SEEING STARS: MATTHEW EFFECTS AND STATUS BIAS IN MAJOR LEAGUE BASEBALL UMPIRING

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ABSTRACT

Despite a growing body of research about the Matthew Effect and status, we still know little about the cognitive biases that underlie the ability of high status actors to accumulate advantages over their lower status peers. In this paper we test the assumption that actors' status biases evaluators' judgments made about those actors' quality. We posit that high status actors benefit from over-recognition of quality, wherein evaluators are more likely to erroneously attribute high quality to an actor's performance, and that evaluators systematically and erroneously under-recognize quality in low status actors. Using unique data from Major League Baseball umpires' evaluation of pitch quality, which allow us to observe the difference in a pitch's objective quality and in its perceived quality as judged by the umpire, we show that umpires are more likely to over-recognize quality in high status pitchers and under-recognize quality in low status pitchers. Ambiguity and the pitcher's reputation as a "control pitcher" moderate the effect of status on umpire judgment. Further, we show that umpire errors resulting from status bias lead to actual performance differences, decreasing the probability that high status pitchers allow players to get on base and increasing the likelihood of winning the game.

Keywords: Status, Cognition, Bias, Performance

Authors in alphabetical order. We benefitted from helpful comments by Jeremy Freese, Bruce Kogut, Ko Kuwabara, Damon Phillips, Lauren Rivera, Michael Sauder, and Olav Sorenson.

Sociologists have long understood status to be an indicator of hierarchical position and prestige that helps individuals and organizations procure resources and opportunities for advancement (e.g., Whyte 1943; Podolny 2001). Status markers, like ranking systems in education (Espeland and Sauder 2007) or All-Star selections in professional sports, accentuate quality differences among actors and create greater socio-economic inequality. Research on status characteristics has advanced our understanding of how status hierarchies emerge and persist, and how status becomes associated with particular characteristics such as race and gender (Berger, Rosenholtz, and Zelditch 1980). In contrast, the question of how status hierarchies, once developed, lead to performance differences among individuals within that hierarchy has received relatively less attention in this literature. Variation in ultimate performance due to status differences is, of course, the central problem of interest in Merton's Matthew effect. Merton (1968) postulated that high status individuals experience performance advantages relative to their peers due to the increased recognition given to their high quality output, which consequently leads to more opportunities to excel and more resources that can be used to improve future performance.

Despite ample evidence that actors experience differential rewards for having high status, scholars studying the Matthew Effect have not thoroughly examined the social psychological processes that account for status-based performance differences. Underlying the Matthew Effect is an assumption that individuals are biased to positively evaluate high status individuals, and Merton himself proposes to develop a "conception of ways in which certain psychosocial processes affect the allocation of rewards" (p. 56). However, despite the accumulation of research on status in sociology, we have little evidence of this bias. Though bias is implicit in the status advantages seen in a wide range of contexts, much of the literature on status has ignored the social psychological foundations of this bias, instead focusing on the origins of status orders and hierarchies (e.g., Webster and Hysom 1998; Ridgeway and Correll 2006), on the psychological rewards of status attainment (e.g., Willer 2009; Anderson et al. 2012), or on outcomes for individuals and organizations such as the accumulation of power, price and wage differentials, and other economic benefits (Podolny 1993; Benjamin and Podolny 1999; Thye 2000; Correll et al. 2007; Bothner, Kim, and Smith 2011; Pearce 2011). In a recent review paper, Sauder, Lynn, and Podolny (2012) even argue that the psychological bias underlying status deference is unobserved and assumed, thus creating a need for closer inspection of instances where status bias is manifest.

The lack of evidence of status bias is due, in part, to the empirical and conceptual challenges of establishing what the correct amount of recognition should be given to an actor's performance. Disentangling status and quality has always been an empirical challenge (see Azoulay, Stuart and Wang 2013 for a discussion and resolution of the endogeneity issue), but establishing what actors "should" receive in rewards for their performance poses an additional hurdle in determining the presence of bias. For example, imagine a low and high status scientist receiving 10 and 100 citations for the exact same discovery. We have clear evidence of a status advantage, but to identify bias, we must be able to answer the question: is the fundamental value of a scientific discovery worth 10 citations or 100 citations? While prior studies have convincingly shown that higher status actors receive more recognition than low status actors (e.g., Simcoe and Waguespack 2010), less is known on whether higher status actors are more or less likely to receive amounts of recognition that deviate from what they deserve given their performances. Because of this empirical challenge, most research on status and inequality can only observe the actual outcomes of evaluative processes but lack convincing evidence that the evaluative processes are actually biased by status differences. Even studies that show a clear relationship between a diffuse status characteristic, such as ethnicity, and performance outcomes cannot observe whether the outcomes were determined by biased evaluations or whether they were due to differences in opportunities and resources (e.g., Yuchtman-Yaar and Semyonov 1979). In short, measurement challenges have made it difficult to isolate the social psychological mechanisms that underlie status advantages.

Another reason that the literature on the Matthew Effect has ignored sources of status bias is because the analytic focus of the perspective is usually on the objects of evaluation (e.g., wine; films) rather than on the evaluators themselves. Thus, our understanding of the Matthew Effect is largely driven by egocentric considerations – e.g., high status actors get more resources, which makes it less costly to produce high quality performances – and ignore the altercentric aspects that stem from their evaluators' assessments of performance. Understanding status advantages through the lens of bias shifts attention towards the evaluator, and the cognitive processes that underlie evaluators' judgments. Relatively little is known about the critical link between human cognition and status influence on evaluations despite recent evidence indicating that status sensitivity is hard-wired and based in cognition, rather than simply learned or acquired through socialization (Deaner, Khera, and Platt 2005 on status in primate societies; Zink et al. 2008 on brain imaging studies documenting the different neurological patterns enacted by status).

The purpose of this paper is to conceptualize how evaluators of quality enact the Matthew Effect through their biased judgments of actors' performances, leading them to reward undeserving performances of high status actors and fail to reward the deserving performances of low status actors. We draw on status characteristics and expectation states theory in social psychology to explain the mechanisms that underlie status bias and that promulgate the Matthew Effect in evaluative situations. We argue that evaluators are biased to recognize quality in high status actors, which can at times lead to erroneous over-recognition of quality. High status structures the expectations of evaluators and leads them to "see" quality in high status actors, especially when a performance is ambiguous. Furthermore, because this status bias is driven by expectations, we argue that an actor's reputation (i.e., history of past performance) moderates the impact of status. High status actors that are also known for certain kinds of performance will receive more favorable evaluations than high status actors who do not carry those same expectations. Thus, an actor's past performance helps to magnify future advantages gained from occupying a high status position inasmuch as the expectations from an actor's reputation and status are aligned. When an actor's reputation is not well aligned with that actor's status, he or she may not benefit from the same expectations.

