



What's *Really* Behind Home Field Advantage?

IN ALMOST EVERY SPORT, EVERYWHERE ON EARTH, THE VISITING TEAM LOSES MORE OFTEN THAN NOT. YOU PROBABLY THINK YOU KNOW WHY. AND YOU'RE PROBABLY WRONG

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Illustration by SEAN MCCABE

FOR ALL THE CONVENTIONAL SPORTS WISDOM THAT can be deconstructed, disproved or called into question, home team advantage is no myth. Indisputably, it exists—and it's remarkably consistent. Across all sports and at all levels, from Japanese baseball to Brazilian soccer to the NFL, the team hosting a game wins more often than not.

The size of the advantage is remarkably stable in each sport too: The home team's success rate has been almost exactly the same in the last decade as it was 50 and even 100 years ago. And home field advantage is the same *within* any sport, no matter where it is played. The home winning percentage in Arena Football is essentially the same as in the NFL. The home field advantage in the NBA is a virtual carbon copy of that in the WNBA. In professional soccer, the sport with the greatest home field advantage, the host teams in three of Europe's most popular leagues—England's Premiership, Spain's La Liga and Italy's Serie A—win about 65% of the time. In 40 other soccer leagues in 24 countries, the home field advantage hovers around 63%.

In the NBA an astounding 98.6% of teams fare better at home than on the road. That means that in most seasons *all* NBA teams have better home than road records. In hockey and soccer, more than 90% of the teams win more at home than on the road. Even in the

Not only do home teams win more often, but the success rate in each sport has also remained consistent over the last decade—and even the last century.

HOME FIELD ADVANTAGE

NFL and major league baseball, the leagues with the lowest home winning percentages, more than 75% of teams do better at home.

It's little wonder, then, that leagues reward the best teams in the regular season with home field advantage in the playoffs—it's a hell of an incentive to win those dreary midseason games. There is also considerable economic incentive for home teams to win as often as possible. The better the home team plays, the more likely fans are to buy tickets and hats and T-shirts and renew their luxury-suite leases; the more likely corporations are to buy sponsorships; and the more likely local television networks are to bid for rights fees.

That the home field advantage exists is undeniable. But *why* does it exist?

It's not for the reasons you might think.

[MYTH #1]

HOME TEAMS WIN BECAUSE THEIR CROWDS BOOST PLAYERS' PERFORMANCE

It's reasonable to think that you play better when you're cheered, your favorite songs blare on the P.A. system and your pregame introduction is accompanied by fireworks. But fans' influence on the players is actually pretty small. How do we know this? One of the problems with testing the effect of crowd support is that almost every feat in team sports is a function of not only the player and the crowd but also the player's teammates, the defender, the defender's teammates and the referee. How do we isolate the crowd effect? We need to look at an area of the game divorced from all the other factors, such as free throws. Free throws are an isolated interaction between one player—the shooter—and the crowd that is trying to distract him.

Over the last two decades in the NBA, encompassing more than 23,000 games, the free throw percentage of visiting teams has been 75.9%, and that of home teams has been . . . 75.9%. Are these shooting percentages any different at different points in the game—say, during the fourth quarter or in overtime, when the score is tied? No. Even in close games, when home fans are trying their hardest to distract the opponents and exhort the home team, the percentages are identical.

What about other sports? In hockey there's a rough equivalent to free throws: the shootout, in which each team chooses three players to shoot one-on-one at the goalie. In the 624 NHL games decided by shootouts from 2005–06 (when the shootout was instituted to settle ties at the end of overtime) to '08–09, home teams won 308 (49.4%) and

away teams won 316 (50.6%). In other words, for shootouts—held when you'd expect the crowd to be *especially* involved—the NHL's significant home ice advantage *evaporates*.

