 statistical tests are run to understand the differences in 2020 vs. earlier years. First, whether or not the difference between home win percentage in 2020 and 2017-19 is statistically significant. To confirm the difference we see in the winning percentage is truly significant. Then we can look for differences in home scoring in 2020 vs 2017-2019. Similarly, we can do the same test, but for differences in away scoring in 2020 vs 2017-2019. Also, differences in team shooting (for two pointers, three pointers, and free throws) from 2020 vs 2017-2019 for both home and away teams. The results from these simple tests will bring a new understanding of how home-court advantage is impacting games by altering the performance of the home and away teams.

II. Literature Review

There is tons of published literature on the effects of home-court advantage. (Kotecki 2014) studies the impact of home-court advantage on winning in the NBA. Kotecki proves the existence of home-court advantage using performance-based statistics, specifically field goal percentage, free throw percentage, and points. All of which he proves significantly improved from home-court advantage, indicating home-court helps teams play better. This conclusion comes from comparing home performance vs. away performance in games.

(Carron and Courneya 1992) cite 4 main game location factors for home and away teams. First, the crowd factor, which is the impact of fans cheering. Second, learning factors, which they categorize as the advantage from home teams from playing at a familiar venue. Third, travel factors, the idea that away teams may face fatigue and jet lag from traveling. Last, rule factors, which says that home teams may benefit from some advantages in rules

and officiating. They acknowledge that these factors would all be removed if games were played at a neutral site even if one team was designated as “home team”. This study was reviewed a decade later by (Carron, Loughhead, and Bray 2005). The 2005 review goes over the new findings from studies about the significance of these 4 game location factors. Since 1992 they found that results on these 4 factors are mixed. However, there is some evidence supporting crowd and travel factors impact games in the NBA. There is less evidence suggesting learning and rule factors impact the NBA. One interesting finding cited by (Carron, Loughhead, and Bray 2005) is that in the absence of crowds result in overall performance increases.

(Cao, Price, and Stone 2011) study the effects of pressure on performance in the NBA. They use free throws as their measure of interest, and research home and away factors in the study. They expected that home fans could distract and put pressure on opposing players to make free throws, which would negatively impact away team shooting. Likewise, the home team would see a positive effect on free throw shooting. However, they find insignificant evidence that home status has a substantial impact on missing from the free throw line.

(Greer 1983) focuses his study on the influence of spectator booing on home-court advantage in basketball. The three methods of performance used in this study were scoring, violations and turnovers. This study was conducted using the men’s basketball programs at two large universities. The study finds that social support, like booing, is an important contributor to home-court advantage. Greer explains, whether the influence is greater on visiting team performance or referee calls is less clear. However, the data does seem to lean slightly in favor of affecting visiting team performance.

(Harris and Roebber 2019) use two point shots, three-point shots and free throws as measures of interest to study home-court advantage. They find that two point shots are the strongest predictor of home-court advantage. They suggest that evidence supports that home teams should try to shoot more two point shots and force their opponent to take more two point shot attempts. This strategy will maximize the benefits of home-court advantage and give them the best chance to win.

College basketball, as noted before, does offer some opportunity to study home-court vs. neutral court. One study conducted by (Harville and Smith 1994) studied the effect of home-court advantage using the 1991-1992 college

basketball season. Unlike the NBA, it is not uncommon to have a few games played at neutral sites during the college basketball season. This allowed them to construct two samples, one of home teams and one of neutral teams. They formulate their study as a regression equation predicting the expected difference in score for home teams. They set up their study to find if the home teams won games by more points when they had home-court advantage vs. when playing at neutral court. This study succeeds in proving that home-court advantage exists.

