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The Home Advantage in Elite-Level Ice Hockey

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Abstract

Home advantages exist throughout every sport and can be seen in all levels of play. However literature on the topic has been inconsistent. Some support the theory of a home advantage while others argue that there might be a home disadvantage, especially in important games such as championships. This paper examines whether a home advantage exists in men's ice hockey at the collegiate level by taking an in-depth look at one conference in Division I hockey. Two sets of data were analyzed. The first set of analyses examined the impact of goals for and against, team quality, attendance, attendance percentage, and penalty data on home ice advantage over one season of play. The results showed that there was actually a home ice disadvantage. However, one major finding from this data, showed that as crowd density increased, the probability of the home team winning increased with it. Because of these mixed results, a second set of analyses were conducted on data collected from over four seasons of play. An examination of home and away winning percentages, as well as goals for and against, showed that a home advantage did exist within the same teams over fours years. These results suggest further research that should be conducted to mimic the results found in this study.

The Home Advantage in Elite-Level Ice Hockey

In any sport, especially professional sports, a good team is always surrounded by a good crowd. When a team comes from behind to win a game at home, you will usually hear some reference to the crowd's energy and support. The biggest comebacks recently have been the Red Sox' defeat of the New York Yankees in the 2004 American League Championship Series. Down 4-3 in the bottle of the ninth with the Yankee's star closer on the mound, the Red Sox were able to feed off of the support of the Fenway Faithful and rally to win Game Four and propel them to World Series Champions. In last year's Stanley Cup finals, the Detroit Red Wings shut out the Pittsburgh Penguins throughout the first two games in Hockeytown. But even though the home advantage is a common concept, whether it actually exists is still up for debate. After all, if you look back to the 2008 NBA Championship series, the Boston Celtics were able to rally from a 24-point deficit to come back and beat the Los Angeles Lakers on the home court of their arch rivals. Regardless, it is fair to say that a home advantage seems to exist in all sports. More importantly, for this study, research has shown that the home advantage has been most prominent in the sports of ice hockey and basketball, where the crowd is closer to the playing surface (Schwartz & Barsky, 1977; Bray, 1999).

There is a debate on whether home ice advantage exists when it comes to the playoffs and championship games. Theorists who believe that there might be a home disadvantage attribute it to a team "choking" in their home arena. There is literature that supports this theory (Baumeister & Steinhilber, 1984; Bray, 1999), but it does not discount the obvious home advantage that research has shown during the regular season.

Although there will always be upsets in sports, it doesn't take much effort to recall numerous teams in sports history who are known to be teams that are tough to beat at home. For

example, this paper examines whether a home ice advantage exists within one collegiate conference in Divisions I ice hockey. Twelve teams comprise the chosen conference, including two teams that are well known to have a tough arena for a visiting team to play in. Furthermore, most everyone attributes this to the loud and dense crowd that exists during the teams' home games.

But is it the crowd that really gives the home team an advantage? Zajonc (1965) presented his theory of social facilitation, which says that the presence of others serves as a source of arousal. Arousal increases the likelihood of an organism making habitual or well learned responses. Social facilitation theory also suggests that the presence of others makes performing habitual tasks easier, but new and complex tasks more difficult. However, for the purpose of athletics, it is simpler to just concern ourselves with the mere presence of others and the simple fact that it affects the athletes' performance. There have been studies that show that a player is affected when they simply believe they are being watched or even taped (Baumeister & Steinhilber, 1984).

Social facilitation flows very nicely into the debate about the home ice advantage or disadvantage. Does the mere presence of others produce a good or bad effect on the athletes? Someone who believes in the home advantage would obviously believe that it produces a good effect. The possible thought process could be that a team playing at home, during the regular season, is playing at ease and performing more simple tasks rather than facing a visiting arena and visiting crowd, which would be more complex (Cashmore, 2002). Those who believe that there is a home disadvantage, such as Baumeister and Steinhilber (1984), usually feel that this exists in championship games. In relating this theory to social facilitation, it could be that playing in a playoff game is more "complex" than the regular season, and the presence of others

makes them perform worse. However, there is no reason why this effect would be any different for the visiting team.

Either way, there is evidence for the home ice disadvantage in championship games. Baumeister and Steinhilber (1984) believe that self-presentational concerns may be greater in front of supporting audiences, hindering the home team's ability. As Schlenker and Leart (1982) suggested, this may be due to the athletes experiencing an increase in self-focused attention due to the increase in motivation for self-presentation in front of supportive audiences. In other words, as the home team, the athletes might feel more pressure to perform in front of their family, peers, and fans, thus increasing their anxiety and self-awareness. In short, "the heightened self-attention caused by the prospect of imminent success may ironically hamper the performance that is supposed to bring about that very success," (Baumeister & Steinhilber, 1984, p. 86). The results of Baumeister and Steinhilber's study also show that because home audiences cheer at success and boo at mishaps, whereas the crowd does not react nearly as much to the away team's actions, the home players are much more aware than the visitors are of being watched.

Despite some evidence for a home ice disadvantage, the research for a home advantage (at least up until a championship game) is overwhelming. And the home crowd is certainly not the only source contributing to the home advantage phenomenon.

Carron, Loughhead and Bray (2005) identified four game location factors (crowd factors, familiarity factors, travel factors, and rule factors) that are considered to influence psychological states and critical behavioral states of three group of actors involved in the outcome of a competition- coaches, competitors, and officials.

An athlete's psychological state is extremely important in competition. Confidence and anxiety can contribute immensely to a home ice advantage or disadvantage. In conjunction with expectations when at home, Courneya and Carron (1992) found that players were also more self-confident when playing at home. The product of this self-confidence can be explained in an experiment conducted by Dunn and Cosgrove-Dunn (1999).

Dunn and Cosgrove-Dunn (1999) found that among male hockey players a task orientation positively predicted respect and concern for social conventions, respect and concern for one's full commitment to hockey, and respect for the rules and officials. A task-oriented athlete focuses on learning and mastery of the sport (Gane-Overway, Guivernau, Magyar, Waldron & Ewing, 2004). They find mastery of skill intrinsically rewarding and are less disposed to mediocre sport conduct. On the other hand, and ego orientation negatively predicted respect for rules and officials. Furthermore, Gane-Overway et al. (2004) found that while playing at home, athletes are more likely to adapt an ego orientation rather than a task orientation. This means that they are less likely to respect rules and officials, which could cause more penalties, along with many other factors, that negatively impact their game.

Jurkovac (1985) conducted one of the first studies examining athletes' psychological states before a game. Jurkovac reported on data gathered from collegiate basketball players and indicated that they had higher confidence and motivation when playing at home than away. Recent research has complemented Jurkovac's earlier work. Bray, Culos, Gyurcsik, Widmeyer and Brawley (1998) found that being overconfident when playing at home was a disadvantage. So, the evidence for a home advantage is equivocal.