In the NFL we could look at punters and kickers. But it turns out that yards per punt are identical for home and visiting punters (about 41.5 yards). Likewise, field goal success from the same distance and extra-point accuracy are identical for kickers at home and on the road (about 72%). Of course, you could question whether punters and kickers have the ball long enough to be affected by a rabid crowd. O.K., then, let's take quarterbacks. Extreme crowd noise might be expected to distract visiting quarterbacks, but actually it doesn't seem to. In fact, visiting teams pass slightly *better* than home teams.

In baseball the closest we can come to measuring the crowd's influence is to examine the pitcher. Not his ball-strike count—influenced, as it is, by the batter, the umpire and the game situation—but his velocity, movement and placement. Data from the MLB.com technology Pitch f/x, tracking more than two million pitches over the last three years, show that major league pitchers are as accurate at home as they are on the road, throwing a ball within the strike zone 44.3% of the time at home and 44.5% of the time on the road. They also throw with the same velocity—87 mph on average when the ball crosses the plate—and movement.

We can also use the Pitch f/x data to help gauge whether playing at home has any impact on batters. The data show that when a player swings at a pitch, in or out of the strike zone, his probability of hitting the ball is exactly the same at home and away. *Hey-batter-batter-batter-swing?* Sorry. He's going to do it just as well whether you're chattering or not.

[MYTH #2]

HOME TEAMS WIN BECAUSE THE RIGORS OF TRAVEL DOOM VISITORS

The rigors of the road exist, of course, but they don't underpin the home court advantage. Why? Consider what happens when teams from the same or a nearby city play

each other—such as when the Lakers face the Clippers (who share their NBA arena), or when the NHL's Rangers play the Islanders: The designated home teams have the exact same advantage they do in all the other games they host. Likewise, road teams don't lose more often when they travel greater distances.

In baseball, too, in games involving teams from the same metro area (interleague play between the Cubs and White Sox, Yankees and Mets, Dodgers and Angels, Giants and A's), the home teams win at exactly the same rate at which they normally do. The fact that home field advantage has been remarkably constant over the last century—it was virtually the same in MLB from 1903 to '09 as it was from 2003 to '09—suggests that teams jetting on chartered flights have no more success than the teams that traveled to games in Pullmans.

Nor does travel play much of a role in the NFL's home field advantage. Teams play only one game per week and in fact usually depart for a game a few days in advance to acclimate themselves. As in the other sports, when nearby teams play—Raiders versus 49ers, Giants versus Jets, Ravens versus Redskins—the home field advantage holds firm at its normal level.

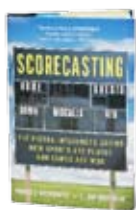
[MYTH #3]

HOME TEAMS WIN BECAUSE THEY BENEFIT FROM A KINDER, GENTLER SCHEDULE

In the NBA the vast majority of back-to-back games are played by visiting teams, which is exhausting for the players. Could that help create home court advantage? Yes. Of the 20 or so back-to-back games NBA teams play each season, an average of 14 are on the road. By our calculations, teams win only 36% of those 14 games. That translates into one or two additional games that teams lose each season on the road.

It's not just back-to-back games, either. Home teams generally have more off days within the same time span, such as the last three days, the last week or even the last two weeks. All this takes its toll on visitors. We estimate that about 21% of the NBA's home court advantage is attributable to scheduling.

Scheduling is less of an issue in baseball; teams play in three- and four-game series. When teams travel, they stay put in the visiting city, and the consecutive games have less of a physical impact on the athletes. And in the NFL, the one league that unapologetically strives for parity, there is no evidence of scheduling bias.



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HOME FIELD ADVANTAGE

In college sports, by contrast, there's abundant evidence. College boosters might claim that the exceptionally high home winning percentage in NCAA sports is a consequence of rabid school spirit, but what really drives it is the scheduling of weak opponents early in the season. We found that schedule padding accounts for roughly half of the home team advantage in college football. If we adjust for the quality of teams—or look at in-conference games, for which the conferences and not the big schools set the schedule—home winning percentage drops from 64% to 57%. Amazingly, that 57% is almost the same rate at which home teams win in the NFL and Arena Football.