III. Data Collection and Methods

The 2020 bubble provides a new and exciting opportunity to study home-court advantage for the NBA. Unlike college basketball, aside from a few exhibition/preseason games, the NBA always has a home and away team. So, for the first time in NBA history the bubble allows NBA home and away performance to be compared vs a control/neutral field. The NBA bubble, as a neutral court, removed all 4 possible game location factors impacting home-court advantage hypothesized by (Carron, Loughhead, and Bray 2005). The NBA bubble featured 8 seeding games then a standard playoff format. The focus of this study was the play during the playoff games since it followed the standard playoff format and can easily be compared back to other playoffs. For this study, the 2020 playoffs were compared against the three previous playoffs collectively. It is important to make sure that any observed differences are truly from a home-court advantage. So, in order to control for the changing play style of the NBA, we will limit the study to 2020 vs 2017-2019. The reason being the faster pace play and more common use of the three-point shot in modern basketball. If we used data from say 10 years ago, or earlier, observed differences may not be from effects of the NBA bubble, but rather from the effects of drastic changes in the style of play between the seasons. However, basketball evolves slow enough that we can reasonably assume 2017-2019 are at least very close in pace and playing style to 2020.

Data was collected from the official NBA website. The main variables of interest are whether or not the home team won, scoring totals for home and away teams, and shooting percentages for home and away teams on two pointers, three pointers, and free throws. These variables were very popular and frequently used in the related literature discussed earlier. While many

other measures could be used for measuring the outcome of the game and team performance, scoring seemed to be the most important. The winner of a game is determined by who scores more points. So, naturally when studying the outcome of winning, changes in scoring and scoring efficiency are important to understand.

Home-court advantage is the basic idea that the home team is more likely to win. So laying a foundation of typical home-court advantage is crucial. Before focusing on the 2017 to 2020 playoffs we can take a quick look at home team win percentages since 2010. Notice on the graph below in Figure 1, the 10 years before 2020, the home team winning percentage ranged from around 0.56 to 0.7 and never dipped below .5. The 2020 bubble, however, broke this historic pattern dipping down below .5. Foreshadowing, the confirmation of the expectation that the effect of home-court advantage was removed in the 2020 playoffs.

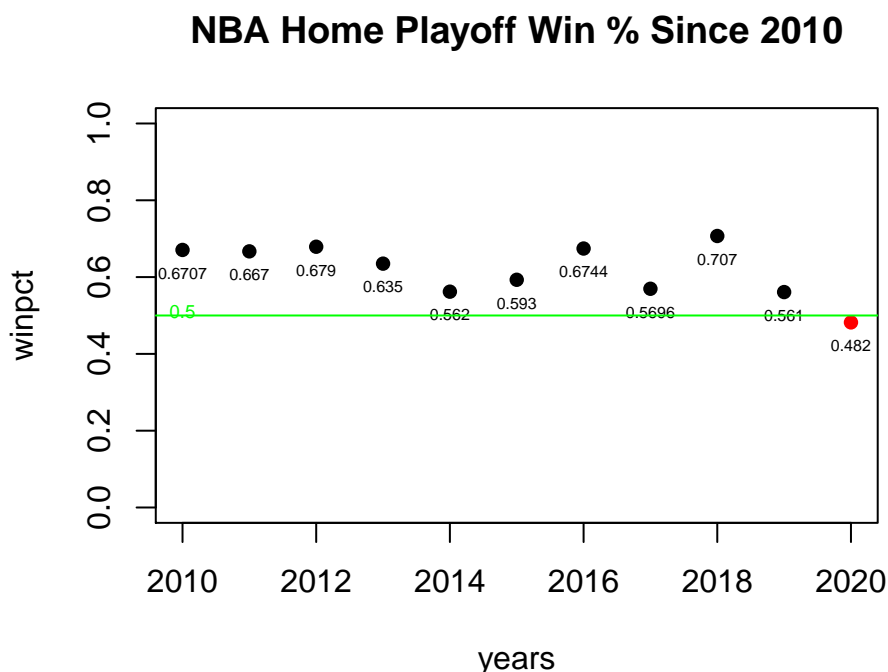


Figure 1: Winning percentage of NBA home teams in the playoffs since 2010, the green line denotes .500.

Moving on to the main focus of the study, comparing 2020 to 2017-2019. First, a brief look at the distribution of scoring depicted below in Figure 2.