We utilize a unique dataset of judgments made under uncertainty, coupled with precise data on actual quality that allow us to examine the influence that status has on the rate and direction of status bias. Major League Baseball (MLB) operates four cameras placed around each ballpark to record the locations and trajectories of pitches throughout the game. Leveraging the considerable amount of detail provided by these cameras, we compare the umpiring decision on balls and strikes with the actual location at which the pitch crossed home plate. We find that the evaluator (i.e., umpire) is more likely to recognize quality when quality is absent (i.e., calling a strike when a pitch was actually a ball) if the actor (i.e., pitcher) has high status, measured by the number of All-Star game selections. This is akin to Merton's insight that Nobel Prize winning scientists receive more credit for the same discovery. In addition, we find evidence that umpires are more likely to withhold recognition of true quality (i.e., not calling a strike for a good pitch) when the pitcher is lower in status, a phenomenon that was noted in Merton's original treatment of the Matthew Effect, but has received less attention from scholars. We further find that ambiguity and players' reputations shape the effect of these status biases, consistent with the expectations mechanism. All of the actors involved view umpire accuracy as an important dimension of the sport, as it ensures neutrality and fairness in competition. Our analysis demonstrates, however, that umpires commit errors at a different rate depending on the status of the player.

The results suggest that paying attention to the biases of evaluators provides a more detailed picture of the accumulated advantages enjoyed by high status actors. Our analysis contributes to the literature on status in several different ways. First, by drawing on status research in social psychology, we demonstrate how psychological biases underlie the perpetuation of the Matthew Effect. Second, our study provides a systematic test of status bias in a real world situation, which allows us to more carefully identify the causal effect of status bias on evaluative judgments. Third, while past research has tended to show differences in outcomes for high status actors, our study is among the first to empirically examine differential evaluations among undeserving versus deserving performances by high status actors. Our study is able to show how evaluation bias leads high status players to be rewarded even when their performances are undeserving. And fourth, we show how reputation conditions status effects. Past research has largely ignored the link between these two important concepts and how they combine to produce evaluation differences. The analysis points to a mechanism – performance expectations – that underlies status bias.

STATUS BIAS IN THE EVALUATION OF QUALITY

High status actors tend to experience greater recognition for their performances and attain higher returns compared to lower status peers. Evidence about the Matthew Effect suggests that the differential benefits accrued by high status individuals and organizations result from them receiving greater recognition even when one controls for the underlying quality of the product. For example, wineries associated with higher-status regions can charge higher prices than wineries in lower-status regions for wines with similar ratings (Benjamin and Podolny 1999). Start-up companies backed by prominent venture capital companies have also been shown to secure valuable resources than start-ups with no prominent connections (Stuart, Hoang, and Hybels 1999). Even purportedly objective third-party raters of quality such as the Motion Picture Association of America (MPAA) are more lenient in their classifications for films involving high-status producers and director (Waguespack and Sorenson 2011). Evidence from social psychology similarly indicates that members of groups perceive high status members as being more influential (Anderson et al. 2001; Ridgeway and Correll 2006). Further, evaluators tend to see high status actors as being more technically competent and defer more to them (Berger et al. 1977; Ridgeway and Berger 1986; Sutton and Hargadon 1996). Even diffuse status characteristics, such as ethnicity or gender, can hamper evaluative fairness, causing higher status groups to attain greater recognition and rewards for their contributions compared to lower status groups (e.g., Ridgeway 2011). For example, Yuchtman-Yaar and Semyonav (1979) showed that ethnic prejudice in Israel inhibited Asian-African Jews from obtaining similar levels of success in professional soccer as their European-American counterparts.

The research on the Matthew Effect and status assumes that status has an informational signal, serving as a "filter or screen drawing attention from market actors with lower-status affiliates and toward actors with higher-status affiliates" (Benjamin and Podolny 1999: 565; for a review of status research in economic sociology, see Sauder et al. 2012). High status actors receive more recognition because others assume that their status is associated with quality, which leads them to attract higher levels of attention from evaluators and subsequently more rewards, better relationships, and future opportunities to perform. Such an approach assumes that the effect of status is grounded in semi-rational, deliberative decision-making. Inasmuch as status is a signal of quality (Podolny 2001), it is a key heuristic for ascertaining quality under conditions of uncertainty. But this explanation also assumes that most status enters individuals' decision-making in a fairly conscious and active way and ignores the implicit and passive ways in which status alters evaluative judgments. Signal-based accounts ignore the potential for status to subconsciously bias decision-making.

Research in social psychology has demonstrated that cognitive biases profoundly shape judgment and decision-making (e.g., Gilovich and Griffin 2002; Shah and Oppenheimer 2008). For example, research on gender shows that gender stereotypes situationally influence individuals' perceptions of competence and cause them to modify their behavior (Deaux and Major 1987; Wagner and Berger 1997; Ridgeway 2001). This research suggests that status bias may underlie assessments of quality, which perpetuates status differences in the future. By saying that status biases evaluations, we mean that differences in recognition or evaluative outcomes for two actors (or groups) with identical quality but different status result from implicit and subconscious sensitivities to status by the evaluator. Status bias should lead evaluators to reward undeserving performances and ignore deserving performances.

We argue that status bias, or the extent to which evaluation differs from the fair level of recognition due to status of the evaluated, can take on two distinct forms. First, the status position of the actor can bias the evaluator to provide more recognition than deserved by quality, what we term *over-recognition*. Alternatively, status can lead actors to receive evaluations that are below what is warranted by quality, or *under-recognition*. While star scientists receive more recognition than obscure scientists for similar discoveries (Merton 1968), this could be because the scientific work of star scientists is overrated, while no such halo enhances the attractiveness of the no-name scientists' work (i.e., over-recognition of high-status actors' output). Alternatively, this could be a result of academia missing good work by lower status scientists, and only seeing the true value of a discovery when highlighted by a famous figure (i.e., under-recognition of low-status actors' output).[1]

Drawing on status characteristics theory and expectation states theory (e.g., Berger et al. 1972; Berger et al. 1977; Ridgeway 1991; Wagner and Berger 2002), we argue that status bias is generated by expectations created by certain status characteristics, which tilt evaluators' assessments in favorable directions for high status actors. High status invokes expectations of high performance from evaluators, and subsequent success by high status actors is not considered surprising. On the other hand, low status members of groups such as women or racial minorities evoke lower performance expectations, and thus, a successful task outcome is unexpected and surprising for the observer (Foschi and Foschi 1979; Foschi 1989, 2000). The attribution of unexpected success is more likely to be directed toward external factors rather than the disposition of individuals (Feather 1969), and as a result, observers consciously or unconsciously demand more evidence to conclude that the performance was the result of competence of the individual. More lenient evaluation standards for high status actors, and harsher evaluation standards for lower status actors together create conditions for bias and mistaken judgments by the evaluating actor, even when quality is identical.