So scheduling bias gets us only so far. It accounts for half of the home field advantage in college football and basketball and partially explains the home field advantage in the NBA and the NHL. In baseball, soccer and the NFL, however, it doesn't provide any explanation at all.

[MYTH #4]

HOME TEAMS BENEFIT FROM UNIQUE "HOME" CHARACTERISTICS

An NBA court is an NBA court, and an NHL rink is an NHL rink. The games are played indoors, in climate-controlled environments. In the NFL, however, the climate and playing conditions can vary immensely. Is the league's home field advantage influenced by teams tailoring their rosters to the weather?

No. Much as broadcasters talk about those poor Dolphins faltering on the redundantly "frozen tundra" in Green Bay, climate is largely irrelevant in the NFL. After studying data from nearly 6,000 games between 1985 and 2009, we found that cold-weather teams are no more likely to win at home when the weather is brutally cold, nor are warm-weather teams more likely to win at home when the temperature is awfully hot.

What about baseball? After all, not only do the playing conditions vary, but each stadium is also unique. Don't the home players get an advantage from being more familiar with their ballparks' idiosyncrasies? What about the notion that baseball teams win more games at home because they tailor their rosters to their fields' dimensions? We

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looked at the most obvious case—"hitter-friendly" ballparks versus "pitcher-friendly" ballparks—and found that teams in hitters' parks, presumably stacked with sluggers, don't outthit their visitors by more than teams in pitchers' parks outthit theirs. We also found that teams from hitters' ballparks hit no better on the road than teams from pitchers' parks. That is, the Rockies (hitters' park) hit as well as the Mets (pitchers' park) when each team plays the Cardinals in St. Louis.

Nor do deception and "dark arts"—sign stealing, groundskeeping shenanigans, locker room sabotage—help explain baseball's home advantage. At one time they might have, but because of standardized league rules, surveillance technology and stiff punishments for cheating, it would be hard to pull off this kind of skulduggery today.

[THE BIG QUESTION]

SO WHAT REALLY DRIVES HOME FIELD ADVANTAGE?

Every sports fan believes that officials make bad calls against his or her team. The home crowd voices this displeasure the loudest, emitting cries that range from the passably clever ("Ref, if you had one more eye, you'd be a Cyclops!") to the troglodytic ("You suck!"). We've found that officials *are* biased, but not against the louts screaming epithets at them. They're biased *for* them—and the bigger the crowd, the worse the bias. In fact, *officials' bias is the most significant contributor to home field advantage.*

Let's start by determining how to measure referee bias. We looked for a component of a sport that the refs control and that isn't influenced by players. We found it in soccer. But if it hadn't been for a diligent grandmother in Spain religiously recording years of Sunday-evening matches, we might not have discovered this bias at all.

In soccer the referee has discretion over the addition of extra time, referred to as "stoppage time," at the end of the game to make up for suspensions of play for injuries, penalties and substitutions. Using handwritten notes that his elderly mother had made while watching matches in her living room, Natxo Palacios-Huerta, a professor at the London School of Economics, joined with two colleagues from the Univer-

sity of Chicago, Luis Garicano and Canice Prendergast, to study the officials' conduct. Examining 750 matches from La Liga, the researchers determined that in close matches in which the home team was ahead, the referees reduced the extra time significantly. In close games in which the home team was behind, the referees lengthened the injury time. If the home team was ahead by a goal at the end of regulation, the average injury time was barely two minutes, but if the home team was behind by a goal, the average injury time was four minutes. Sure enough, when the score was tied the average injury time was right around three minutes.

What happened when the home team was *significantly* ahead or behind? There was no bias at all. The extra time was roughly the same whether the home team was ahead by two goals or more or behind by two goals or more. This makes sense. A referee has to balance the benefit of any favoritism with its costs: harm to his reputation, media scrutiny and potential reprimands. If the extra time wasn't going to affect the game's outcome, why stretch or condense it, right?