Examination of other such factors of mood states show a positive home advantage. In a unique study conducted by Bar-Eli, Levy-Kolker, Pie and Tenenbaum (1995), athletes were

presented with a variety of scenarios that occur during games that would cause the athletes to experience a "psychological crisis". The results showed that crisis states were significantly less likely to occur when competing at home than away, most likely due to a lower state of anxiety coupled with higher confidence.

In another study, Bray and Widmeyer (2000) asked collegiate athletes about their perceptions of the home advantage. They reported that the athletes believed their team to have a higher collective efficacy when playing at home. Results also revealed that players thought they were less anxious, more motivated and better able to concentrate when playing at home than away, which in turn, could play an important role in overall better performance. Terry, Walrond and Carron (1998) echoed Bray and Widmeyer's (2000) findings. In a comprehensive study on pre-competition psychological and mood states and the home advantage, Terry at al. (1998) found consistent game location effects across all variables. Specifically, they found that cognitive anxiety, somatic anxiety, tension, depression, anger, fatigue, and confusion were all lower before a home match then before an away match, while self-confidence and vigor were higher before the home match. With these findings it seems clear that an athlete's mood states prior to and during competition seem to favor the home team. It is hard to argue that lower anxiety, tension and confusion in conjunction with higher confidence and vigor are anything but an advantage in competition. However the studies conducted on mood states offer no results on whether there was also a home advantage in competition. Although these mood states do suggest an advantage for the home team, there is of course, the common flaw of over-confidence and overlooking the ability and strength of one's opponent, which undoubtedly the supporter of the home disadvantage theory would seek to explore. This can be seen in Baumeister and

Steinhilber's (1984) study, as well as follow up studies by Schlenker, Phillips, Boniecki, and Schlenker (1995).

But there is abundant evidence in support of Terry et al.'s (1998) positive findings on self-confidence and anxiety. Thout, Kavouras and Kenefick (1998) and Bray, Jones and Owen (2002) found significantly lower anxiety before home games and higher self-confidence and self-efficacy for a team of field hockey players before four home and four away matches against evenly-matched opponents. Furthermore, within these games, a home-field advantage (winning percentage over 50%) was observed. Carron, Loughead, and Bray (2005) believe that Bray et al.'s (2002) study was enlightening due to the use of Bandura's (1997) social cognitive theory. Bray et al. (2002) used Bandura's theory to justify the examination of self-efficacy by highlighting the ability to not only predict changes in psychological states that could be correlated to game location, but to help explain the variances in mood states.

A number of additional factors have been examined in attempts to explore the home advantage phenomenon. For instance, certain rules of ice hockey favor the home team, such as last line change on whistles. This could have an effect on the advantage that the home team exhibits, but it is tough to examine. Another effect that could impact the home advantage is travel. Snyder and Purdy (1985) examined the effect of the distance travelled by the visiting team and found that the home team won 58.5% of their games when the visiting team travelled less than 200 miles compared to a home winning percentage of 84.6% when the visiting team had to travel over 200 miles.

Courneya and Carron (1992) tested these same variables in the National Hockey League and concluded that the effects of travel on the home advantage were minimal. However, the home advantage in ice hockey in their study was approximately 61%. Therefore, any factor that

accounts for even 1% of the variance, such as distance travelled, must be taken seriously. In contrast, in the most comprehensive study of travel and the home advantage since 1992, Smith, Ciacciarelli, Serzan and Lambert (2000) found that, in the NHL, increases in distance travelled to the venue reduced the odds that the home team would win.

Another possible contributing factor to the home advantage is venue and field/court/ice familiarity. But in a study conducted by Shwartz and Barsky (1977) the home advantage did not prove to be prominent in baseball, where the field familiarity would be most important to the game. In other studies on venue familiarity, a change in home venue did not prove, overall, to factor into the home advantage. (Moore & Brylinsky, 1995).

It has been suggested that a home advantage could simply be a result of a self-fulfilling prophecy. That is, players play better at home and worse away simply because that is what they expect to do. It is difficult to research this theory, but it certainly seems plausible.

In the comprehensive study by Bray and Widmeyer (2000) mentioned earlier, they explored athletes' perceptions of the reasons for the home advantage. Athletes believed the home crowd was an important factor in contributing to the home advantage, but not one of the most prominent reasons. However, this could be due to the fact that the athletes questioned did not experience a large crowd at their games. [Audience sizes for the team questioned in the Bray and Widmeyer (2000) study had less than 200 people at their regular season games]. It is not unlikely that if the athletes studied were on professional sports teams or collegiate teams with good crowd support, that they would have attributed more of their success at home to the crowd. This suggests two possibilities: one, that crowd size might make a difference; and two, that there are other factors involved in the home advantage.

Even though home crowd, and more particularly a large and energetic crowd, seems the most common reason for a home advantage, there are relatively few studies on crowd density. Schwartz and Barsky (1977) found that crowd density in Major League Baseball had a positive effect on home advantage. Their research showed that home team winning percentages increased from 48% to 57% when the crowd density increased to over 40%. Schwartz and Barsky (1977) also found that the home advantage can be most closely linked to superior offensive performance. These results relate to the relationship with the home crowd because offensive performance is most likely to elicit approving noise from the crowd. It is an obvious observation that home crowds everywhere reach their highest volume when the home team is in control of the puck (or ball, etc.). So in ice hockey, it is important to note that the crowd might be even louder during a fight, i.e. aggressive behavior. This could play a factor in game outcome and be a related reason why the home crowd is important to the home advantage or disadvantage. Schwartz and Barsky (1977) also point out that in indoor sports of ice hockey and basketball, where the home advantage is most prominent, the crowd noise is magnified because of its proximity to the playing area, and that it is simply the sheer compactness (or crowd density) and immediacy that create such an intense audience. Also, because the puck (or ball) is in play for more extended periods of time, the crowd noise tends to be more intense and unremitting (Schwartz & Barsky, 1977).

Agnew and Carton (1994) examined several factors associated with the presence of crowds at ice hockey games. The results indicated that only crowd density was related to game outcome, and as the crowd density increased, so did the extent of the home advantage.

More research must be done on the effect of crowd density on the home advantage, but it seems likely that a large and dense crowd will have more of an effect than a small and dispersed

crowd. An intriguing question is whether a small crowd, especially in a large venue, might have negative effects on the home advantage (possibly affecting psychological states of the athletes).