EMPIRICAL SETTING AND HYPOTHESES

Sports performance provides an intriguing window to assess the social dynamics of status bias and evaluation, primarily because in certain sports one can observe objective differences in performance outcomes and, in a quasi-experimental fashion, control for other factors that should affect performance, such as skill or situational characteristics. Sports is also a setting in which status is highly visible, and has a considerable influence over the behavior of all actors involved. Baseball in particular is a sport that is steeped in tradition, and status distinctions such as the Hall of Fame and All-Stars have been an integral part of the sports popularity and prominence in American culture (Allen and Parsons 2006). Our analysis focuses specifically on baseball umpires' calls of non-swinging pitches during at-bats in Major League baseball games. From a batter's point of view, the purpose of an at-bat is to hit the ball into play and avoid getting three strikes called against him. In order to get a strike against the batter, a pitcher must pitch the ball through the strike zone—an imagined box extending upward from the batter's knees to slightly below his chest and out from the center of the plate to the plate's edges[2]—without the batter putting the ball into play. The batter, in contrast, hopes to either hit the ball or to advance to first by getting walked when a pitcher misses the strike zone four times during an at-bat. For all non-swinging pitches, the umpire is the arbitrator of pitch quality, determining whether a pitch is a strike or a ball. Specifically, our analysis focuses on the effect of pitchers' status on umpire calls because, as we discuss below, umpires ultimately determine whether a pitcher's pitch is high quality (i.e., a strike), not whether a batter performed well during the pitch, and thus their attention is primarily directed to the pitcher's performance.[3] Thus, our hypotheses are based on the relationship of a pitcher's status and an umpire's evaluation of his pitch.

For a number of reasons, umpire decision-making is an ideal setting to observe status bias in quality evaluation. The first reason is that baseball umpires' evaluations of non-swinging pitches ultimately determine how well a pitcher performs, allowing us to assess the extent to which status bias confers certain advantages on players. In situations in which a batter does not actually swing at a pitch, the umpire gets to decide whether a pitcher threw a strike or not. Unlike other sports in which the officials are mainly responsible for enforcing players' errors or fouls, baseball umpires are directly involved in determining the quality of a player's performance. Depending on the situation, a missed call by the umpire can be the difference between winning and losing a game, and at times, determine the success and failure of a team's season.[4]

Another reason for studying status effects on umpire decision-making is because, despite objective differences in player performance quality, sports officiating is inherently subjected to bias. Across a number of sports, officials exhibit perceptual and cognitive biases that vary their subjective assessments of player performance (e.g., Plessner 2005; Ford, Goodwin, and Richardson 1996). Umpires are called upon to make instantaneous judgments of quality without the benefit of deliberation or rational decision-making. Social factors, such as demographic characteristics or normative influences, may partly shape how officials "see and call" the game (e.g., Rainey et al. 1989), causing officials' judgments to vary by situation. For example, a recent study found that professional basketball officials were more likely to call fouls against players of a different race than they were against players of their own race (Price and Wolfers 2010). Parsons et al. (2011) similarly found that Major League Baseball umpires are less likely to call strikes when the race/ethnicity of umpire and pitcher do not match.

The Parsons et al. (2011) study highlights that baseball umpires are no exception to subjectivity, although Major League Baseball has made recent efforts to closely monitor and evaluate the accuracy of umpires. For most of the history of major league baseball in the U.S., the umpire had nearly complete discretion in determining the boundaries of the strike zone (for a vivid account of the history of the strike zone, see Weber 2009). Even though the rule book clearly stated its dimensions, umpires were notoriously idiosyncratic in how they called the strike zone. Some umpires had much wider zones than others, which gave considerable advantage to the pitcher. Other umpires allowed the strike zone to get bigger over the course of the game if the pitcher was able to accurately hit the edges of the strike zone during the early innings of the game. Although MLB owners may have preferred that umpires called a uniform strike zone, until recently they had no way to monitor umpire performance or enforce uniformity. Hence, umpires had considerable discretion to call pitches as they saw them. The journalist Bruce Weber, who spent several years interviewing and training with umpires, described the tension in creating an accurate judgment:

> [T]he strike zone isn't, nor has it ever been, set in stone, or even sand. It's set in air, a concept, not a thing. It can't be transported from one ballpark to another, but like the memory of a secret code it has to be formulated by each umpire each time he squats behind the catcher, every game, every pitch (2009: 172).

Even though umpires still have discretion to call pitches as they see them, technology now exists that can objectively determine the accuracy of umpires' calls. In the early part of the 2000s, improvements in camera and computer technology made it possible for major league officials to set up a monitoring system that would capture the exact location of a ball at the moment that it crossed the plate, allowing external observers to determine if a pitch was objectively inside the boundaries of the strike zone. By 2007 a camera system was set up in every major league ballpark, giving MLB administrators and owners an unprecedented level of information about the accuracy of their umpires. Relevant for our analysis, using the same data produced by the Pitch f/x system, we can observe the accuracy of umpires directly. More specifically, assuming that umpires judge a pitch's quality by its location in the strike zone, we can verify if an umpire has under-recognized quality (i.e., calling a ball that was really a strike) or over-recognized quality (i.e., calling a strike that was really a ball).

The new monitoring technology revealed what many observers had always believed - umpires are not completely accurate. Our analysis of non-swinging, called pitches indicates that umpires make the wrong call – either type of error – 14.66% of the time. Umpires often make calls at the edges of the strike zone, where accuracy is more difficult to attain. Situational factors, such as the closeness of a score in the final innings of a game, may make umpires more conservative in their calls. And of course as we argue, a pitcher's status in the league, may bias the umpires' judgment of quality.

Anecdotal evidence indicates that players, managers, and umpires alike are well aware of umpire biases. The longtime baseball umpire, Bill Klem, is known for responding to a player who inquired whether a pitch was a strike or a ball, "Sonny, it ain't nothing until I call it." His response is indicative of many umpires' views: they have the authority to call a strike zone the way they see it. Their role of intermediary, as evaluator of quality, is unquestioned. As intermediaries, the league grants them complete decision-making autonomy during the game. A called strike or ball is completely in their control and cannot be reversed by any other official.

Status-based Over-recognition of Quality

Even though umpires seek to create a fair strike zone, and the 14.66% mistake rate suggests that most of the time they are accurate, they are also not immune from social and cognitive biases. Umpires rely on keen perception to discern the borders of the strike zone, but players may influence this perception. Ozzie Guillen, a former player and manager in the league, summarized this bias in a less obsequious tone:

> Everybody has their own strike zone…This year they come to us and say, We're gonna call the strike zone from here to here –' he sliced the air at the knees and the letters – 'but they have to say something every year to make us think they're working. But if Roger Clemens or Pedro Martinez or Greg Maddux, Tom Glavine, is pitching, it's a strike. Jose Cruz pitching? It's a ball. Same way for hitting. You're fucking Wade Boggs? That's a ball. You're Frank Thomas? That's a ball. Ozzie Guillen hitting? Strike, get the fuck out (as quoted in Weber 2009: 179).

In short, Guillen believes that umpires treat high status players, pitchers like Maddux and Glavine and hitters like Boggs and Thomas, differently than players with lower status. More specifically, the quote expresses the belief that for an identical pitch, high-status pitchers are more likely to receive a strike call than low-status pitchers. But to what extent are high-status pitchers benefitting from unfairly called strikes? While Guillen's quote implies that high-status players receive undue favoritism, it is unclear whether calling more strikes for high-status pitchers is actually a mistaken judgment or not. High status pitchers, after all, should be expected to throw more strikes.