This wasn't unique to Spain. Researchers found the same injury-time bias in the Premier League, Serie A, Germany's Bundesliga, the Scottish league and MLS. Soccer referees also award more penalties in favor of the home team. Looking at more than 15,000 matches in the Premier League, La Liga and Serie A, we found that home teams receive many fewer red and yellow cards. Suddenly it isn't so surprising that the home team in soccer wins nearly 63% of its games.

But surely U.S. sports wouldn't be subject to the same referee bias.

[OR WOULD THEY?]

LET'S START WITH BASEBALL

It turns out that the most significant difference between home and away teams is that home teams strike out less and walk more—a lot more—per plate appearance. Balls and strikes are the domain of the home plate umpire. Could he be biased toward the home team? This would explain the differences in strikeouts and walks despite the lack of any difference in hitting and pitching. But walks and strikeouts are not the right statistics to measure, because some walks are intentional and many strikes occur when a batter swings and misses or fouls off a ball. Those don't require any judgment on the part of the umpire. A better metric is *called* balls (eliminating intentional walks) and strikes—

pitches that don't involve swings by the batter. It turns out that home batters receive far fewer strikes per called pitch than away batters do.

It's even more apparent when we look at called strikes and balls at different points in the game. A wizard sabermetrician, Tom Tango, devised the Leverage Index to measure the relative importance of game situations. A leverage index of 1 is the average situation; an index of 2 means the situation is twice as crucial. For example, down by four runs with two outs and nobody on in the bottom of the ninth, the game

isn't in much doubt, and the leverage index is 0.1—one tenth as crucial as the average situation. Down by one run in the bottom of the ninth with two outs and the bases loaded, the leverage index is 10.9, almost 11 times more crucial than the average situation.

Using the index, we found that when the game is not in much doubt, the home team advantage in receiving fewer called strikes and more balls goes away. But the called-strike advantage for home teams grows considerably as the game situation gets more important.

Now let's look at other calls that fall under the domain of the umpires, such as stolen bases and double plays. We found that home teams are more likely to be successful when stealing a base and when turning a double play. In addition the success rates of home teams in scoring from second base on a single or from third on an out—typically close plays at the plate—are much higher than they are for their visitors in high-leverage situations.

But the most damning evidence of umpire bias comes, ironically, from an attempt by the major leagues to police it. A digital technology called Umpire Information System (UIS), from QuesTec, was introduced in 2001 to monitor the accuracy of umpires. According to MLB, QuesTec was installed in six ballparks in the first year; by the time it was discontinued in 2008, 11 parks had the technology. With two cameras positioned at field level and two in the upper deck, QuesTec tracked where the ball crossed the plate. We compared all pitches, about 5.5 million of them, from 2002 to '08 in stadiums using QuesTec versus those without it. What did we find? Called strikes and balls went the home team's way only in stadiums *without* QuesTec—that is, ball-

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parks where umpires were not being monitored. We also found something surprising. When QuesTec was watching them, umpires called more strikes and fewer balls on *home team* batters. In short, when umpires knew they were being monitored, the advantage swung to the visiting team.

If QuesTec is our smoking gun in the case to prove umpires' home team bias, Pitch f/x provides the ballistic support. We found that pitches in the *exact same location* are called differently for home and away batters. According to data we examined on terminal pitches—ones that result in either a strikeout or a walk—516 more strikeouts are called on away teams and 195 more walks are awarded to home teams over the course of a season thanks to umpire bias. And this doesn't take into account errant calls made earlier in the pitch count that could confer an even greater advantage for the home team.

Calculating the value of a walk and a strikeout in various game situations, we found that each home team gains 7.3 runs per season thanks to the plate umpire. Cumulatively, home teams outscore their visitors by only 10.5 runs in a season. Thus more than two thirds of the home field advantage comes by virtue of the home plate umpire's bad calls.