Another factor of crowd effects is the affect that a crowd might have on officials and referees. It is tough to distinguish an officiating bias from the effects of a crowd. For the most part, you would think that if there is an officiating bias, it is perhaps subconscious because of the home crowd that they are subjected to. But this is one of the only ways to really observe and research an officiating bias. In a study by Nevill, Balmer and Williams (2002), the influence of the presence or absence of crowd noise on officiating was investigated. In the experiment, the officials were exposed to either an audible crowd noise or a silent group. The results showed that the officials in the audible group called significantly fewer fouls against the home team than referees in the silent group. The results also showed that the officials in both groups did not penalize the away team more often, so overall, it appears that the presence of crowd noise reduces the number of penalties called on the home team, rather than increases the number called against the visiting team. It is hard to conduct further studies on the officiating bias unrelated to a crowd effect.

Sumner and Mobley (1981) noted that because home teams generally perform better than the visiting team, what appears to be an officiating bias may simply be a direct reflection of true behavior on the part of the visiting players (i.e. dysfunctional aggression). Regardless of confounding factors or other explanations, Nevill et al.'s (2002) study still showed a significant difference in the number of fouls called on the home team compared to the away team. On average, officials called 2.3 fewer fouls against the home team when they experience crowd noise compared to the silent condition. This shows that referees are more reluctant or uncertain when it comes to calling fouls against the home team.

Aggression and aggressive acts are related to factors involving the psychological state of athletes and are important factors in the home advantage, especially in ice hockey where aggression plays a key role in the game. It has already been noted how a crowd at sporting events might encourage aggressive behavior. But aggression is also a separate possible factor in the home advantage in itself. There is a widespread belief that aggression in ice hockey is a normalized and necessary feature of the game (Anshel, 1994; Goldstein, 1983; LeUnes & Nation, 1989; Smith, 1980, 1982; Vaz, 1977). The frustration-aggression theory (Dollard, Miller, Doob, Mourer & Sears, 1939) claims that aggression is always a consequence of frustration. Berkowitz (1978) revised the theory to suggest that frustration (in hockey, anything that inhibits scoring a goal) does not always produce aggressive behaviors, but rather heightens one's predisposition toward aggression. If this is the case, then a home crowd might be a contributing factor towards heightening one's aggressive behavior, especially when they are unable to score.

In addition, as stated previously, Dunn and Cosgrove-Dunn (1999) and Gane-Overway et al. (2005) found that athletes playing at home adapt an ego oriented psychological state, which in turn means that they are less likely to respect rules and officials, and therefore, could lead to a possible effect on aggression output.

McGuire, Courneya, Widmeyer and Carton (1992) also examined aggressive behavior and its relation to game location. They found that home team players were more aggressive during games they won, while visiting team players were more aggressive during games they lost. Thus, when higher levels of aggression are present, the outcome seems to favor the home team. This is an important finding, but again, this outcome could be related to multiple factors including an officiating bias.

An increase of aggression while playing at home might not affect the players alone. Dennis and Carton (1999) examined strategic and tactical decisions made by coaches in ice hockey. In one study, they found that NHL coaches report that they purposely implemented more assertive strategies at home. And in another study, findings verified the coaches' reports by tracking behavior in 62 NHL games. Teams showed more assertive forechecking tactics at home, which not only shows the coaches' strategy, but also reflects the behavior of the athletes. Overall, studies seemed to show that the home team tends to exhibit higher aggression outputs and more assertive behavior, which seem to favor the home team, regardless of the effect of an officiating bias.

Although there have been numerous studies examining the factors contributing to a home advantage or disadvantage, the ones that will be examined in this study are crowd density and support, officiating biases, and both the psychological and physical state of aggression. The main hypothesis of this research is that there is, in fact, a home ice advantage. This will be confirmed if the winning percentage of a particular team is statistically significantly higher at home than when the team is away. In an effort to explain home ice advantage, crowd size and densities along with the number of penalties called at home versus away and the type of penalties (whether they are or are not instances of aggression) are examined. This paper will attempt to confirm the hypothesis that a large or dense crowd increases the home advantage in three ways: 1. Crowd support positively affects the athletes, 2. A large crowd, whether consciously or subconsciously, affects the officiating resulting in the home team being called for fewer penalties than the away team, and 3. The mere presence of the crowd, coupled with the fact that a team is at home, results in a more aggressive and assertive style of play from the home team, positively affecting the outcome of the game.

Method

Subjects

The teams used for this study competed in a major collegiate hockey conference in the U.S. Two data sets were used. One was comprised of data and statistics from every conference game from the 2007-08 season. This first data set included 168 conference games that were played over a single season, and then the data was doubled so that each team had a set of 28 regular season conference games (14 at home and 14 away). The second data set collected statistics from the same teams but over four years of play (2004-05 season to 2007-08 season). The league was divided into three clusters of four teams. Within one season, each team in a cluster played every other team in their cluster four times, two games at home and two games away. Each team played the other eight teams not in their cluster two times. Whether they played two at home or on the road or one at each venue varied depending on the proximity of the two schools in question. It is important to note that these are collegiate teams and to keep in mind that each season, players depart and new players come in, creating seasons with young teams and others with older teams. The average collegiate hockey player is just over 21 years of age. It is also important to note that the head coaches of 10 of the 12 teams have remained the same throughout the four year period. Two schools had a change of head coach, both at the start of the 2005-06 season.

Variables

The dependant variables were almost always the game outcome (win/loss), goals for and goals against. The outcome was coded as 0 for a loss or a tie at home and a 1 if the home team won or managed a tie on the road. The independent variables varied in each analysis. Attendance at games was used in many of the tests as a string variable. Attendance percentage

(attendance/total capacity of the arena) was also used as an independent variable. Team quality and opponent quality were used in some of the analyses as well. The quality of the team was based off of the team's final place in the standings at the end of the 2007-08 season. The top four teams were assigned a value of 3, the middle four teams were assigned a value of 2, and the bottom four teams were given a value of 1. The last variable used was related to the penalties. For each game, the penalties called on both the home team and their opponent were coded into five categories: total, nonaggressive, aggressive, aggressive-violent, and violent. Within the nonaggressive group were penalties for interference, holding, hooking, tripping, throwing the puck, and diving. The aggressive penalty group included clipping, butt-ending, cross-checking, high sticking, pushing, charging, elbowing, kneeing, roughing, spitting, boarding, slashing, spearing, checking from behind, and all obstruction calls. Unsportsmanlike conduct, swearing, and abuse were categorized as aggressive-violent, and the violent category included all misconduct penalties, fighting, kicking and hitting. These penalties were coded using the method of Tenenbaum and Kirker (2003). The penalty variables were used as both independent and dependent variables in this study.

Procedure

The data was collected from collegehockeystats.net, the official statistics of collegiate hockey. The box score for each conference game for every team in the league was used to compile the data. The data was then coded into an EXCEL file and then converted into an SPSS format. All regressions and analyses were conducted using SPSS. The attendance percentage was determined by using the attendance figure from the box scores on collegehockeystats.net and then dividing that number by the total capacity of the arena. The total capacity for each team's home arena was found on the conference's website under information about each school. When a

game was played on neutral territory such as one of the near by professional sport team's arena, the attendance was divided by the capacity of those facilities.