It is precisely this expectation that high status pitchers will throw strikes that leads to strike calls even when the pitch does not warrant this judgment. Greg Maddux, a renowned pitcher in the National League who spent his prime years playing for the Atlanta Braves, is an example of how expectations can alter the judgment of the umpire. A four-time Cy Young winner and eight-time All-Star, Maddux often received favorable calls from umpires, usually by locating his pitch just outside the lower half of the zone away from the hitter. Bob Gibson, another multiple time All-Star, described the favoritism that umpires showed to Maddux:

> Maddux can throw a pitch three or four inches outside, and the umpire will say, 'Striiiike!' because he's always there. If the umpires call that one, Maddux will come right back to that spot, or maybe stretch it out another half-inch. His control is just that good. The umpires know who's out there, and they have a tendency to give you a break if you have good control and you're always right there where you want to be (Gibson 2009: 163).

Our theoretical propositions suggest that status can have an influence on umpires' tendency to over-estimate the quality of a pitch, calling a strike when the pitch is in fact a ball. Just as the Nobel Prize winning scientist can receive considerable recognition even for a mediocre paper, the high expectations that umpires have for high status pitchers should cause them to expand their strike zone, leading to greater over-recognition of quality. The likelihood that a low quality pitch (i.e., ball) will be seen as a high quality pitch (i.e., strike) should be greater for high-status actors. Therefore, for a pitch in a given location, we hypothesize that:

Hypothesis 1: The higher the status of the pitcher, the more likely the umpire will mistakenly call a real ball a strike

Status-based Under-Recognition of Quality

Merton describes the Matthew Effect as consisting of "the accruing of greater increments of recognition for particular scientific contributions to scientists of considerable repute and the withholding of such recognition from scientists who have not yet made their mark" (1968, p. 56). Much of the existing sociological work on status has focused on the first half of the quote, i.e., the added recognition that high status actors receive due to their position. We noted above that this results in an over-recognition of quality by evaluators. In contrast, relatively little work has been done to affirm the second component of the Matthew Effect, i.e., the withholding of recognition due to a lack of status. A scientist affiliated with a low-status institution, or of a low-status race or gender can come up with a highly important scientific breakthrough, only to toil in obscurity because other gatekeepers in the field either do not notice the discovery, or are highly skeptical that someone of low prominence could produce something of such value.

In the context of baseball, the under-recognition of quality manifests itself when the umpire misses a pitch that was in the strike zone, and calls it a ball. As with the over-recognition of quality, we argue that the status-based expectations held by the umpires will have an impact on how likely this type of error is committed. Evaluators expect to see high quality (i.e., strikes) from a high-status actor, and thus, less evidence is required to convince the umpire that the pitch is indeed high-quality. On the other hand, evaluators expect low quality (i.e., balls) from low-status actors, and stronger evidence is necessary for the evaluator to be convinced that the pitch deserves recognition. Pitches must be closer to the center of the zone for these low-status pitchers for umpires to see them as strikes, and this in turn means that umpires will be more likely to miss pitches that are actually strikes. Thus,

> *Hypothesis 2*: The lower the status of the pitcher, the more likely the umpire will mistakenly call a real strike a ball.

Conditions that Heighten Status-Bias: Reputation and Uncertainty

We argued that the mechanism behind umpire status bias is the expectations held by the evaluators. If expectations are the main driver of bias, then conditions that alter the expectations, or those that make expectations more salient should increase the magnitude of the bias favoring high status actors or disadvantaging low status actors. In particular, we highlight the reputation of the pitcher and the ambiguity surrounding the evaluative task as conditions that should moderate the effect of status bias. Sociologists define reputation as "a characteristic or attribute ascribed to him by his partners," and the empirical basis of an actor's reputation is "his observed past behavior" (Raub and Weesie 1990: 629). Baseball players' reputations, for example, are largely determined by their performance in certain statistical categories, which summarize their past performance and are often used to forecast future performance. Like status, a player's reputation should influence performance expectations. Performance ambiguity refers to the extent to which the quality of an actor's performance is difficult to measure or ascertain. In the case of baseball pitches, performance ambiguity refers to those pitches that are difficult to evaluate because they are located near the edges of the strike zone.

The aforementioned All-Star pitcher Greg Maddux benefitted not just from his skill in locating the ball, but also because he had a reputation among umpires of being a control pitcher who could accurately put the pitch in a desired location. His status as an All-Star pitcher, combined with his reputation for being able to control the location of his pitch, made umpires give Maddux the benefit of the doubt in situations where other pitchers would receive an unfavorable call. If reputation shapes the expectations umpires have about pitch quality, one should expect that reputation will moderate the effects of status. More specifically, having a reputation for consistently locating high-quality pitches (i.e., strikes) should lower the criterion for assessing a high quality pitch even further. Thus, high status pitchers with reputations as "control pitchers" (such as Maddux) are even more likely to benefit from increased over-recognition and reduced under-recognition of quality than other high status pitchers. On the other hand, if a high status pitcher has a poor reputation for being able to control the location of the pitch—a track record of not being able to throw strikes despite being able to get batters out[5] — the pitcher's status advantage may be dampened by the umpire's expectation that the pitcher will not be able to carefully locate the ball around the edges of the strike zone. Taken together, we hypothesize that:

Hypothesis 3: The effect that pitcher status has on the umpire's over-recognition and under-recognition will increase with the pitcher's prior performance (i.e., reputation) in throwing strikes.

We should further expect that umpires assessing high status pitchers will be more generous in their recognition of quality for high status pitchers when the pitch location has greater ambiguity. Podolny and Phillips (1996) argued that high status actors tend to benefit more when there is considerable ambiguity about quality. We argue that one reason for this is that when there is greater ambiguity, evaluators will resort to their prior expectations about performance, giving more latitude to the performance of high status actors. For umpires, pitches that are close to the border of the zone are extremely difficult to judge, leading to a greater reliance on expectations. Thus, we expect:

Hypothesis 4: The effect that pitcher status has on the umpire's over-recognition and under-recognition will increase when the pitch is located closer to the border of the strike zone.

DATA AND METHODS

In order to assess the influence of status on umpires' judgments, we evaluated the outcomes from pitches thrown during Major League Baseball games during the 2008 and 2009 seasons. The unit of analysis is a called pitch. Other types of pitches, including swinging strikes or hits, were not used in the analysis since they did not involve an umpire's judgment. We use pitch-by-pitch data from Major League Baseball games played in the 2008 and 2009 seasons to create our pitch-level and at-bat level variables. We obtained these data about each pitch and at-bat from MLB Gameday, a service that collects and stores data about each pitch from every game played during the regular season, including data about pitch location estimated by Pitch f/x.[6] The unit of analysis is the pitch itself, yet we also merged data about the at-bat, player characteristics, and situational characteristics from other publicly available sources including Baseball Databank[7], Retrosheet[8], and Fangraphs[9] in order to account for contextual determinants' of each pitch. Our data set included 756,848 observations (i.e., pitches), which took place over 313,774 at-bats and 4,914 games.

