In this chapter, we set the theoretical framework for the present study. We conceptualise the variables team performance, referee bias, share of foreigners, crowd size, stadium occupancy rate and team age which are used throughout this study. In addition, based on prior research findings, we assess in which way these variables are interrelated. Thus, the aim of this chapter is a review of the body of literature to develop research hypotheses that will be empirically tested.

## 2.2 Crowd support and home advantage

Table 1 shows the overview of the related literature on crowd support plus our contribution. The relationship between crowd support and team performance has been widely studied in the literature. One of the first to formally document the existence of a certain home advantage in sports were Schwartz & Barsky (1977). They find that home advantage exists in varying degrees across different sports. In their research they suggest that the major contributor to home advantage is social support as they find a strong relationship between audience size and home advantage. Nevill and Holder (1999) support this claim as they produce similar results in their analysis of home advantage in English and Scottish soccer matches. Ponzo & Scoppa (2018) argue that a home crowd can be a positive stimulus for home team players and can create an intimidating and hostile environment for the opposition. Home team performance is raised relative to away team performance as their effort and energy is stimulated by the positive support from the crowd. Ponzo & Scoppa (2018) base their conclusions on the analysis of same stadium derbies in Rome and Milan to mitigate other possible factors of home advantage such as traveling and familiarity effects. They find that when controlling for referee decisions and other factors such as team strength, the home team still performs better in the local derby than the away team.

Although these papers deserve merit, they still are limited to using various assumptions and simplifications to assess the effect of crowd support as crowd support interacts with other drivers of home advantage (Pollard, 2008). Some other studies such as the research conducted by Pettersson-Lidbom & Priks (2010) tried to investigate crowd support directly by assessing matches played without crowds. However, their research was limited to 21 games of a single team in a single season. The limited data decreases the abillity to systematically assess the direct impact of crowd support in these studies. We aim to fill this gap by using the large number of games behind closed doors to further investigate the role of crowd support and team performance.

A few studies adopted a similar approach to ours by analyzing “ghost games” played between the restart after corona and the end of the season 2019/20. Thilp & Taller (2020) for example find that home advantage has actually turned into a home disadvantage in case of “ghost games”. Fischer & Haucap (2020) also support the notion of a signifcant alteration in the strength of home advantage in the Bundesliga when crowd support is absent. McCarrick, Bilalic, Neave and Wolfson (2020) report similar findings in their study of home advantage across 11 countries. They discovered that across those leagues the number of goals scored and points obtained by home teams was significantly lower in matches played during the Covid-19 pandemic. However, apart from McCarrick et al (2020), most of the recent papers only include one single country into their analysis. We believe that this approach is limited because single countries could be an anomaly. Additionally, the data these studies use is limited to the 2019/20 season. Within this smaller sample, a few abnormal results could already influence conclusions. Moreover, by using single season data with a majority of the games played with fans increases the chance of a possible confouding effect of scheduling differences. We incorporate match data for multiple countries and seasons in our dataset and extend the analysis to all the “ghost games” played up to the 21st of March 2021 to obtain a larger sample and more generalizable results.

## 2.3 Moderating variables

A second stream of literature attempts to discern whether or not all teams experience a similar influence from their home crowd. Possibly, certain team characteristics or crowd characteristics could be associated with bigger or smaller increases in team performance. Crowds differ substantially in size, occupancy and fanaticism and thus potentially could have diverse influences on team performance. Carron and Agnew (1994) find a significant positive relationship between home advantage and crowd density. In other words, larger crowds and higher occupancy rates are associated with bigger increases in home performance relative to away performance compared to smaller crowds. Boyko, Boyco & Boyko (2007) in an analysis of matches in the English Premier League find that home team performance relative to away team performance increased significantly with increasing crowd size, by about .1 goals per 1,000 supporters. Fischer & Haucap (2020) find a significant alteration in the strength of home advantage due to differences in crowd occupancy. They found a significant decrease in home advantage in the Bundesliga when crowd support is absent. However, due to lower occupancy rates, the 2nd Bundesliga and 3rd Liga did not experience significant changes in team performance.