The green histograms indicate home and red histograms indicate away scoring. The top row is scoring for 2020 and the bottom is scoring for 2017-2019. All histograms seem to be fairly normally distributed which is important for statistical analysis. It's hard to see any clear differences between years, but it's important to look at and understand the distribution of measures before moving onto the analysis.

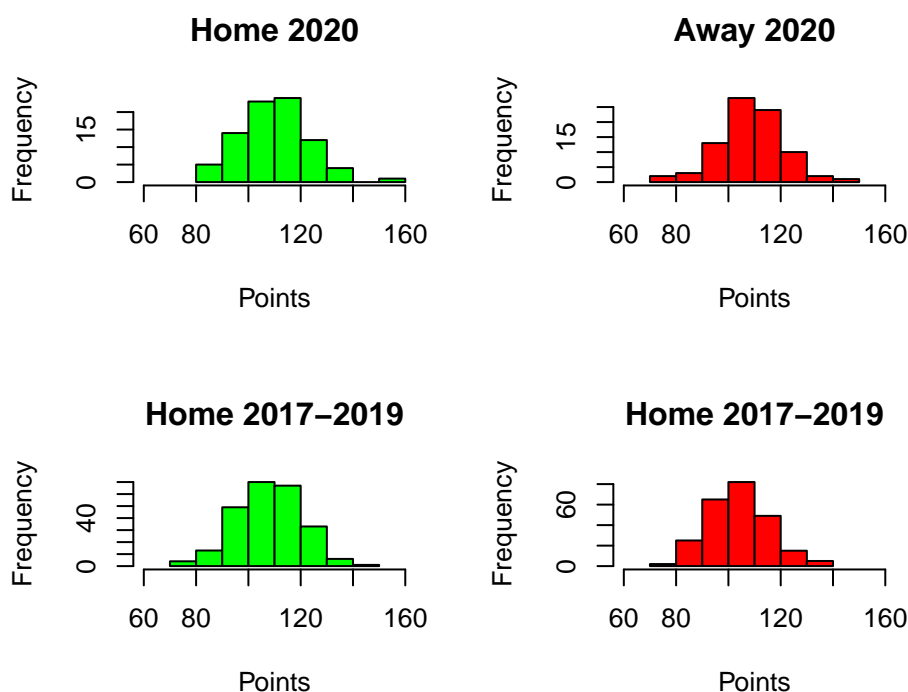


Figure 2: Shows the home(green) and away (red) scoring distributions for 2020(top) and 2017-2019(bottom)

Figure 3 shows home shooting for two pointers, three pointers and free throws for 2020(top) vs. 2017-19(bottom). The histograms appear to be fairly similarly distributed between 2020 and 2017-19. Likewise, Figure 4, shows the same data except for away teams. Just like Figure 3, Figure 4 histograms don't show any obvious differences. The normality of the distributions for both figures 3 and 4 are important for meeting the required assumptions for statistical analysis.

Given the approximate normality of data, 9 different z-tests were performed in order to test the effects of the COVID bubble on the 2020 NBA play-