Dependent variable

Our dependent variable is the occurrence of an umpire mistake. This could take place in two different ways. An umpire over-recognizes quality by mistakenly calling an actual ball a strike.[10] This is equivalent to a Type I error, or error of commission. The second type of mistake happens when an umpire under-recognizes quality when he mistakenly calls an actual strike a ball. This is also known as a Type II error, or error of omission. To operationalize these errors we used data about the location of each pitch and compared those locations against the strike zone. The Pitch f/x system calculates both the location of the pitch as it crosses the plate and the size of the strike zone. To ensure accuracy in their estimates, the Pitch f/x system takes twenty-five pictures of the ball after it leaves the pitcher's hand until it hits the catcher's glove. Thus, the system is not only able to determine the location of the pitch as it crosses the plate, but it also records the velocity, movement, and trajectory of the pitch. For our purposes, we are only interested in the location, although we also use information about movement and velocity to create control variables for the analysis.

A pitch varies in its location relative to the strike zone both vertically and horizontally. To count as an actual strike, a pitch must be located both vertically and horizontally inside the strike zone. To estimate vertical location relative to the strike zone, we compared the height of the pitch as it crosses the plate (labeled *pz* in the Pitch f/x data) with the upper and lower barriers of the strike zone, also measured in feet (labeled *sz_top* and *sz_bottom*, respectively). If the height of the pitch is either lower than the bottom of the strike zone or higher than the top of the strike zone, then the pitch is objectively a ball. To estimate horizontal location relative to the strike zone, we compared the distance of the pitch from the middle of the plate, measured in feet, from the outer boundaries of the strike zone (labeled *px* in the Pitch f/x data). Any pitch that is more than .83 feet from the middle of the plate is objectively a ball. For example, if a strike zone's upper bound is 3.6 and its lower bound is 1.4, and the height of the pitch is 2 and the horizontal location is .05, the pitch would objectively be a strike.

[Table 1 about here]

After we determined whether each pitch was an actual strike or an actual ball, we then compared the actual location to the umpire's call to assess whether he made an erroneous call. Table 1 shows the breakdown of all called pitches from the 2008 and 2009 seasons. The high frequency of pitches that were mistakenly called a ball reinforces the idea that under-recogntion, or the "withholding of recognition" is an equally, if not more, important phenomenon as the over-recognition of quality most associated with Matthew Effects. Because the kind of mistake that an umpire makes is conditional on the type of pitch thrown by a pitcher, we do two different analyses. In the first analysis, we assess the likelihood of under-recognizing quality for all called pitches of actual strikes. In the second analysis we assess the likelihood of over-recognizing quality for all called pitches of actual balls.

Independent variable

The main independent variable in our analysis is the status of the pitcher. Although we include the batter's status in later analyses, we focus on the status of the pitcher since the umpire is evaluating the performance of the pitcher, and not the batter, when assessing whether a pitch is a ball or a strike. We measure status using a pitcher's *number of All-Star appearances* in prior years. All-Star appearances are an adequate measure of status in professional baseball for a number of reasons. Status refers to a privileged position of esteem and distinction that elevates one actor above another (Weber 1978; Simmel 1950; Berger et al. 1972). Status distinctions are often measured through rankings (e.g., Washington and Zajac 2005; Sauder and Espeland 2009) or are made visible through deference patterns in relationships (Podolny 1993); however, the exact way in which status is manifest depends greatly on the context in which it is operating. In professional baseball, the main way in which achievement and esteem is ritually honored is by voting a player into the annual All-Star game – an exhibition game played every July in which each league (National and American) is represented by its sixty-eight "best" players. Players are selected as an All-Star in a combination of fan voting, player voting, and manager selection. Since 2002, fans cast votes for their favorite players and elect seventeen starters to the All-Star game. Managers and players vote to decide who will be the sixteen pitchers and sixteen reserves to fill each position in the field. Finally, the manager for each team fills out the remaining roster spots by choosing players he thinks deserve recognition. Given that All-Star appearances are determined by the accumulated acts of deference (i.e., votes) from fans, players, and managers, this measure is consistent with the sociological view of status as the 'stock' that corresponds to the 'flow' of deference (Podolny and Phillips, 1996).

Although in theory All-Stars are chosen based on the players' performance on the field that year, other factors also account for who is actually chosen. Not all teams receive as much media coverage, have the same level of national visibility, or have the same amount of post-season success, leading to differential valuation of players' abilities.[11] But putting aside team differences, as is true with all measures of status, All-Star selection is also highly inertial and prone to self-reproduction. Once a player has established himself as an All-Star, he is more likely to be chosen in the future. "Perennial All-Stars," which included high status pitchers like Roger Clemens and Roy Halladay, do not have to match the performance of their younger peers to make the All-Star team again. In contrast, players who have never been All-Stars before may need consecutive years of high performance before they will be recognized with the honor. This "loose linkage" between status and quality (Podolny, 1993) further highlights the structural nature of status in the baseball context, and makes it an ideal measure of status as both an enabler and constraint on individual action.

Another way in which being an All-Star confers status is through labeling. Making an All-Star team just once forever labels that player as an All-Star, no matter how his performance varies in the future. The more All-Star appearances a player has, the more prestige associated with the player. Announcers routinely refer to elite players by the number of All-Star appearances they have made, using it as an honorific title. Being a "seven time All-Star" conveys high status in the same way that a Top Ten ranking would communicate the status of an elite university. In this sense, players differentiate themselves hierarchically by their number of All-Star appearances. We should expect status to increase incrementally with number of All-Star appearances. We obtained information about players' All-Star appearances from the online Baseball Almanac, which contains complete histories of players' statistics and accomplishments.[12]

To create the interaction effects used to test Hypotheses 3 and 4 about the role of ambiguity and reputation, we included variables measuring distance from the strike zone and the career performance of the pitcher respectively. A pitch's *total distance from strike zone* is measured as the absolute number of inches a pitch is from the boundaries of the strike zone when it crosses the plate. We also include a square term of total distance to account for the potential non-linearity in the relationship between distance and ambiguity (i.e., ambiguity being much greater the closer a pitch is to the border). To measure the reputation of the pitcher as a control pitcher we include the pitcher's *career average of walks per batter faced* by dividing the number of walks issued over the number of plate appearances from a pitcher's debut to the season prior to the analysis. A high value of this variable indicates an inability of the pitcher to control the location of his pitch. Pitchers that are "wild," or that have lots of walks, are known for lacking control or precision in their pitch location. This is not to say that these pitchers are poor pitchers. Many pitchers attain high status despite having superlative control. For example, Nolan Ryan, the former pitcher of California Angels, Houston Astros, and Texas Rangers, is considered one of the greatest pitchers to ever play and was an eight-time All-Star largely because of his ability to throw a hard and unpredictable fastball. Despite his dominant fastball, Ryan was also notoriously prone to walking batters. Ryan ranks second all-time in the number of batters walked by a pitcher. His lack of control may have even given him an edge over batters because they were afraid of being hit by a Ryan fastball. Often pitchers who strike out many batters also walk a relatively high number of batters due to abnormal movement in their pitches. In short, a high career average of walks per game is not an indicator of poor quality, but it does indicate whether a pitcher lacks sharp control.