These findings are in contradiction with other results reported in the literature. Pollard (1986) negates the importance of crowd size and crowd density. In his argument he uses the notion of a similar magnitude in home advantage across first and second divisions across Europe. Despite the vast differences in crowd size and crowd density between first and second divisions, the home advantage still persists. Goumas(2014) by studying Uefa Champions League matches proposes that crowd occupancy does not play a significant role. Salminen (1993) and Strauss (2002) even find support for the case that teams are motivated by non-supportive audiences and play better in such situations. These contrasting views in the literature leave room for further investigation on the role of crowd size and stadium occupancy on the relationship between crowd support and team performance.

Another stream of the literature on team performance focuses on familiarity effects. Pollard (2008) describes familiarity effects as key stadium attributes that could help players locate themselves more precisely on the pitch and consequently make better decision on where and how hard to pass the ball or where to position themselves to get the best shot on goal. Older players who have more experience, especially when that experience is within the same league, will be more familiar with venues and could have similar advantages as home team players in visual cues when playing away. The concept of familiarity can also be extrapolated to the realm of crowd support. This school of thought has not been widely studied yet but studies such as that of van der Ven (2016) report a slightly better away performance for teams with a higher average age, compared to teams with a lower average age. Based on surveys sent to 166 coaches he expects that the decrease in influence of crowd support on older players stems from familiarity effects. The knowledge on the influence on team age is largely based on one study with limited data. Therefore we aim to further investigate the role of team age in this study.

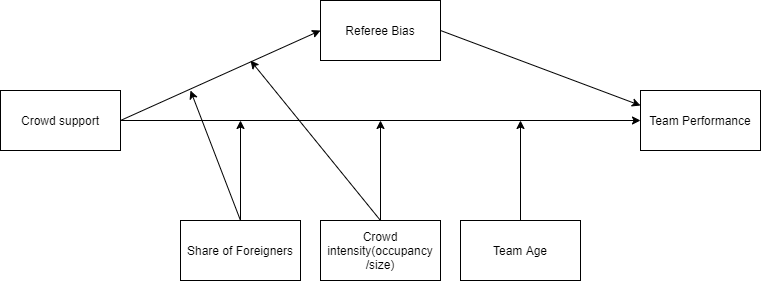
A few studies have been published on the role of fan identifaction and team performance. In the increasing globalized world, international transfers are increasingly common, leading to an influx of foreign players into squads of soccer clubs (Adcroft, Teckman & Madichie, 2009). These foreign players, with increasingly high salaries are difficult to relate to for local often working class soccer supporters (Petersen-Wagner, 2015; Smith, 2003). This leads to fans and players becoming more and more detached from each other, decreasing the bonding between fan and players. Gutierrez (2019) claims that this bonding process between fans and players is a crucial component for fan engagement and consumption. Increased fan engagement leads to a better atmosphere and louder crowds. Lee, Gipson and Barnhill ( 2017) provide further evidence for the influence of fan identification with their team. They surveyed attendants of basketball and baseball games in the NCAA division. The authors found that measures of team identification significantly influenced crowd atmosphere through an indirect effect on flow of supporters, with flow being defined following the definition of Csikszentmihalyi (1990): "the state in which people are so involved in an activity that nothing else seems to matter”. Their findings suggest that a reduced identification of supporters with their team decreases atmosphere within the stadium. Most of the studies in this area based their conclusions on qualitative research and literature reviews. Lee et al (2017) provide a statistical analysis. However, their study is limited to 203 surveys to visitors at American college sports games. We aim contribute to the literature by providing a statistical study on the role of foreign players in the relationship between crowd support and team performance.