Data Analysis

Regressions, ANOVAs, and *t*-tests were run to test the hypotheses discussed in the introduction. Multiple linear and logistic regressions were run on the data set involving the twelve teams over one season. Data was entered on each teams' quality, opponents' quality, location and outcome of the game, goals for and against, as well as all penalty information.

When game outcome was the dependent variable, and either location, attendance or team quality was the independent variable, logistic binary regressions were run. When testing for types of penalties, goals for or goals against, linear regressions were employed. In all regressions, it was necessary to compensate for the fact that each game was treated as independent from every other. However, in reality this would not be the case because it was the same team playing all the other teams for each of their 28 games. In order to avoid these interdependencies, dummy coding was used and the teams were added as covariates while running the regressions.

Also taken into account was the doubling effect that was caused when entering data twice for every game: once for the home team and once for the away. When location was an independent variable, this doubling effect was null, but when testing without location as a variable, it was necessary to split the cases to include only the games that were played at home for each team.

In the second data set, the number of home wins, away wins, home losses, away losses, total goals for and against at home and total goals for and against on the road were computed over four seasons for each team. This time, all games, rather than just conference games, were

used. This data set was very helpful in analyzing whether a home advantage existed over multiple seasons of play. Barnett and Hilditch (1993) suggested that team quality may be a variable in game location outcome. A team's home winning percentage is not necessarily an accurate variable in a team's home advantage. For example, if a bad or low quality team only wins 25% of their games, then even if all those wins are at home, their home winning percentage would at best be 50%. But there clearly would be a home advantage, even though their home winning percentage (HWP) is not above 50%. So, rather than use a team's home winning percentage to determine the home advantage, it is more accurate to use a teams home winning percentage minus their away winning percentage. If the resulting variable is a positive number, then there is a home advantage; if it is negative, then no home advantage exists. This number can be called the home/away winning percentage differential (H/AD) (Bray, 1999). In order to get an accurate H/AD, the sample must include an equal number of home and away contests from a large number of teams over several seasons of elite level play. The second data set was able to calculate accurate H/ADs, and is one reason why the second data set was collected.

The analyses used for the second data set were much more basic than the first. Only game outcome, location, goals for and goals against were used in the analyses of the four seasons of play. One-sample *t*-tests and paired *t*-tests were used to compare winning percentages at home versus away, as well as goals scored for and against at home compared with away. Descriptive statistics were used to make sense of the results.

Results

Results are presented for the single season data first, followed by results for the four year data set. Single season results are addressed relative to the hypotheses expressed earlier in the paper. First, game outcome based on location is presented. Second, the effect of attendance and

attendance percentage on game outcome is addressed. Third, the impact of location and attendance percentage on goals scored is presented. Fourth, the influence of penalties on outcome and goals is examined. Finally the impact of team quality on game outcome and goals for and against are discussed.

Single-season data

A major hypothesis of the study is that location will predict outcome. A logistic regression with location as the independent variable and outcome as the dependent variable showed a trend towards a home disadvantage, however the result was not significant (β=-.382, p>.080). The results suggest that when a team is playing at home, the probability of them winning is not as great as when they are playing on the road. However, lack of statistical significance suggests overall that there is no difference.

A main hypothesis for explaining home ice advantage is the home crowd. The next regression tested whether attendance and attendance percentage had any effect on the outcome of the game. According to the hypothesis, the larger and denser the crowd, the more likely the home team should win. The results for actual attendance showed no significance (β=.000, p>.999). However there were significant results when looking at the crowd density (or attendance percentage). The results showed that as the crowd became more dense, or as more people packed the arena, the home team was more likely to win (β=.012, p<.046).

Another way to test the outcome of the game is to look at the goals for and goals against. When testing to see if location had an effect on goals for or against, results would explain if more goals are scored when a team is at home or on the road. These results reported no significant findings (β=.060, p>.700). There were also no significant findings when testing to see if attendance percentage had an effect on goals for or goals against (β=.001, p>.700). Had these

results been significant, they would have explained that as the crowd either became more sparse or more dense, the home team would have scored either more or fewer goals. But as neither result reported significant findings, it shows that teams were as likely to score goals and give up goals whether playing at home or on the road. This is consistent with the earlier finding that there was not a home disadvantage or advantage.

Because no significant results were found when testing both the location and the attendance percentage as an interaction, tests were conducted by examining data for home games only. This way, it was possible to test whether or not crowd density had an effect on just the home team in relation to goals for, goals against, and game outcome providing insight as to reasons for a possible home advantage or disadvantage. This time, the results were significant. A regression analysis indicated that attendance percentage positively impacted goals for (β=.013, p<.007). This result shows that when a team is at home, they score more goals as the crowd becomes more dense. A second regression revealed that attendance percentage negatively impacted goals against (β=-.012, p<.013). That is, when a team is playing at home, the opposing team scores fewer goals as the crowd becomes more dense. Both these results are consistent with the hypothesis that a dense crowd instigates the home offense, thus giving the home team an advantage.

Linear regressions were used to test the effect of attendance, attendance percentage and location on the total number of penalties for the home team and away team, as well as each type of penalty (aggressive, nonaggressive, violent, and aggressive-violent). The resulting βs have very small values due to little variance in the data collected on the game penalties. The first five regressions tested whether attendance had an effect on penalties. Refer to Table 4 to see that no significant results were found (total penalties: $\beta=2.513^{-5}$, p>.770; nonaggressive penalties:

$\beta=2.217^{-5}$, $p>.580$; aggressive penalties: $\beta=3.788^{-5}$, $p>.420$; violent penalties: $\beta=-2.725^{-5}$, $p>.360$; aggressive to violent penalties: $\beta=-9.88^{-6}$, $p>.150$).

The impact of attendance percentage on penalties was also tested and these results showed that crowd density did impact penalties. The first regression showed that crowd density had a positive impact on the total number of penalties being called on the home team ($\beta=.015$, $p<.024$) (Refer to Table 5). So the home team is committing more penalties as the crowd becomes more dense. The next regression showed that there was a positive effect on the number of aggressive penalties ($\beta=.010$, $p<.021$). This means that the home team is being called for more aggressive penalties the denser the crowd gets. The next regression showed that there was a trend towards more nonaggressive penalties as the crowd becomes more dense ($\beta=.006$, $p<.093$). There was no significant finding between the crowd density and the number of violent penalties ($\beta=.000$, $p>.900$) being called on the home team. There was, however, a trend when testing the effect of crowd density on the amount of aggressive-violent penalties ($\beta=-.001$, $p<.054$) being called. This means that as attendance percentage increases, there is a trend to fewer aggressive-violent penalties being called on the home team. There were no significant results when testing whether crowd density had an effect on nonaggressive penalties. These findings show that as crowd density increases, more penalties and more aggressive penalties are called on the home team, which support the hypothesis that athletes may exhibit more aggression when playing at home.