Control variables

Situational variables We account for a number of situational factors used in other statistical analyses of baseball that may influence umpires' decision-making. We included a dummy variable indicating if the pitcher's team was the *home team* to account for the ubiquitous home team advantage (Schwartz and Barsky 1977). The at-bat's *leverage* measures the importance of the at-bat to the outcome of the game. Leverage is defined as the expected change in probability of the pitcher's team winning the game relative to the average change in winning percentage for all situations taking into account the inning, score, outs, and number of runners on base. A leverage of 1 means that the at-bat has the same importance as a typical game event, while a leverage index of 2 means that the expected value of possible outcomes swing the winning percentage of the team by twice as much of an random state.[13] Another situational measure that accounts for the urgency of the at-bat is *run expectancy* - the number of runs that are expected to score in that inning based on historical outcomes for identical runners-on-base and outs states. We included an estimate of the *fan attendance* to the game to account for the possibility that higher profile events (and the expected scrutiny associated with these events) will change umpires' accuracy. We also include dummy variables controlling for the *ball count* of the at-bat (e.g., no balls no strikes, three balls two strikes, etc.), and a dummy to indicate whether the batter bats from the left or right side of the plate (i.e, *Batter stands)*, and a control for the *inning* of pitch to account for potential umpire fatigue that influences accuracy. Finally, to control for the relative difficulty of assessing different speeds and spin rates of pitches, we include dummy variables indicating whether the pitch was classified by MLB as a breaking pitch (i.e., curve ball or slider), off-speed pitch (i.e., change-up, knuckleball), or unknown.

Pitcher characteristics We also control for a number of pitcher characteristics to account for differences in the quality and experience of the pitcher. We obtained these data from the online Baseball Data Bank. *Pitcher's tenure* controls for the number of years that a pitcher has been in the major leagues. *Pitcher's hand* is a dummy that indicates if a pitcher throws with his left hand, which will affect the way the ball looks as it crosses the plate. The race/ethnicity of the players and umpires have been discussed as a factor in baseball, so we collected the profile pictures of the players and umpires in our sample from the MLB website, and classified each player into one of four categories ("White/Caucasian", "Black/African American", "Latino/Hispanic", and "Asian"). We created a dummy variable *Pitcher is non-Caucasian* to indicate whether a pitcher is a minority ethnicity.

Statistical estimation

Because the dependent variable of the analysis is a binary outcome, we use logit regression to estimate the coefficients. To account for unmeasured heterogeneity across umpires, we included umpire fixed effects in all of the models. For simplicity of presentation, we do not show these coefficients in the tables below. In later models we show umpire-specific regression results to examine heterogeneity among umpires. To reduce collinearity bias, we mean centered all of the independent variables that we used to create interaction terms. After making this transformation, we found that the VIFs for all of the independent variables were within an acceptable range.

RESULTS

Table 2 shows the descriptive statistics and correlations for our variables. The mean pitcher has 5.07 years of service, issues a base-on-balls to 8.9 percent of the batters he faces, and has been voted an All-Star 0.4 times. The correlations between situation and player variables are not very high, while player characteristics such as tenure and All-Star appearances show moderate correlation as one would expect.

[Table 2 about here]

Over-Recognized Pitches (Actual Balls that were Mistakenly called Strikes)

Table 3 shows the results from logit models estimating the likelihood that an actual ball is mistakenly called a strike by the umpire. This captures the umpire's likelihood of offering greater recognition of a pitch despite the quality not being worthy of such recognition. The baseline regression (Model 1) shows that a wide range of situational characteristics and pitcher characteristics influence over-recognition, and act as important control variables for subsequent models focused on the status variables. Umpires exhibited a higher likelihood of mistakes when the pitcher was from the home team, with the odds of over-recognition increasing by 7.8 percent.[14] Umpire over-recognition also increased as the game progressed, with the results implying a 4.7 percent increase in odds of over-recognition for the 9th inning relative to the 1st inning of the game. Also, umpires were significantly less likely to make over-recognition mistakes when the batter was right-handed, with a 41 percent decrease in the odds of mistake. The closer the pitch was to the border of the strike zone, the more likely the umpire was to make a mistake ($p<.01$), implying that uncertainty increases the difficulty of the judgment task. The relationship between distance and over-recognition exhibits a non-linear relationship with a rapid decline in the odds of mistake as distance increases. While the potential for runs to be scored (i.e., run expectancy) did not show any statistically significant effects, doubling the importance of the situation (i.e., an increase of leverage by 1) led to a 1.5 percent increase in the odds of a mistaken strike ($p<.05$), which, along with the positive effect for attendance ($p<.01$), contradicts the notion that potential scrutiny should reduce the mistakes by umpires (e.g., Parsons et al., 2011). The results also clearly show that the baseline rate of mistake varies significantly across pitch count—for example, the odds of an umpire mistakenly calling a strike is 62 percent lower when the count is 0-2 (i.e., no balls and two strikes, and thus, a strike would end the at-bast), whereas the odds of over-recognition are 49 percent higher when the count is 3-0 (i.e., three balls and no strikes, a count that is known for generous strike calls)—validating the inclusion of count dummies.

For pitchers, each year of additional tenure in the league increased the odds of over-recognition by 2.1 percent ($p<.01$). Also, pitcher reputation had an effect on the likelihood of a mistaken strike, as the pitcher's tendency for control (i.e., lower BBs per batters faced) was associated with a higher rate of over-recognition—for every 10 percent increase in the percentage of batters walked in the pitcher's career leading up to the season, there is a 22 percent drop in the odds of over-recognition—consistent with a mechanism of expectations driving umpire judgment errors. The pitcher being of a minority race did not show any statistically significant effect in the baseline model, but has a statistically significant negative effect on over-recognition in models once status is included as shown below.

[Table 3 about here]

Model 2 includes the pitcher's status in a regression of the likelihood of calling of over-recognizing a pitch. As hypothesized, umpires are more likely to mistakenly call a real strike a ball when assessing an All-Star pitcher. An additional appearance in an All-Star game leads to a 4.8 percent increase in the odds that an umpire will over-recognize a strike ($p<.01$). Based on the predicted probabilities, going from no All-Star appearances to one All-Star appearance increases the predicted probability of a mistaken strike from 12.8 percent to 13.2 percent, and with no overlap in the confidence intervals, this suggests statistically different probabilities. A player with 5 All-Star appearances has a 14.9 percent chance of a mistaken strike, a 16.4 percent increase over the probability that a pitcher with no All-Star appearances would receive the same favorable call. A summary of the effect of selected coefficients is shown in Figure 1.