## 2.4 The mediating role of referee bias

Apart from directly influencing team performance, crowd support is said to affect team performance through the referee. Multiple studies including: (Nevill, Balmer & Williams, 1999 ; Nevill, Balmer & Williams, 2002; Garicano, Palacios-Huerta & Prendergast, 2005; Unkelbach & Memmert , 2010; Sutter & Kocher, 2004) find consistent evidence of a referee bias in favor of the home team. Examples of this bias include the issue of more stoppage time at the end of the first and second half when the home team is trailing. In more recent research Endrich & Gesche (2020) find that referees give less cards and fouls to home teams and more cards and fouls to away teams on average, which could be interpreted as a sign of referee bias in favour of the home side. Previous studies found evidence that crowd cheering and noise are the main contributor to referee bias (Endrich & Gesche, 2020; Nevill, Balmer & Williams, 2002). Referees can be heavily influenced in their decision making by the heavy cheering of the crowd favoring the home team (Unkelbach & Memmert , 2010). Experiments conducted by Nevill, Balmer and Williams (2002) show the role of crowd noise by asking participating referees to evaluate fouls. One group of the referees were shown the fouls with sound of the crowd in the background whereas the other group watched the fouls in silence. The referees watching with crowd noise on average gave 15 percent less fouls to the home team compared to referees watching in silence. Referee bias and crowd noise is well documented in the literature. However, there is less empirical research on to what extent crowd size and occupancy influence referee decisions. Research like ours on the incidence of referee bias in ghost games settings could be useful in discerning whether or not crowd size and occupancy play a role in referee decision making. Furthermore, previous work focused on the existence of referee bias rather than implications for team performance. We extend the current literature by incorporating the influence of referee decisions on team performance as a mediating variable in the relationship between crowd support and team performance.

Figure 1 presents a schematic overview of the variables and relationships we investigate in our model.