The effect of crowd density on the opposing team's penalties was also tested via regression analyses. The first test showed that there was a significant effect of crowd density on number of penalties being called on the opposing team ($\beta=.014$, $p<.041$). This means that as the crowd density increased, so did the number of penalties for the away team. In the next

regression, there was a trend towards more nonaggressive penalties being called on the away team as the crowd became more dense (β=.006, p<.093). The impact of crowd density on the number of aggressive penalties being called on the opponent was also found to be significant (β=.010, p<.021). As crowd density grew, the away team seemed to commit more aggressive penalties. Finally, there was a trend on the effect that the crowd density had on the number of aggressive-violent penalties on the away team (β=-.001, p<.054). When the crowd became more dense, the away team tended to commit less aggressive-violent penalties. However, there were no significant results when examining the effect of crowd density on the number of violent penalties (β=.000, p>.900). These results were neither supportive nor contradictory to the hypothesis of the home team exhibiting more aggressive behavior, but they do provide insight into the hypothesis that there might be an officiating bias.

Team quality has been indentified as a factor in the home ice advantage. Therefore, the impact of team quality on game location outcome is an important finding in this study. However, very few results concerning team quality shed any interesting light on the home ice advantage phenomenon. Both logistic and linear regressions were conducted to test an effect that team quality may have on the outcome based on location, crowd size and density. Not surprisingly, team quality had a significant effect on the outcome of the game (β=.797, p<.001). This means that as the quality of the team was higher, they had a more likely chance of winning the game. In other words, the better the team, the higher their home ice advantage was. In reverse, as the opponent quality got higher, the home team had less of a chance of winning (β=-.824, p<.001). An interesting, but sensible, result was found when testing to see whether attendance and attendance percentage had an effect on the team quality. Significant results showed that higher quality teams correlated with higher attendance (β=5.676^{-5}, p<.002) and higher attendance

percentage (β=.009, p<.001). Although this makes sense, because fans like to watch winning teams, it is important, because it supports the hypothesis that a large and dense crowd at least correlated with a home ice advantage.

Based on the results from the earlier analyses, additional tests were run to further examine the data. Logistic regressions were used to examine whether the number of penalties had an effect on the outcome, but no significant results were found. When testing the effect of number of penalties for the home team on the outcome, the results were not significant (β=.030, p>.550). There were also no significant results for the impact of the number of penalties for the away team on game outcome (β=.069, p>.160). Finally there were no significant results when testing whether location had any effect on the number of penalties for the home or away team (β=.196, p>.500; β=.193, p>.570, respectively).

Four-year data

The data from the 2007-08 season suggests that hockey teams did not experience a home ice advantage. In fact, the data suggests that there may be a home ice disadvantage. However, findings may be impacted by the use of data from a single season. The season selected may not be a representative sample of a typical hockey season. Therefore, the second data set examined statistics from over four seasons of play. Descriptive tests (Table 6) as well as one-sample *t*-tests (Table 7) and paired *t*-tests (Table 8) were used to examine whether a home ice advantage existed within the league from the 2004-05 season to the 2007-08 season.

This four-year data was analyzed to test the main hypothesis of whether there is a home ice advantage. Furthermore, analyses of goals for and against were able to provide support for the results of the home advantage data. Using a one-sample *t*-test, there was a significant finding of a home ice advantage (t=6.675, p<.001 with a mean of .1753 and a standard deviation of

.09096). The mean value says that teams, on average, teams had a H/AD (home winning percentage-away winning percentage) of .1753, with a standard deviation of about .09. These results indicate that even though there was not a home advantage when looking at just the 2007-08 season, there was in fact a home ice advantage when including that season with the previous three seasons.

The impact of location on goals for and goals against was also examined via paired *t*-tests to see if location affected the goals for and goals against. By comparing the average goals for at home with the average of goals for when away, a significant difference was found indicating that a team scored, on average, more goals when at home than away t=2.388, p<.036 with a mean of .708 and a standard deviation of 1.027). Teams scored nearly one more goal per game at home than on the road. However, when comparing the average of goals scored against at home with the average of goals scored against on the road, no significance was found (t=.884, p>.300). Overall, the results supported the hypothesis made at the beginning of the study and indicated that a home ice advantage does exist within this Division I conference.

Discussion

The results of the single season data did not show a home ice advantage. However, the 2008-09 season was arbitrarily chosen and even though it wound up not supporting the hypothesis, it still presented many interesting results that do support the hypotheses formed at the beginning of this study and suggests possible future research on the topic. To begin with, the results did not show a significant difference in a team's winning percentage at home compared to away, but it did show that there was a trend towards a home ice *dis*advantage. Although these results were not significant, it is still important to try and explain why this trend happened. One factor to examine is whether the crowd size and crowd density had any effect on the outcome of

the game. It turned out that there were no significant findings when taking crowd size into consideration. That means that neither team was more likely to win when a game took place in front of a 3,000 person crowd or an 8,000 person crowd. However, the crowd density did have an effect. So say, for instance, a team was playing at a school with an arena that could hold upwards of 17,000 people (which is the case for one of the schools in the sample), when the crowd was more dense (say 10,000 people), the home team was more likely to win than when there were only 5,000 people there. This supports the hypothesis that the home team is more likely to win when there is a dense crowd at the game. So even though there was a trend towards a home ice disadvantage, in games in which the crowd was dense, the home team was still more likely to win. This is a plausible finding and it is possible to see this effect at any school that has a tendency to sell out their games.

The results from crowd density analyses supported this study's hypothesis of a home ice advantage. Part of having a home ice advantage means that the home team has better offensive production, i.e. they score more goals. Because there was not a home ice advantage in the one year data, it also must be true that the home team did not, in general, score more goals. However, the results did show that as crowd density increased, the home team's offensive production increased significantly as well. Because there is a home ice advantage when there is a dense crowd, it follows that a dense crowd stimulates the home team to score more goals, while at the same time, inhibiting the away team in their offensive production. The question that stands out is as follows: if a team scores more goals at home in front of a large crowd, and thus is more likely to win when in front of a dense home crowd, then which results support the home ice disadvantage that was found? The only answer is that, on average, there are not high-density crowds at these teams' conference games. Although this study does not have evidence to support

this, it is the only logical conclusion that can follow from the results provided. (If the results showed that the home team lost more games at home than they won (even if it was not a significant amount more games), but the results also showed that when there was a dense crowd the home team won more often, then it must follow that at more games than not, there was not a dense crowd).