[Figure 1 about here]

In Hypothesis 3 we suggested that pitchers who have reputations as control pitchers (i.e., low percentages of walks given to batters) will benefit more from being high status than other types of dominant pitchers. The interaction effect of status and a pitcher's career average of walks per game is negative and significant ($p<.05$), which indicates that players who have a reputation for being "wild" or lacking in control do not get as many status-based over-recognition as pitchers who are known for their precision pitching. In other words, a pitcher's reputation for being a control pitcher amplifies the effect of status on umpires' likelihood of over-recognition mistakes. Figure 2 shows the relationship between the percent of base-on-balls issued by the pitcher per batters faced, and the probability that a pitcher will receive a strike call when in fact the pitch is an objective ball for a pitcher with no All-Star appearances, one All-Star appearance, and five, with 95 percent confidence intervals for the estimated probabilities. The likelihood that an umpire calls a ball a strike does not differ statistically when the pitcher issues a high proportion of base-on-balls (i.e., 15% of batters faced), but when pitchers have a low proportion of base-on-balls in their career (i.e., a reputation for better control), status amplifies the beneficial effect.[15]

[Figure 2 about here]

Contrary to Hypothesis 4, Model 4 shows that being closer to the border of the strike zone (i.e., increasing ambiguity) did not enhance the effect of status ($p>.10$). Similarly, situational factors, like pitching for the home team or attendance did not moderate the impact of status on the tendency for umpires to over-recognize quality.

Under-Recognized Pitches (Actual Strikes that were Mistakenly called Balls)

Table 4 contains the results of the logit model estimating the likelihood that a real strike is mistakenly called a ball. This captures the likelihood that the umpire will fail to recognize quality despite the pitch deserving recognition (i.e., a strike call). Consistent with the over-recognition of quality, the baseline results shown in Model 1 indicate that situational characteristics and individual attributes shape the mistakes made by umpires. Similar to over-recognition, umpires were more prone to make mistakes when the situation became more important (as reflected in leverage, run expectancy, and inning), although attendance did not have an effect on the likelihood of missing a good strike. Other situational variables such as home team, inning, pitch count and distance had similarly strong effects on the baseline effect. Pitcher characteristics such as tenure or prior reputation had effects as expected, with the notable exception of race, where minorities (i.e., non-Caucasians) had fewer under-recognition mistakes relative to Caucasians.[16]

Model 2 shows the results when the status of the pitcher is included. Consistent with Hypothesis 2, pitchers with high-status (i.e., more All-Star appearances) are less likely to have their strikes missed. An additional All-Star appearance lowers the odds of under-recognition by 2.7 percent. For example, the model predicts that an average pitch within the strike zone thrown by a pitcher with no All-Star appearances will be mistakenly called a ball 18.9% of the time; in contrast, the same average pitch within the strike zone thrown by a pitcher with five All-Star appearances has only a 17.2% of being mistakenly called a ball. A summary of the effects of key variables on under-recognition is shown in Figure 3.

[Figure 3 about here]

In Model 3 we include the interaction effect of pitcher's status and the pitcher's reputation. While the coefficient of the interaction term suggests that having a reputation of wildness (i.e., high percentage of base-on-balls) weakens the effect of status, the effect is not statistically different from zero. In Model 4, we show how the pitch's distance from the strike zone interacts with status. The effect is positive, indicating that when the pitch is located closer to the edges of the strike zone (i.e., a lower total distance), higher status players get a greater advantage in being evaluated accurately than do lower status players. For example, the probability that a pitch that is right down the middle of the zone, thus being a combined two feet from the border of the strike zone will have a 0.041 percent chance of being mistakenly called a ball for a pitcher with no All-Star game appearances, and 0.045 percent with 5 All-Star appearances, showing no statistical difference between the chances of mistake. In contrast, for pitches that are a combined three inches from the border of the strike zone, the predicted probability of a mistaken ball for the pitcher with no All-Star is 52.7 percent, and for a pitcher with five All-Star appearances 50.5 percent. Figure 3 depicts the relationship between predicted probability of a mistaken ball as a pitch approaches the border, and uncertainty increases. High status players, then, tend to benefit from ambiguity, inasmuch as umpires attend more to the quality of their pitches in the more ambiguous parts of the strike zone. This finding, then, indicates that high-status pitchers get more close strike calls to go their way, in part because the umpires are more accurate when there is uncertainty. On the other hand, low-status pitchers are not given the benefit of the doubt in these situations, leading to a higher number of under-recognized strikes relative to those with high-status.

[Figure 4 about here]

In models not shown, we included a number of other interaction effects to assess whether situational variables moderated the impact of status on the likelihood of umpires under-recognizing quality. Notably, we did not find that situational effects such as game attendance, leverage, or run expectancy make status's influence any greater. The effect of status does not seem to be augmented by situational elements of the game.

Batters and Catcher Effects

While our paper focuses on the effect that pitcher status has on umpire judgment, two additional actors are also involved in the pitch: batters and catchers. Players and managers have long held the suspicion that some batters receive more favorable judgments than others. In the aforementioned quote by Ozzie Guillen, the former player and manager points out that it is the "same way for hitting" with Hall of Fame inductee Wade Boggs, and two-time league Most Valuable Player (MVP) Frank Thomas are more likely to receive "ball" calls for the same pitch. This suggests that the status of the batter should have the opposite effect of pitcher status in that high status batters are more likely to lead to less over-recognition of quality (i.e., balls called strikes) and more under-recognition of quality (i.e., strikes called balls). Furthermore, both Wade Boggs and Frank Thomas were well-known for their exceptional "batting eye", or ability to tell apart a ball from a strike, so Guillen is also implying that their reputations play a role in setting the expectations of umpires. To examine these mechanisms, we include both batter status (as measured by All-Star appearances) and the batter's reputation for plate discipline (as measured by his career rate of base-on-balls per plate appearance) in Model 5 in Tables 3 and 4. The results show that batter status and reputation does indeed influence the judgment of umpires, mainly in a way that is unfavorable towards pitchers. For each additional All-Star appearance of the batter, the odds of over-recognition goes down by 1.3%, while the odds of under-recognition increases by 1.3%. The results of pitcher status remain robust to including these batter effects. [17]

The catcher plays an even more direct role in the judgment of the pitch, through an act that is commonly known as "framing the pitch". Catchers move around the home plate area to help guide a pitcher throw to specific locations, and this in turn, can influence how the pitch appears to the umpire. For example, if the pitcher and catcher agree upon throwing a pitch to the outside part of the strike zone, the catcher can shift his position to the outside so that the center of his glove would rest at the agreed upon location. Not only does this provide a visual cue for the pitcher (i.e., throw to the catcher's glove), but it also helps "sell" the pitch to the umpire because the catcher does not have to reach to catch the ball, leading to an impression that the pitch was straight down the middle. This ability to "frame" the pitch has always been thought of as a valuable skillset in baseball, and if this is indeed a repeatable skill, could potentially explain the likelihood of mistaken judgment from the umpires.

We attempt to control for this heterogeneity in catching skill through two means: first, we include catcher fixed effects in our models, which does not alter the pattern of our results. Second, we use our data on mistakes to isolate the framing ability of catchers and include this as a control variable. In short, we looked at the rate at which catchers gained "extra strikes" for their pitchers relative to the pitchers' own inherent ability to get these "extra strikes" and included the normalized variable in our regression models.[18] The logit estimates including this variable and a count of All-Star game appearances for catchers are shown in Model 6 in Tables 3 and 4. While catcher status (i.e., All-Star appearances) does not seem to influence the likelihood of over-recognition or under-recognition by umpires, the framing ability (or reputation of framing) has a strong and significant effect on calls ($p<.01$). Being a catcher that is one standard deviation higher in his ability to get extra calls leads to an increase in the odds of a over-recognized pitch by 7%, and a decrease of the odds of under-recognition by 10%. The effect of pitcher status remains robust, implying that the observed status advantages for pitchers were not driven solely by high-status pitches pairing with catchers who are more adept at framing.