**Fig**%3CmxGraphModel%3E%3Croot%3E%3CmxCell%20id%3D%220%22%2F%3E%3CmxCell%20id%3D%221%22%20parent%3D%220%22%2F%3E%3CmxCell%20id%3D%222%22%20value%3D%22Crowd%20support%22%20style%3D%22rounded%3D0%3BwhiteSpace%3Dwrap%3Bhtml%3D1%3B%22%20vertex%3D%221%22%20parent%3D%221%22%3E%3CmxGeometry%20x%3D%2220%22%20y%3D%22110%22%20width%3D%22120%22%20height%3D%2260%22%20as%3D%22geometry%22%2F%3E%3C%2FmxCell%3E%3CmxCell%20id%3D%223%22%20value%3D%22Referee%20Bias%22%20style%3D%22rounded%3D0%3BwhiteSpace%3Dwrap%3Bhtml%3D1%3B%22%20vertex%3D%221%22%20parent%3D%221%22%3E%3CmxGeometry%20x%3D%22340%22%20y%3D%2220%22%20width%3D%22120%22%20height%3D%2260%22%20as%3D%22geometry%22%2F%3E%3C%2FmxCell%3E%3CmxCell%20id%3D%224%22%20value%3D%22Team%20Performance%22%20style%3D%22rounded%3D0%3BwhiteSpace%3Dwrap%3Bhtml%3D1%3B%22%20vertex%3D%221%22%20parent%3D%221%22%3E%3CmxGeometry%20x%3D%22660%22%20y%3D%22110%22%20width%3D%22120%22%20height%3D%2260%22%20as%3D%22geometry%22%2F%3E%3C%2FmxCell%3E%3CmxCell%20id%3D%225%22%20value%3D%22Share%20of%20Foreigners%22%20style%3D%22rounded%3D0%3BwhiteSpace%3Dwrap%3Bhtml%3D1%3B%22%20vertex%3D%221%22%20parent%3D%221%22%3E%3CmxGeometry%20x%3D%22200%22%20y%3D%22240%22%20width%3D%22120%22%20height%3D%2260%22%20as%3D%22geometry%22%2F%3E%3C%2FmxCell%3E%3CmxCell%20id%3D%226%22%20value%3D%22Crowd%20intensity(occupancy%26lt%3Bbr%26gt%3B%2Fsize)%22%20style%3D%22rounded%3D0%3BwhiteSpace%3Dwrap%3Bhtml%3D1%3B%22%20vertex%3D%221%22%20parent%3D%221%22%3E%3CmxGeometry%20x%3D%22340%22%20y%3D%22240%22%20width%3D%22120%22%20height%3D%2260%22%20as%3D%22geometry%22%2F%3E%3C%2FmxCell%3E%3CmxCell%20id%3D%227%22%20value%3D%22Team%20Age%22%20style%3D%22rounded%3D0%3BwhiteSpace%3Dwrap%3Bhtml%3D1%3B%22%20vertex%3D%221%22%20parent%3D%221%22%3E%3CmxGeometry%20x%3D%22480%22%20y%3D%22240%22%20width%3D%22120%22%20height%3D%2260%22%20as%3D%22geometry%22%2F%3E%3C%2FmxCell%3E%3CmxCell%20id%3D%228%22%20value%3D%22%22%20style%3D%22endArrow%3Dclassic%3Bhtml%3D1%3BentryX%3D0%3BentryY%3D0.5%3BentryDx%3D0%3BentryDy%3D0%3B%22%20edge%3D%221%22%20target%3D%224%22%20parent%3D%221%22%3E%3CmxGeometry%20width%3D%2250%22%20height%3D%2250%22%20relative%3D%221%22%20as%3D%22geometry%22%3E%3CmxPoint%20x%3D%22140%22%20y%3D%22140%22%20as%3D%22sourcePoint%22%2F%3E%3CmxPoint%20x%3D%2270%22%20y%3D%22320%22%20as%3D%22targetPoint%22%2F%3E%3CArray%20as%3D%22points%22%3E%3CmxPoint%20x%3D%22140%22%20y%3D%22140%22%2F%3E%3C%2FArray%3E%3C%2FmxGeometry%3E%3C%2FmxCell%3E%3CmxCell%20id%3D%229%22%20value%3D%22%22%20style%3D%22endArrow%3Dclassic%3Bhtml%3D1%3BexitX%3D1%3BexitY%3D0.5%3BexitDx%3D0%3BexitDy%3D0%3BentryX%3D0%3BentryY%3D0.5%3BentryDx%3D0%3BentryDy%3D0%3B%22%20edge%3D%221%22%20source%3D%222%22%20target%3D%223%22%20parent%3D%221%22%3E%3CmxGeometry%20width%3D%2250%22%20height%3D%2250%22%20relative%3D%221%22%20as%3D%22geometry%22%3E%3CmxPoint%20x%3D%22150%22%20y%3D%22160%22%20as%3D%22sourcePoint%22%2F%3E%3CmxPoint%20x%3D%22330%22%20y%3D%2250%22%20as%3D%22targetPoint%22%2F%3E%3C%2FmxGeometry%3E%3C%2FmxCell%3E%3CmxCell%20id%3D%2210%22%20value%3D%22%22%20style%3D%22endArrow%3Dclassic%3Bhtml%3D1%3BexitX%3D0.5%3BexitY%3D0%3BexitDx%3D0%3BexitDy%3D0%3B%22%20edge%3D%221%22%20source%3D%225%22%20parent%3D%221%22%3E%3CmxGeometry%20width%3D%2250%22%20height%3D%2250%22%20relative%3D%221%22%20as%3D%22geometry%22%3E%3CmxPoint%20x%3D%2220%22%20y%3D%22370%22%20as%3D%22sourcePoint%22%2F%3E%3CmxPoint%20x%3D%22260%22%20y%3D%22140%22%20as%3D%22targetPoint%22%2F%3E%3C%2FmxGeometry%3E%3C%2FmxCell%3E%3CmxCell%20id%3D%2211%22%20value%3D%22%22%20style%3D%22endArrow%3Dclassic%3Bhtml%3D1%3BexitX%3D1%3BexitY%3D0.5%3BexitDx%3D0%3BexitDy%3D0%3BentryX%3D0%3BentryY%3D0.25%3BentryDx%3D0%3BentryDy%3D0%3B%22%20edge%3D%221%22%20source%3D%223%22%20target%3D%224%22%20parent%3D%221%22%3E%3CmxGeometry%20width%3D%2250%22%20height%3D%2250%22%20relative%3D%221%22%20as%3D%22geometry%22%3E%3CmxPoint%20x%3D%2220%22%20y%3D%22370%22%20as%3D%22sourcePoint%22%2F%3E%3CmxPoint%20x%3D%22650%22%20y%3D%22120%22%20as%3D%22targetPoint%22%2F%3E%3C%2FmxGeometry%3E%3C%2FmxCell%3E%3CmxCell%20id%3D%2212%22%20value%3D%22%22%20style%3D%22endArrow%3Dclassic%3Bhtml%3D1%3B%22%20edge%3D%221%22%20source%3D%226%22%20parent%3D%221%22%3E%3CmxGeometry%20width%3D%2250%22%20height%3D%2250%22%20relative%3D%221%22%20as%3D%22geometry%22%3E%3CmxPoint%20x%3D%22400%22%20y%3D%22230%22%20as%3D%22sourcePoint%22%2F%3E%3CmxPoint%20x%3D%22400%22%20y%3D%22140%22%20as%3D%22targetPoint%22%2F%3E%3C%2FmxGeometry%3E%3C%2FmxCell%3E%3CmxCell%20id%3D%2213%22%20value%3D%22%22%20style%3D%22endArrow%3Dclassic%3Bhtml%3D1%3BexitX%3D0.5%3BexitY%3D0%3BexitDx%3D0%3BexitDy%3D0%3B%22%20edge%3D%221%22%20source%3D%227%22%20parent%3D%221%22%3E%3CmxGeometry%20width%3D%2250%22%20height%3D%2250%22%20relative%3D%221%22%20as%3D%22geometry%22%3E%3CmxPoint%20x%3D%2220%22%20y%3D%22370%22%20as%3D%22sourcePoint%22%2F%3E%3CmxPoint%20x%3D%22540%22%20y%3D%22140%22%20as%3D%22targetPoint%22%2F%3E%3C%2FmxGeometry%3E%3C%2FmxCell%3E%3CmxCell%20id%3D%2214%22%20value%3D%22%22%20style%3D%22endA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1 Conceptual model**