We can't expect umpires to be perfect, and in fact they call strikes and balls correctly 85.6% of the time, according to QuesTec. But the errors they do make don't seem to be random. They favor the home team.

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[NOW, FOOTBALL]

IS IT THE SAME IN THE NFL?

For evidence of official bias in the nation's most popular sports league, it makes sense to start with penalties. Home teams receive fewer penalties than away teams (about half a penalty less per game) and are penalized fewer yards per call. Of course, this does not prove officials are biased. Away teams might commit more fouls and play more sloppily or more aggressively. But when we look at more crucial situations in the NFL, we find that the penalty bias is exaggerated. The more valuable penalties, those which result in first downs, also favor the home team.

The most compelling evidence of referee influence in the NFL comes from instant-

replay challenges, which were instituted in 1999 and were followed by a decline in the home team success rate from 58.5% (1985–98) to 56% (1999–2008). Coincidence? We can start by looking at turnovers. Before instant replay home teams enjoyed more than an 8% edge in turnovers, losing the ball far less often than road teams. When replay challenges came along, the turnover advantage was cut in half!

We can also distinguish between fumbles lost and fumbles retained. The home team does not fumble less often than the away team, but before replay challenges the home team *lost* fewer fumbles than the away team. After instant replay this advantage miraculously disappeared. In close games, when referees' decisions *really* matter, home teams enjoyed a healthy 12% advantage in recovering fumbles before instant replay was installed. Afterward, that edge also vanished.

If away teams are indeed getting more bad calls than home teams, we should see more of their calls being overturned on instant replay. And they are. We looked at the results of nearly 1,300 instant-replay challenges from 2005 to '09 and found that away teams are more successful in overturning calls than home teams are, if only by a modest margin (37% versus 35%).

These statistics are misleading, though, because referees are less likely to make biased judgments when the game is no longer in doubt. So what happens if the home team is behind? Then its challenges are successful 28.4% of the time, while challenges by the away team are successful 40.0% of the time. Thus away teams seem to get more than their fair share of bad calls when they are winning, which is when bad calls would be most valuable to the home team.

Could referee bias explain a large part of the home field advantage in football? Absolutely. Again we see a dramatic reduction in the home team's edge when instant replay is introduced. Yet instant replay affords each team only three incorrect challenges per game and is limited to certain circumstances. Clearly other calls are not being challenged that could go the home team's way, such as penalties. The fact that home teams in football have better offensive stats could be the result of getting more favorable calls and fewer penalties and committing fewer turnovers. If you play at home and sense that you're less likely to get called for a penalty, you may be more inclined to block more aggressively or challenge a receiver.

HOME FIELD ADVANTAGE

[THE REASON]

WHY OFFICIALS FAVOR THE HOME TEAM

First, let's be clear: There is no evidence that officials are *instructed* to rule in favor of the home team. We believe that the vast majority, if not all, of them are upstanding professionals doing their best to be fair. All things considered, they do a remarkable job.

They are not, however, immune to social pressure, and that's where we think the explanation for home team bias lies. Referees are, ultimately, human. In test after test, psychologists have found that social influence has a powerful effect on people's behavior and decisions—*without their even being aware of it*. Psychologists call this influence *conformity*, because it causes an individual's opinion to conform to a group's opinion. In other words, when humans are under enormous stress—say, making a crucial call with a rabid crowd yelling a few feet away—it is natural for them to want to alleviate it. Making snap judgments in favor of the home team is one way to do that. Umpires also may be taking cues from the crowd when they're uncertain. They don't know whether that tailing 95-mph fastball crossed the strike zone, but the crowd's reaction may change their perception.

In that case umpires aren't consciously favoring the home team; they are doing what they believe is right. In trying to make the right call, they conform to a larger group's opinion, swayed by thousands of people witnessing the exact same play they did.

