## 2.1.1 Crowd support and home advantage

Different results seem to occur because of the difficulty in disentangling each of the various forces driving home advantage. Pollard (2008) explains that struggles concerning the unraveling of individual factors effect on home advantage sterns from the phenomenon that the multiple psychological and physiological influences involved all interact with each other and possibly reinforce each others significance. For exactly this reason “ghost games” provide such a unique opportunity to specifically study changes in home advantage as a consequence of crowd support. Therefore we use “ghost games” to examine whether crowd occupancy and crowd size significantly affect team performance.

Table 1 shows the overview of the related literature on crowd support plus our contribution. Home advantage 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.

Crowd support can raise home team performance relative to away team performance directly through cheering and booing. Crowd support can inspire home teams to perform to their potential, increasing home team performance. Thus, home team performance relative to away team performance could be lower when in a situation of no or less crowd support. 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.*

An interesting question then arises whether all teams experience a similar boost from their home crowd or that certain team characteristics or crowd characteristics could be associated with higher levels of home advantage. Each home crowd is unique, crowds differ substantially in size, density and also fanaticism. Carron and Agnew (1994) find a significant positive relationship between home advantage and crowd density. In other words, more crowd support leads to a stronger home performance relative to away performance and consequently a higher chance of a home win than an away win. Fischer & Haucap (2020) also find that there seems to be 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, in the 2nd Bundesliga and 3rd Liga home advantage did not change significantly during ghost games. They account this difference to the differences in occupancy rates between these competitions.

However, other researchers questioned whether crowd size and occupancy actually are important. Pollard (1986) negates the importance of crowd size and crowd density. In his argument Pollard (1986) 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. Furthermore, Salminen (1993) and Strauss (2002) claim that crowd support in the form of cheering does not affect team performance. In fact, they even find support for the case that teams are motivated by non-supportive audiences and play better in such situations.

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 of the home team, knowing they have got the backing from so many fans, and thus could lead to larger performance boosts for home teams for teams backed by large crowds compared to teams supported by smaller crowds. This leads to the following hypothesis on the effect of crowd size on team performance.

*H1b: The effect of crowd support on team performance increases when crowd size increases.*

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 switch to a completely empty stadium in this case might be less severe than a case where 15.000 very fanatic fans completely fill up a small stadium with stands close to the pitch and a fiery atmosphere. A completely empty stadium then all of a sudden makes a very big change.Therefore we hypothesize the following on the effect of stadium occupancy on team performance.

*H1c: The effect of crowd support on team performance increases when stadium occupancy rate increases.*

Another stream of the literature on home advantage 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. Teams with a higher average age could be more experienced with facing home crowds, which in turn could decrease the effect of these crowds on their performance. Russell (1983) for example finds that older players develop certain coping strategies to deal with the influence of the crowd on their performance.

A different component of team composition that could influence the effect of crowd support on team performance is the amount of foreign players featuring for the teams. 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. They 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. The difference in atmosphere within the stadium could influence team performance.

Another aspect of team composition that we analyze is the division between local and foreign players for teams. 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.

*H1e: The effect of crowd support on team performance is weakened when the share of foreigners increases.*

Apart from directly raising home 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 probably due to social pressure from the crowd. 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. A referee has a large influence on the outcome of the games (Boyko, Boyko & Boyko, 2007). Especially in a sport as soccer which is of a low scoring nature (Decroos, Bransen & Davis, 2019). A decision to award a team a penalty in the 89th minute of the match with the score at 0-0 could completely change the match outcome. Or an early red card significantly alters the course of the match with both teams adjusting their tactics and strategy and as such, influence team performance.

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 provide useful in discerning whether or not crowd size and occupancy play a role in referee decision making. Furthermore, most of the papers tend to focus solely on the existence of referee bias rather than on the implication of a possible referee bias on team performance. We extend the current literature by incorporating the influence of referee decisions on team performance as a mediating variable.

## 2.2.2 The impact of crowd support on 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. Additionally, a red card can change a teams entire game plan, tactics and performance.

*H2: The effect of crowd support on team performance is mediated by Referee Bias*

Similar to the expected moderating effect of crowd occupancy and crowd size on the direct relationship between crowd support and team performance, we expect crowd occupancy and crowd size to influence the relationship between crowd support and referee bias (Nevill, Balmer & Williams, 2002) demonstrated in an experimental setting the significant 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. Often more 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 higher crowd size, with more crowd noise, will result in a stronger referee bias towards the home team. This leads to the following two hypotheses.

*H2b: The mediating effect of referee Bias on the relationship between crowd support and team performance increases when Stadium Occupancy increases.*

*H2c: The mediating effect of referee Bias on the relationship between crowd support and team performance increases when average Crowd Size increases.*

Similar to the expected moderating effect of share of foreigners within a team on the direct relationship between crowd support and team performance, the share of foreigners within a team influences the relationship between crowd support and referee bias. 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 influenced by crowd noise and crowd reactions, their decisions will be less favorable for home teams when the crowd noise is lower. Accordingly, we construct the following hypothesis.

*H2d: The mediating effect of referee bias on the relationship between crowd support and team performance decreases when the share of foreigners increases.*

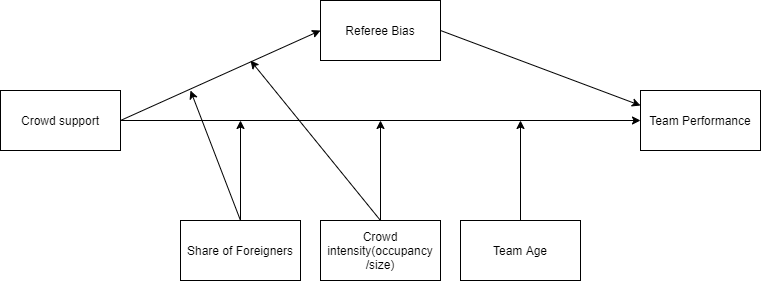
## 2.1.2 Team composition and home advantage

## 2.1.3 Covid-19 and home advantage

A few preliminary studies attempted 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. Especially when the data is also limited to only the end of the 2019/20 season. Within this smaller sample, a few abnormal results could already influence conclusions. We incorporate multiple countries in our dataset and extend the analysis to all the “ghost games” played up to date to obtain a larger sample and more generalizable results.

Figure 1 shows 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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