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## 2.4 Hypotheses

In this section we propose our expectations on the relationships between the variables in our model.

***Crowd support***

Crowd support can increase motivation for home players through loud and supportive cheers. The increased motivation stimulates players’ effort that they exert in the game. As a result home teams perform better compared to away teams ( Ponzo & Scoppa, 2018). The players are more effective since they are motivated and want to win in front of their home crowd, with Link and De Lorenzo (2016) that motivated players run faster, make more attempts and more sprints. A more active team and motivated team will often outplay a more lacklustre team. This leads us to generate the following hypothesis regarding the effect of crowd support on team performance.

*H1: Crowd support positively influences home team performance relative to away team performance.*

***Referee Bias***

Referees have shown a consistent bias towards home teams when awarding fouls and cards. Referees are subconsciously influenced by crowd noise when making decisions on potential fouls, cards and penalty’s (Nevill & Holder, 1999). Punishing home teams less severe in situations with crowd noise. Potential explanations include the use of visual cues in decision making when the situation is not very clear, with crowds reaction to a foul serving as a potential indicator of the actual situation and referees relying partly on these crowd judgements when making a decision. Additionally, referees could favor home teams in order to avoid potential crowd displeasure aimed at them during the rest of the game and even after the game. In soccer, much more compared to other sports, one action can decide the entire game. A 1-0 win with a single shot on goal is certainly a possibility. As a consequence, referee decisions have the potential to be decisive for team performance. A red card leaves a team weakened with fewer players and can change the entire game plan, tactics and performance. We therefore hypothesize the following on the role of referee bias.

*H2: The effect of crowd support on home team performance is mediated by a referee bias towards the home team.*

***Crowd size***

Crowds come in all shapes and sizes and different crowds will have different influences on team performance. Bigger crowds in general make more noise and can be more intimidating than smaller crowds. There is a big difference in playing for large crowds compared to small crowds. Crowd support has a direct effect on team performance and a larger crowd size is associated with larger crowd noise. This larger crowd noise and size could boost confidence and motiviation of the home team, and thus could lead to larger performance boosts for home teams for teams backed by large crowds compared to teams supported by smaller crowds.