So far, it is clear that crowd density positively affects the home team, both in outcome of the game and in a breakdown of offensive production. Further predictions of this study suggested that other reasons for a home advantage might be based on aggression and officiating biases. To test these hypotheses, statistics on penalties were collected and tested. Significant findings were consistently related to attendance percentage. In other words, any time the attendance was high, there were significant effects on penalties being called. This means that the games in which there was an effect on the offensive output are the same games in which there was an effect on penalties called. So the home team performed better with a dense crowd, but also had more penalties called on them. In particular, they had more aggressive penalties called on them. On the other side of things, when the crowd was more dense, the away team was also more likely to be called for more penalties. From that, it is possible to conclude that both teams were playing more aggressively with a dense crowd, but it positively affected the home team, while having a negative impact on the away team. Previous studies by Terry et al.'s (1998), Thout, Kavouras and Kenefick (1998) and Bray, Jones and Owen (2002) found that athletes were more anxious when playing away rather than at home. This could cause away teams to react negatively when being called for penalties whereas the home team, who Gane-Overway et al. (2004) say takes on an ego-oriented attitude, would be less anxious when on the penalty kill, and perform better because of this. Also, the home team has been found to react better in crisis states, such as being

put on the penalty kill in a close game (Bar-Eli, Levy-Kolker, Pie & Tenenbaum, 1995).

The results of this study support the stated hypotheses. Berkowitz's (1978) revised frustration-aggression theory suggests that frustration heightens one's predisposition toward aggression and certain cues can trigger a predisposition towards frustration. It is possible that one of those cues might be a high-density crowd that expects you to win. So when playing at home, athletes may become more frustrated, which in turn would lead towards a tendency for aggressive behavior. Since aggression is a necessary feature of the game (Anshel, 1994), it would follow that playing aggressively positively affects the home team. Furthermore, even though the aggressive behavior provokes more penalties, according to the results of this study, the away team is also being called for more penalties, thereby washing the two results out. It is possible that the away team is not even playing more aggressively, but that the rise in penalties called is a result of an officiating bias. However, this hypothesis has not been proven in studies, rather in one of the only studies on this topic (Nevill et al., 2002), high density crowds provoked officials to call fewer penalties on the home team, not more on the away team. But because an officiating bias is so hard to prove, it is still possible that that the referees, subconscious or not, feel the need to call an equal amount of penalties on the away team. So when the home team is playing more aggressively and being called for more penalties, the away team, even though they may not have an increase in aggression, is consequentially being called for more penalties as well. This would give a major advantage to the home team. Not only are they playing more aggressively, which is good in ice hockey, but the away team is getting an equal amount of penalties called on them, which may not be a result of aggressive behavior. Keep in mind that in the games where this is happening (when there are high density crowds and teams are being called for more penalties), the results showed that the home team did have an advantage. It is

only when considering every game played (not just the games with high density crowds) that there a trend towards a home ice disadvantage was found.

The previous results showed that attendance percentage had an impact on the penalties being called. But another important result was that penalties did not have any effect on the outcome of the game. So even when there was a game with a large amount of penalties, the penalties themselves did not have an effect on the game. However, the results do not take into account the possibility of penalties affecting the offensive output through power plays (more goals scored when on the man-advantage), which in turn would then affect the outcome of the game. It is not possible to form hypotheses on officiating biases without more data, which would have to be examined in further studies. As stated before though, the results from this study could indicate that officials call more penalties on the away team when they are undeserving of them. It is also possible that a large and dense crowd causes the referees to call more penalties, but not more so on either the home or away team.

The results indicating higher aggressive behavior from the home team are not surprising. Prior research has shown that aggressive behavior is expected from the home team (Gane-Overway et al., 2004). Not only do they play more physical but they play with a more assertive style such as using an aggressive forecheck. The best explanation of this style of play has been described by Dunn and Cosgrove-Dunn (1999). In this study, they explain that the home team exhibits an ego-oriented attitude. When at home, players tend to have a mindset where they are more confident and less anxious. They also believe that they have an overall higher self-efficacy. The combination of confidence and less anxiety produce fewer crisis situations. So even if the home team is losing, it is more likely that they will become frustrated, and not anxious, allowing them to play more aggressively and put the puck in the net.

On the other side of things, it is important that the home team does not become over-confident. Over confidence is a big factor in both Baumeister and Steinhilber (1984) and Bray's (2003) findings of a home ice disadvantage. Overconfidence, without the support of a dense crowd, could be one of the reasons behind the disadvantage found in the data of this study.

This brings us back to the crowd support factor. Overall, when there was a dense crowd, the home team exhibited an advantage. As hypothesized, the results showed the home teams use a dense crowd to add to their home ice advantage. At ice hockey games, the crowd is right up against the glass and right in the action. This makes any effect that the crowd would have on the game and the players even more pronounced. The results of this study indicate that this may be what it is happening.

The final results of the single season data are the correlations found between crowd density and high quality teams. Although these results seem obvious, they are intriguing findings. High quality teams tend to have high-density crowds at their home games. The question is whether the high-density crowds give an advantage to the home team, thus making them a high quality team or if the high quality team attracts a high-density crowd? There is no way to answer this question based on the data in this study, but it seems a good place for future research to start.

The indecisive results of the first part of this study initiated the second part of the study on the four-year data. Although the results supported the hypotheses on aggression and officiating biases in the single season data, the results did not support the hypothesis of a home ice advantage. The four-year data, however, did support this important hypothesis. So the question is if the results can explain why.

The only data that was tested besides the home and away winning percentages of the twelve teams was the goals for and goals against both at home and on the road. Taking the average of goals per game, the results showed that teams scored nearly one more goal per game when at home than on the road. There was no significant difference of goals against when a team was at home rather than on the road. This relates directly to the hypothesis that a team's home advantage exists mostly in their offensive production, rather than their defensive abilities. Although there is not data for crowd support or for penalties called over the past four seasons, it is easy to look at the data, more specifically at their home winning percentage minus their away winning percentage, for each team and compare that data with teams that have, on average, high density crowds in their arenas. For example, one team that had the highest overall H/AD had over 80% of their arena filled for eleven of their fourteen home games. Another team with an H/AD of .017 (fourth highest) never had a home game that was not at least 90% full, and most were a sellout. On the other end of the spectrum, one team with one of the lowest H/ADs only recently started to sell out their venue. Last season, they held a significant home advantage while selling out most of their home games. However, in previous seasons, before they became a top team in the conference, their arena was hardly ever near capacity. So even though they had one of the lowest H/ADs over four seasons, if you looked at just the past season (when they sold out almost every home game), their H/AD would have been a lot higher. Finally, one team plays their games in the same arena as their basketball team, which can house 17,500 fans. This school had the lowest H/AD, and even though their games reached upwards of 8,000 fans on a good night, their attendance percentage was never near half-capacity.

The four-year data cannot support any of the other hypotheses or further explain any of the results, but the results do confirm a home ice advantage in Division I collegiate hockey.