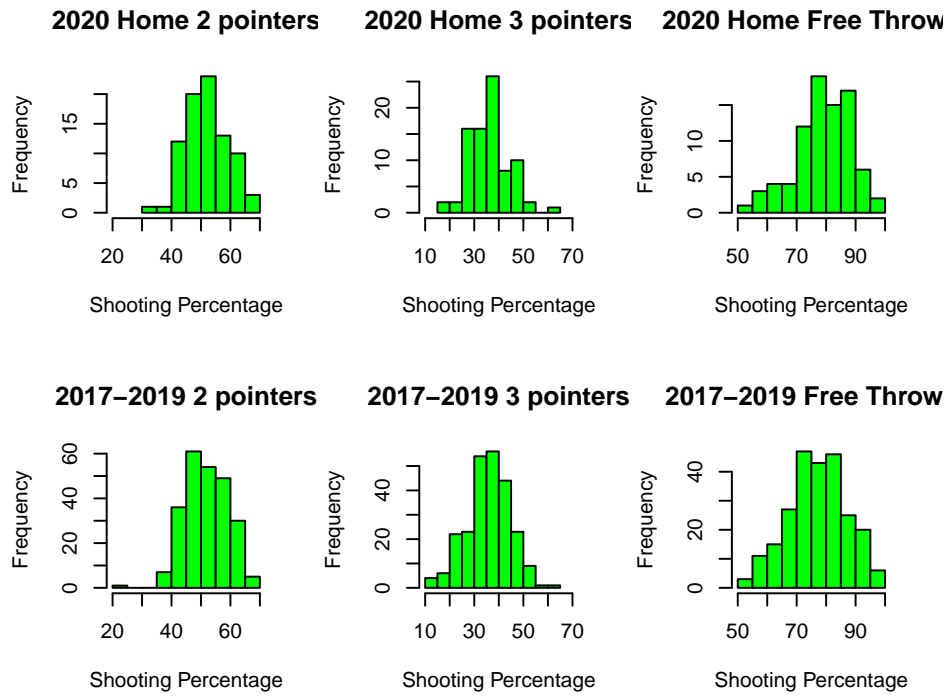


Figure 3: Home shooting percentages for two pointers, three pointers and free throws for 2020(top) vs. 2017-19 (bottom)

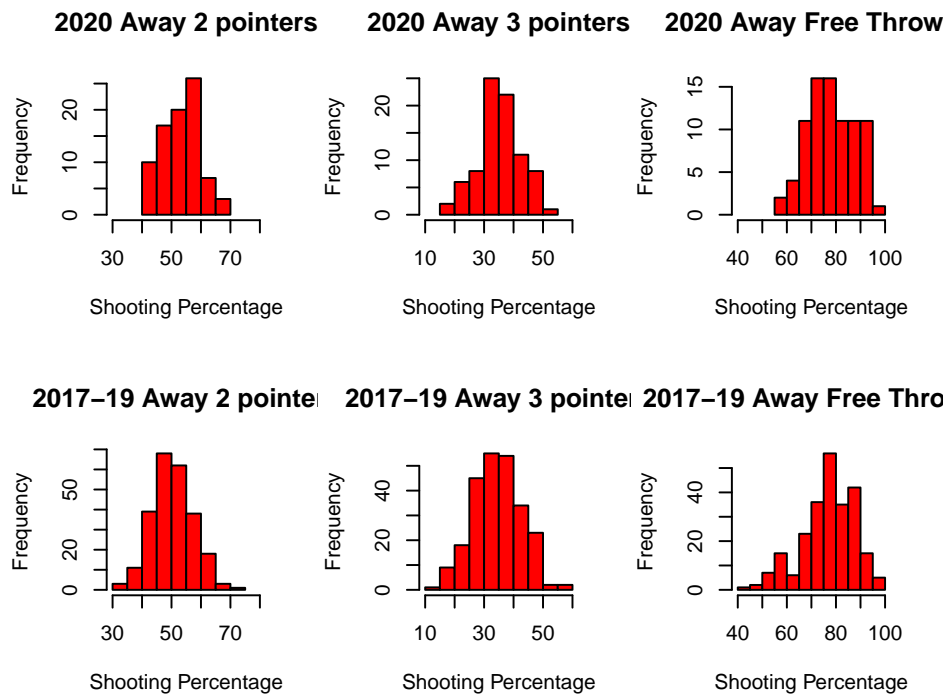


Figure 4: Away shooting percentages for two pointers, three pointers and free throws for 2020(top) vs. 2017-19 (bottom)

offs. The 9 questions answered were:

- * Is the home team winning percentage in 2020 different than that it was in 2017-2019?
- * Is the average home team scoring different in 2020 than it was over 2017-2019?
- * Is the average away team scoring different in 2020 than it was over 2017-2019?
- * Are home teams making two pointers at the same rate in 2020 as 2017-2019?
- * Are home teams making three pointers at the same rate in 2020 as 2017-2019?
- * Are home teams making free throws at the same rate in 2020 as 2017-2019?
- * Are away teams making two pointers at the same rate in 2020 as 2017-2019?
- * Are away teams making three pointers at the same rate in 2020 as 2017-2019?
- * Are away teams making free throws at the same rate in 2020 as 2017-2019?