Let's look at our previous results on referees through the lens of psychology and our understanding of the human propensity to conform. The stoppage time in soccer? It probably reflects the ref's desire to please the crowd—and in some cases preserve his safety. The strike-ball discrepancy in baseball and disparities in fouls and turnovers in hoops, hockey and football may also be the result of what psychologists call “informational conformity” in the face of social pressure, using the crowd as a cue to resolve uncertainty.

If this is true, psychology suggests that the larger and more passionate the crowd is, and the more ambiguous the situation is, the greater the home favoritism should be. Recall the original study of La Liga. The authors found that the bias in regard to stoppage time was greater when the crowd was larger. But even more interesting was a study conducted in Germany, where many soccer stadiums have running tracks that act as moats, separating the stands from the field

of play. In those stadiums the referees are more removed from the fans. Guess what? The bias that refs exhibit for the home team is cut in half.

What about the extra walks awarded to home teams and the extra strikeouts called on away teams by home plate umpires? These also occur predominantly in high-attendance games. The highest fifth of attended games account for about half of the entire strikeout and walk advantage given to home teams each season.

In the NBA crowd size also affects the home-away differences, particularly with more ambiguous calls. Traveling is whistled 15% less often against home than away players, but at the most attended games the home team is 28% less likely to be called for traveling. And even in the NFL, in which most games are sold out, the home-away discrepancies in penalties and turnovers increase with crowd size. In virtually every sport the home advantage is significantly larger when the crowd is bigger.

In the least attended games in each sport, conversely, the home field advantage all but vanishes. In baseball, if you look at the 20% of games that are least attended, the home field advantage is only 50.7%. In the NBA the least attended games are won by the home team only 55% of the time and the most attended games 69% of the time. In the NHL the home team wins only 52% of the time in the lowest attended games but 60% of the time in the highest attended games. And in European soccer the home team wins 57% of the time in the lowest attended games and an astonishing 78% of the time in the highest attended matches.

Still not convinced by the psychological explanation for referee bias? Consider a study performed in 2001. Researchers made videos of soccer matches, focusing on tackles, and showed them to two groups of referees. The first group was shown the tackles with the crowd noise audible. The second group was shown the same tackles with the crowd noise muted. The referees who watched with the crowd noise were much more likely to call the tackles *with* the crowd. That is, tackles against the home team were more likely to be called fouls, and tackles

by the home team were less likely to be called fouls. The referees who viewed the tackles in silence showed no bias.

Not only that, but the referees watching with sound also reported more anxiety and uncertainty regarding their calls, consistent with the stress they felt from the crowd. Imagine how much more intense that stress would have been if they were on the actual field of play.

But perhaps the most persuasive evidence for the effect of crowds on referees occurred when *no fans* were present. On Feb. 2, 2007, supporters of two soccer clubs in Italy—Catania and Palermo—clashed with each other and police. Following the episode, the Italian government forced teams with deficient security standards to play their home games without any spectators. Two economists (and soccer fanatics) from Sweden, Per Pettersson-Lidbom and Mikael Prikis, collected data from 21 soccer matches that were played before empty bleachers. What they found was amazing. When teams played without spectators, the home bias in favorable calls dropped by 23% in fouls, 26% in yellow cards and 70% in red cards. The players, on the other hand, performed the same whether or not there was a crowd.

In the end referee bias explains not only the home field advantage but also why the home team's success rate hasn't changed in more than a century. Although sports have altered their rules—raising and lowering the pitcher's mound, introducing a shot clock and the three-point line—the official's role in the game hasn't changed much. Umpires still call balls and strikes; referees still call fouls and penalties; and they are still human beings, none of them immune from human psychology. Although we will never be able to measure or test all the decisions an official makes, if we can see that some of them are biased in favor of the home team, it's likely that other judgments we can't see are also going the home team's way. Think of the father who comes home early from work and catches his teenage daughter kissing her boyfriend. He's upset about the kiss, but he's more upset about what else she might be doing when he isn't looking. □

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