Further research on this four-year data could look more in-depth at attendance percentage and penalty data to help support the remaining hypotheses.

Future Research

The findings in this current study provide clear directions for future research. Although there have been many studies on various aspects of the home advantage, there have been relatively few going into the in-depth view which the data of this study attempted to do. Gathering data for conference games over one season proved to be beneficial, but also limited. The data on goals for, goals against, attendance, attendance percentage, penalties for and against as well as type of penalty proved to be very useful in predicting why a home ice advantage might exist, but limiting the data to one season proved to be inadequate. This is apparent because the most important result showed a home-ice disadvantage. However, this disadvantage reversed when analyzing game results and data from over four seasons of play. Further analyses on this same data, but over a longer series of time, and maybe expansion to all college hockey data, not just one conference, could prove very enlightening.

Further research involving postseason play would also be helping in furthering the debate about a home ice advantage and postseason home ice disadvantage. No data was collected for postseason play, but it would be particularly interesting within this same subject group because all twelve teams make the postseason. In first round play, the bottom four teams (quality=1) travel to the middle four team's (quality=2) for a best out of three series. The quarterfinal round involves the winner of these four series traveling to the home rink's of the top four teams (quality=1) to see who will advance to the semi-finals in neutral territory in front of a usual ~60% capacity crowd of 14,000 fans. This data could further either hypothesis supporting a home ice advantage or disadvantage.

This leads to an area that was unable to produce any interesting results within this study – team quality. In this study, there were no significant findings when looking at a particular quality of team (say a high quality team) and whether they were playing a certain quality opponent (say a low quality opponent), or looking at other data such as attendance data or penalty data. The only results found showed that a poor quality team was less likely to win and scored fewer goals when playing a high quality team and vice versa. This had to be the case based on how the teams were categorized by quality (a high quality team was a team which won the most games). Further data examining a team which moves from a low quality in one season to a middle or high quality team in another season might shed further light on how attendance factors into outcome and offensive production. For example, although no statistical analyses were run, it is was easy to see that attendance might have a factor on one team who went from a low quality team four seasons ago to a high quality team this past season. Currently, they sell out most of their games, and currently, they are a high quality team. But four years ago, they were a low quality team. Did this coincide with low-density filled arenas? Further research would have to be conducted in order to answer this question.

It is also possible for future research to attempt to answer more questions on density and crowd size. Is it possible that there is a psychological effect of players seeing empty seats in low-density arenas? Maybe a high-density crowd elevates arousal and increases the effect of social facilitation. There are so many areas in which future studies on the home advantage can explore, and these options are just a few which would further the data gathered in this study.

Limitations

The current study employed data from the 2007-08 season and data from four seasons ranging from 2004 to 2008. Using this data limits the abilities of this study in a few ways.

First of all, the home crowd, aggression, and officiating biases are all interrelated, and it is difficult to attribute certain results to a particular effect. Secondly, this study only examines twelve different teams in one division of collegiate ice hockey, so the data cannot be generalized to all ice hockey, let alone all sports. Thirdly, this study does not have statistics on teams' hits and turnovers, which could be very useful information. Turnovers could exemplify a team's anxiety, while hits could exemplify a team's aggression.

There were some issues that came up when running the analyses. First of all, the data set had a duplicate of every game, so for many of the tests, it was necessary to split the file to only include the home games – thus limiting the tests that could be run testing location. Secondly, each game was treated independent from every other game. But since every team played 28 of the games in the sample, and every game was played against each other, the data is interdependent, but treated as if each game is independent of one another. It is necessary to keep in mind this fact when analyzing the results. How one team played during the first game of a conference weekend might affect how they will play the following night, especially since in most cases, it is against the same team. The other factor that must be taken into account is ties. For the purpose of this data set, every tie for a home team was considered a loss and every tie for an away team was considered a win. That way, they all evened out. But it is unfair to the home team that is a poor quality team to give them a loss when they actually tied a high quality team, even if it was at home. Finally, as mentioned in the results section, the data concerning penalties had very little variance resulting in extremely small βs that still sometimes produced significant results.

Another limitation could help explain why there was a home ice disadvantage within the single season data. The 2007-08 season was arbitrarily chosen because it was the most recent.

But it turned out that there was not much discrepancy in the league that year. The top quality teams were by far and away the best four teams in the league and won almost every game, whether it was home or away. In contrast, the low quality teams were easily the worst four teams in the league, losing almost all of their games regardless of location. This could account for the fact that no advantage appeared within that single season of play.

Finally, it was not possible for this study to examine the results to the extent possible with the data available. Certain analyses are too complex to run and include dummy coding of each team in the sample. Future research can include more analyses of interactions between location and outcomes, location and densities, and densities and penalties. With further data and the ability to run more complex tests, hopefully more answers on the topic of home advantage can be answered.

Conclusion

This study examined the possibility and reasons for a home ice advantage in collegiate ice hockey. The results were interesting, varying from an overall home ice disadvantage within the 2007-08 season to a home advantage during high-density games and a home advantage over four seasons of data. The results were explained by crowd size and crowd density at games, and also penalty data and officiating calls in each game. The mixed results present interesting areas for future research to delve into, but also provide intriguing conclusions. This study shows that a large and dense crowd does in fact help the home team and give them an advantage in games, presenting reasons based on aggressive behavior and possible officiating biases. Hopefully future research can continue to explain this conclusion and bring about further explanations.

References

Agnew, G.A., & Carton, A.V. (1994). Crowd effects and the home advantage. *International Journal of Sport Psychology, 25*, 53-62.

Bar-Eli, M., Levy-Kolker, N., Pie, J.S., & Tenenbaum, G. (1995). A crisis-related analysis of perceived referees' behaviors in competition. *Journal of Applied Sport Psychology, 7*, 63-80.

Baumeister, R., & Steinhilber, A. (1984). Paradoxical effects of supportive audiences on performance under pressure: the home field disadvantage in sport championships. *Journal of Personality and Social Psychology, 47*, 85-93.

Botterill, C. (2004). The psychology of professional hockey. *Athletic Insight: The Online Journal of Sport Pyschology, 6*.

Bray, S.R., & Martin, K.A. (2003) The effect of competition location on individual athlete performance and psychological states. *Psychology of Sport and Exercise, 4*, 117-123.

Bray, S.R., Culos, S.N., Gyurcsik, N.C., Widmeyer, W.N., & Brawley, L.R. (1998). Athletes' causal perspectives on game location and performance: the home advantage? *Journal of Sport and Exercise Psychology, 20,* 100.

Bray, S. R., Jones, M. V., & Owen, S. (2002). The influence of competition location on athletes' psychological states. *Journal of Sport Behavior, 25*, 231-242.