IV. Analysis and Results

Table 1: The results from the 9 statistical tests

	2020	2017-19	95% CI LL	95% CI UL	Test Stat.	P-value
Home Team Win %	0.4819	0.6132	-0.2550	-0.0075	2.0914	0.0365
Home Team Scoring	110.0602	108.1029	-1.2531	5.1678	1.1950	0.2321
Away Team Scoring	109.0602	104.0247	2.0828	7.9883	3.3424	0.0008
Home Team 2P%	0.5225	0.5153	-0.0105	0.0249	0.7833	0.4335
Home Team 3P%	0.3635	0.3574	-0.0145	0.0266	0.5632	0.5733
Home Team FT%	0.7933	0.7735	-0.0012	0.0407	1.8170	0.0692
Away Team 2P%	0.5362	0.5038	0.0147	0.0503	3.5869	0.0003
Away Team 3P%	0.3566	0.3463	-0.0101	0.0309	0.9831	0.3256
Away Team FT%	0.7825	0.7774	-0.0165	0.0269	0.4398	0.6601

Starting from the top of the Table 1, we see a statistically significant change in home win percentage in 2020 from 2017-19, with p-value of 0.0365. The 95% confidence interval of (-0.255, -0.0075) confirms our belief that home-court

advantage was lost in the 2020 NBA playoffs. However, after accounting for multiple tests using Bonferroni correction the p-value is no longer significant. So, we may only cautiously say there is evidence that home-court advantage was not a factor in 2020.

Home team performance did not seem to be negatively impacted by losing home-court advantage like expected. Home scoring, two point, three point shooting and free throw shooting all show no significant difference, on average, between 2020 vs. 2017-19. Home teams do not appear to have any evidence suggesting they played at a lower level in 2020 than they did in previous years when they had home-court advantage.

Away teams saw more of an impact than home teams. For starters, they saw a significant increase in mean points per game by about 5 points (95% CI: 2.083, 7.988) Likewise, the away team two point shooting efficiency increased by an average of about 0.03 (95% CI: 0.0147, 0.0503). However, unlike two point shooting, away teams did not see a statistically significant difference in three point and free throw shooting. Overall, away teams have evidence of change in performance in the bubble. The away teams seemed to perform better than they would under normal conditions as a visiting team.

V. Discussion

Generally it seemed that away teams fared better in the 2020 NBA playoff bubble than previous years on the road. Starting from the dip in home winning percentage to below .482 it's clear something was different. Although the difference was not significant after a Bonferroni correction it's still important to consider and understand that home teams seemed to struggle to win compared to normal conditions. Compared to (Kotecki 2014) who finds home teams consistently have a significantly better record than away teams boasting about a 60.5% win percentage in his sample, the 48.2% home winning percentage of 2020 home teams is a shift from normal. It's clear that home teams did not benefit from the usual advantages provided by being the home team.

While the home teams in 2020 did see a slight uptick in average scoring it was not large enough to be statistically significant. However, away team average scoring did increase by a statistically significant amount. This goes

hand in hand with our intuition and conclusion about the home winning percentage decreasing. If away teams are scoring significantly more and home teams are not, then we expect to see away teams winning a larger amount of games. This may give more reason to believe the conclusion that there was a significant decrease in home winning percentage in 2020, despite failing to be significant after Bonferroni correction. Only away team scoring being significantly impacted by playing on a neutral court indicates that home-court advantage stems mainly from adverse effects on the visiting team.

An interesting finding is all shooting and scoring numbers for both home and away teams did make at least small increases. Although these increases weren't all significant these increases are exactly what is reported in (Carron, Loughhead, and Bray 2005) when they explain how evidence suggests that teams perform better with the absence of fans. This is important because it coincides with our conclusion that home-court advantage mostly plays into games by negatively impacting away teams. If fans cause overall performance to drop, then home court advantage must come from a bigger drop in away performance than the drop in home performance. This is why away teams were able to close the gap with home teams with home-court advantage removed.