*H3a: The positive effect of crowd support on home team performance increases when crowd size increases.*

We expect crowd size to play a significant role in the mediating framework between crowd support, referee bias and team performance. As mentioned in section 2.4 Nevill, Balmer & Williams (2002) in an experimental setting the significant demonstrated the effect of crowd noise on referee decision making. Referees are more uncertain in their decisions when crowd noise is present compared to situation where there is only silence. Favoring the home team in a situation with crowd noise by being more lenient in giving fouls and cards. Therefore, a higher occupancy and a bigger crowd size, with more crowd noise associated, will result in the crowd noise effect to be stronger and consequently a stronger referee bias towards the home team. Therefore we hypothesize the following.

*H3b: The mediating effect of referee Bias on the relationship between crowd support and home team performance increases when crowd size increases.*

***Crowd occupancy***

Crowd occupancy is also important for atmosphere within a stadium, and in turn the effect of crowd support on team performance support. Fischer & Haucap (2020) find that teams with higher occupancy rates pre covid-19 experience a greater decrease in home advantage post corona. If you play for 30.000 fans in a stadium where 100.000 fit, the atmosphere seems to be less intense and the stadium can appear to be almost empty. The less intense atmosphere has consequences for the motivation and effort that players exert in the game. ( Ponzo & Scoppa, 2016) Consequently, the associated performance boost for home teams will be lower. Therefore we hypothesize the following on the effect of stadium occupancy on team performance.

*H4a: The positive effect of crowd support on home team performance increases when stadium occupancy rate increases.*

We expect crowd size to play a significant role in the mediating framework between crowd support, referee bias and team performance. Referees rely on visual cues and crowd reactions and with less crowd attending will have to rely more on their own judgement. Furthermore, referees are subconsciously influenced by fear of social repurcission from the crowd. (Dohmen & Sauermann, 2016) Therefore, a higher occupancy rate which can be associated with a more intense atmosphere will result in more social pressure on the referee and consequently a stronger referee bias towards the home team. Therefore we hypothesize the following.

*H4b: The mediating effect of referee bias on the relationship between crowd support and team performance increases when stadium occupancy increases.*

***Foreigners share***

Tilp and Taller (2020)mention an increased global outlook of soccer clubs, both for recruiting fans and players as a factor, which has led to an increased gap between fans and players. Fans and players due to the increased differences in pay and origins live in completely different realities from each other. Fans do not recognize themselves in the extremely rich and foreign players who play for their local team, Lower fan identification with a soccer team decreases the support of those same fans when attending the match. This decreases crowd cheering and thus indirectly decreases the effect of crowd support on team performance. Consequently, we hypothesize the following regarding the effect of share of foreigners within a team on team performance.

*H5a: The positive effect of crowd support on home team performance is weakened when the share of foreigners increases.*

We expect the share of foreigners to also be an integral part of the mediating framework between crowd support, referee bias and team performance. A team with a high share of foreign players makes it harder for the home crowd to bond with their own team, producing a less intense atmosphere in the match and consequently less crowd noise. Since referee decisions in favor of home teams are mainly influenced by crowd noise and crowd reactions, their decisions will be less favorable for home teams when the crowd noise is lower than in situations of more intense atmosphere. Accordingly, we construct the following hypothesis.

*H5b: The mediating effect of referee bias on the relationship between crowd support and team performance decreases when the share of foreigners increases.*

***Team age***

The degree to which crowd support will influence team performance will vary per team. Each individual player reacts differently to playing environments. Team composition thus seems to play a role. Van de Ven (2016) finds that experienced sides with older players tend to perform better away from home than inexperienced sides. Possible reasons could include familiarity with the away venue and more experience with hostile crowds. Older players who have more experience, especially when that experience is within the same league, will be more familiar with venues and could be more experience with home crowds. Older players can develop coping strategies to decrease the influence of opposition crowds on their performance when playing away (Russell, 1983). Based on the literature and theory we formulate the following hypothesis of the effect of age on the relationship between crowd support and team performance.

*H6: The positive effect of crowd support on home team performance is weaker for teams with older players.*