Bray, S. R., & Widmeyer, W. N. (March 2000). Athletes' perceptions of the home advantage: an investigation of perceived causal factors. *Journal of Sport Behavior, 23*, 1.

Bray, S. R. (1999). The home advantage from an individual team perspective. *Journal of Applied Sport Psychology, 11*, 116-125.

Carron, A.V., Loughead, T.M. & Bray, S.R. (2005). The home advantage in sport competitions: Courneya and Carron's (1992) conceptual framework a decade later. *Journal of Sports Sciences, 23*, 395-407.

Cashmore, Ellis. (2002). *Sport Pyschology: The Key Concepts*. 10-15, 130-131, 242-244.

Courneya, K.S., & Carton, A. V. (1992). The home advantage in sport competitions: a literature review. *Journal of Sport and Exercise Psychology, 14*, 28-39.

Dennis, P. W., Carton, A.V., & Loughhead, T.M. (2002). The relationship between game location and decisions by National Hockey League officials. *Avante, 8*, 67-73.

Duffy, L.J., & Hinwood, D.P. (1997). Home field advantage: Does anxiety contribute? *Perceptual and Motor Skills, 84*, 283-286.

Dunn, J.G.H., & Dunn, C.J. (1999) Goal orientations, perceptions of aggression, and sportspersonship in elite youth male ice hockey players. *The Sport Psychologist, 13*, 183-200.

Forrest, D., Beaumont, J., Goddard, J., &Simmons, R. (April 2005). Home advantage and the debate about competitive balance in professional sports leagues. *Journal of Sports Sciences, 23*, 439-447.

Gano-Overway, L., Guivernau, M., Magyar, T. M., Waldron, J., & Ewing, M. (March 2005). Achievement goal perspectives, perceptions of the motivational climate, and sportsmanship: individual and team effects. *Psychology of Sport and Exercise, 6*, 215-232.

Henningsen, D., and Henningsen, M. (2001). A test of social facilitation as a predictor of home performance advantage. *Journal of Sports and Recreation, 1*.

Jurkovac, T. (1985). Collegiate Basketball Players' Perceptions of the Home Advantage. *Arena Review, 11*, 19-27.

Loughhead, T.M., Carron, A.V., Bray, S.R., & Kim, A. (2003). Facility familiarity and the home advantage in professional sports. *International Journal of Sport Psychology and Exercise Psychology, 1*, 264-274.

McGuire, E.J., Courneya, K.S., Widmeyer, W.N., & Carton, A.V. (1992). Relationship between game location and aggression in professional hockey. *Journal of Sport and Exercise Psychology, 14*, 148-158.

Moore, J.C., & Brylinksy, J.A. (1995). Facility familiarity and the home advantage. *Journal of Sport Behavior, 18*, 302-311.

Nevill, A. M., Balmer, N. J., & Williams, A. M. (2002). The influence of crowd noise and experience upon refereeing decisions in football. *Psychology of Sport and Exercise, 3*, 261-272.

Schwartz, B., & Barskey, S. (March 1977). The home advantage. *Social Forces, 55*, 641-661.

Tenenbaum, G., & Kirker, B. (2003). Methodological principles in the study of behaviors in team sports: an example of aggressive acts in ice hockey and basketball. *The Psychology of Team Sports*, 21-53.

Terry, P.C., Walrond, N., & Carton, A.V. (1998). The influence of game location on athletes' psychological states. *Journal of Science and Medicine in Sport, 1*, 29-37.

Thout, S.M., Kavouras, S.A., & Kenefick, R.W. (1998). Effect of perceived ability, game location, and state anxiety on basketball performance. *Journal of Sport Behavior, 21*, 311-321.

Wright, E., Voyer, D., Wright, R., & Roney, C. (1995). Supporting audiences and performance under pressure: the home-ice disadvantage in hockey championships. *Journal of Sport Behavior, 18*.

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Table 1

Single Season Data - Results from Logistic Regressions (Dependent Variable: Outcome)

Independent Variable	β	*p*
Location	-.382	.081
Attendance	.001	1.00
Attendance percentage	.012	.046
Total penalties	.030	.567
Opponent penalties	.069	.169

Table 2

Single season data - Results from Linear Regressions (Dependent Variable: Goals For)

Independent Variable	β	*p*
Location	.071	.686
Attendance	5.416^{-5}	.316
Attendance percentage	.013	.007

Table 3

Single season data -- Results from Linear Regressions (Dependent Variable: Goals Against)

Independent variable	β	*p*
Location	-.060	.738
Attendance	2.18^{-5}	.558
Attendance percentage	-.012	.013

Table 4

Single season data -- Results from Linear Regressions (Independent Variable: Attendance)

Dependent Variable	β	*p*
Penalties	2.513^{-5}	.774
Nonaggressive penalties	2.217^{-5}	.585
Aggressive penalties	3.788^{-5}	.427
Aggressive-violent penalties	-2.725^{-5}	.364
Violent penalties	-9.88^{-6}	.159

Table 5

Single season data -- Results from Linear Regressions (Independent Variable: Attendance Percentage)

Dependent Variable	β	*p*
Penalties	.015	.024
Nonaggressive penalties	.006	.093
Aggressive penalties	.010	.021
Aggressive-violent penalties	-.001	.054
Violent penalties	.001	.928
Opponent penalties	.014	.041

Table 6

Four-year data – Descriptive Statistics

Variable	N	Minimum	Maximum	Mean	Standard Deviation
Home wins	12	27	59	40.58	10.466
Home losses	12	15	36	26.58	6.694
Away wins	12	14	35	26.42	5.807
Away losses	12	19	53	37.25	10.367
Home goals for (HGF)	12	167	342	243.17	51.050
Home goals against (HGA)	12	141	312	204.17	50.655
Away goals for (AGF)	12	151	302	192.58	43.002
Away goals against (AGA)	12	158	286	220.58	43.719
Average of HGF	12	2	5	3.38	.699
Average of HGA	12	2	4	2.84	.703
Average of AGF	12	2	4	2.68	.596
Average of AGA	12	2	4	3.06	.608

Table 7

Four-year data -- One Sample t-tests on the conference's winning percentage by location and the overall home ice advantage

Variable	Mean	Standard Deviation	*t*	*p*
Home advantage				
(home winning % - away winning %)	.1753	.09096	6.675	<.001
Home winning percentage	.5982	.11422	18.143	<.001
Away winning percentage	.4229	.11542	12.694	<.001

Table 8

Paired Sample t-tests for Goals For Average (GFA) and Goals Against Average (GAA)

Variable	Mean	Standard Deviation	*t*	*p*
Home GFA	3.38	.699	--	--
Away GFA	2.68	.596	--	--
Home GFA-Away GFA	.708	1.027	2.388	.036
Home GAA	2.84	.703	--	--
Away GAA	3.06	.608	--	--
Home GAA-Away GAA	-.225	.881	-.884	.395