Separating the effects of the home-court advantage into home effects and away effects allowed for some interesting new insights. Previously, we knew that on average home teams outperformed away teams. It was less clear whether it was from positive effects on the home team or negative effects on the road team or perhaps a bit of both. The biggest takeaway from this study is the main source of home-court-advantage is the negative effects playing on the road away teams face. In 2020 there wasn't any evidence of regression for home team performance, based on the performance measures used, despite being stripped of home-court advantage. Yet, home teams lost about 12% more of games in the 2020 playoffs than the typical average. This was because of the improvement of away teams. No longer having to face the struggle of traveling, pressure from opposing fans, or playing on an unfamiliar court, teams saw an improvement in their play and an increase in winning. The improvement of away teams confirms a proposition from (Greer 1983)) who believed that the positive social impact of crowds benefiting home teams may be a result of inhibiting away teams.

At least some of that improvement from away teams came from significantly

higher two point efficiency. This corresponds with the conclusion from (Harris and Roebber 2019), where they found home teams are best suited to capitalize on advantages from two point shots. Normally, by shooting more 2 themselves and forcing away teams to shoot more 2 they home team benefits from increasing home-court advantage. However, with away teams significantly improving two point shooting in the bubble this strategy was no longer viable and home-court advantage disappeared.

Future studies may want to use the 2020 NBA bubble and compare vs previous years using other performance measures. For example, turnovers, steals, assist, rebounds, and many more game statistics. There are plenty of other possibilities besides just shooting efficiency to pick through looking for more possible sources of added points for away teams. This will further help explain what is lost in the performance of away teams when they travel to opposing arenas. This study is only the beginning of possibilities for studies using the 2020 NBA bubble as a case study for home-court advantage.

Unfortunately, this study is limited by a one time sample. It is unknown if there will ever be another NBA playoffs played in this fashion. It seems unlikely that these conditions will ever be repeated. That being said, it does not seem like a follow-up study using the same measures with a different sample will ever be possible. If possible, that type of study could help strengthen the conclusions made in this paper.

References

- Aschburner, Steve. 2020. "How Orlando's Neutral Site Will Impact Teams, Referees and Games." *NBA.com*. National Basketball Association. www.nba.com/article/2020/06/22/season-restart-home-court-advantage-no-more .
- Cao, Zheng, Joseph Price, and Daniel F. Stone. 2011. "Performance Under Pressure in the Nba." *Journal of Sports Economics* 12 (3): 231–52.
- Carron, Albert V., and Kerry S. Courneya. 1992. "The Home Advantage in Sport Competitions: A Literature Review." *Journal of Sport and Exercise Psychology* 14 (1): 13–27.
- Carron, Albert V., Todd M. Loughhead, and Steven R. Bray. 2005. "The

Home Advantage in Sport Competitions: Courneya and Carron’s (1992) Conceptual Framework a Decade Later.” *Journal of Sports Sciences* 23 (4). Routledge: 395–407.

Greer, Donald L. 1983. “Spectator Booing and the Home Advantage: A Study of Social Influence in the Basketball Arena.” *Journal of Sport and Exercise Psychology* 46 (3). [Sage Publications, Inc., American Sociological Association]: 252–61.

Harris, Austin R., and Paul J. Roebber. 2019. “NBA Team Home Advantage: Identifying Key Factors Using an Artificial Neural Network.” *PLOS ONE* 14 (7). Public Library of Science: 1–9.

Harville, David A., and Michael H. Smith. 1994. “The Home-Court Advantage: How Large Is It, and Does It Vary from Team to Team?” *The American Statistician* 48 (1). [American Statistical Association, Taylor & Francis, Ltd.]: 22–28.

Kotecki, Jason. 2014. “Estimating the Effect of Home Court Advantage on Wins in the Nba.” *The Park Place Economist* 22 (1): 49–57.