Umpire-Specific Regressions

The results establish that pitcher status has a positive (negative) effect on the likelihood of over (under) recognition bias. More specifically, the inclusion of umpire fixed-effects implies that the average within-umpire effect of status has a significant effect on the accuracy of judgments. While removing between-umpire variation in status effects help control for the heterogeneity among individuals, it is often the case that differences across individuals yield additional insight that can be obscured by aggregation. For example, the positive coefficient for over-recognition may be the result of heavily high-status biased umpires outweighing a smaller number of low-status biased umpires, or alternatively, most umpires being moderately high-status biased. The distribution of status bias has particular relevance for our argument that status bias is a cognitive phenomenon, since this suggests that bias will be universal across most actors.

To delve into the heterogeneity among umpires in their status bias, we run logit models with the same specification as discussed in the previous section for each of the 81 umpires in our sample that have called more than 1,500 pitches. Summary statistics for the two coefficients of interest—status' effect on over-recognition (i.e., calling a ball a strike), and under-recognition (i.e., calling a strike a ball), are shown in Table 5. First, the mean of the umpire-specific status coefficients are in the expected direction (i.e., over-recognition positive, under-recognition negative). There is considerable asymmetry in the minimum and maximum coefficients for both over and under recognition, suggesting that while individual umpires can be strongly biased towards high-status pitchers in over-recognizing and under-recognizing pitches, those who favor low-status pitchers are much weaker in their bias, with none having a bias that is statistically different from zero at the 95% level. Most noteworthy is that close to 80 percent of umpires show an over-recognition bias, which implies that status bias found among umpires is not driven by a handful of umpires, but rather is a universal tendency among all umpires. Under-recognition bias is less common, as 64 percent of umpires have a negative coefficient.

The umpire-specific regressions further allow us to explore the relationship between the two biases. Do umpires with a tendency to over-recognize the quality of high-status actors also have a lower likelihood of under-recognizing quality? Alternatively, do umpires that have one bias have lower amounts of the opposite bias? Or do these two biases operate independent of each other? Figure 5 plots the coefficients from each umpire by their under-recognition and over-recognition bias. The resulting graph suggests that it is not the case that the umpires that have one bias will usually exhibit the other bias. The pairwise correlation between the two is -0.1632 implying, at best, a weak correlation between status biases. Focusing on the most biased umpires, the figure suggests that while umpires who have the greatest tendency to miss strikes from low-status pitchers are almost always positive in their over-recognition bias, umpires who are most likely to mistakenly call a ball out of the zone a strike exhibit a less consistent under-recognition bias. None of the umpires were both statistically significant in under and over recognition bias. That the same individuals do not exhibit both biases together further suggests that the two dimensions of status bias are distinct, and governed by different mechanisms.

[Table 5 and Figure 5 about here]

DISCUSSION

Our results suggest that the tendency to over-recognize quality in high status pitchers and under-recognize quality in low status pitchers causes umpires' accuracy to fluctuate in such a way that high status pitchers receive performance advantages over their lower status peers. The strike zone becomes slightly larger for high status pitchers, and smaller for those with no status. But does this seemingly small advantage translate into more significant and enduring performance benefits for high status pitchers? To link status bias to systemic inequality, umpire inaccuracies must have a lasting impact on the trajectory of the performance of the pitchers affected. If status bias causes high status pitchers to get strike calls they do not deserve, then we should also expect these pitchers to have a lower likelihood of putting men on base and a lower threat of having runs scored against them. Using the same MLB data, we are able to empirically test this possibility.

[Table 6 about here]

Table 6 shows the regression results for two outcomes of an at-bat: total bases and Win-Percentage-Added (WPA). The unit of analysis is the at-bat, and total bases refers to the number of bases the batter gains in that at-bat through a hit (i.e., 1 for a single, 2 for a double, 3 for a triple, and 4 for a home run) or a base-on-balls (i.e., 1 total base). Pitchers attempt to minimize the number of bases because the more bases batters get, the more likely runs will result in the current or future at-bats. WPA refers to the increase or decrease in likelihood of winning the game based on the outcome of the given at-bat. Since the impact of a hit or base-on-balls will differ depending on the context (i.e., a hit in the bottom of the ninth when the game is tied is a more damaging outcome to the pitcher than a hit in the bottom of the ninth when the pitching team is leading by ten runs), WPA provides a more accurate indicator of the value of a pitch in a given at-bat.

Models 1 shows the baseline model, which includes the pitcher's career Earned Run Average (ERA), and batter's career On-Base-Percentage plus Slugging Percentage (commonly referred to as OPS) as controls for the players' abilities, the leverage of the situation, whether the pitcher is pitching for the home team, and dummies for the number of outs. As expected, the higher the career ERA (i.e., the worse the pitcher's abilities), and the higher the batter's OPS (i.e., the better the batter's abilities), the lower the Winning-Percentage-Added by the pitcher, and the higher the average number of total bases that result from that at-bat. The leverage variable indicates that pitchers perform better when the stakes are high, and also when they are pitching in front of a home crowd. Also, as the number of outs increase, the more likely the at-bat will end in the pitcher's favor.

Including the umpire bias variables (Models 2) shows that each incremental increase in biased calls during an at-bat has a significant impact on the outcomes to the pitcher. An additional mistaken ball (i.e., under-recognition) decreases the probability that the pitcher's team will win by 0.3% ($p<.01$), while an additional mistaken strike (i.e., over-recognition) increases the win probability of the pitcher's team by 0.3% ($p<.01$). For total bases, an additional mistaken ball increases the resulting number of bases by 0.074 on average ($p<.01$), while a mistaken strike lowers the total bases by 0.067 ($p<.01$). In sum, umpire mistakes caused by status bias have a significant effect on the outcome of at-bats.

More broadly, the outcomes of each at-bat accumulate over the season, and can have implications for matters such as salaries for the pitchers involved. Using the estimates from our model, we can create a back-of-the-envelope calculation of the accumulated effects for a hypothetical pitcher with no All-Star appearances versus one with five All-Star appearances. If this hypothetical pitcher has 1,000 pitches called over the duration of the season, we can expect a total of 147.4 mistaken calls for a pitcher with no All-Stars versus 157.1 for a pitcher with five All-Star appearances given our predicted probabilities of 14.7 and 15.7 percent mistake per pitch. Turkenkopf (2008) calculated the run value of switching a ball to a strike at .133 runs, and thus, the total run value of the extra 9.7 mistakes for the five-time All-Star is 1.28 runs. Baseball statisticians have noted that 10 runs translate into 1 win for the team[19], implying that the total "status effect" equals 0.128 wins over the course of the season. While this may seem to be a small effect, similar studies have estimated the monetary value of each extra win at roughly $4.5 million[20], and assuming that the market for baseball talent is relatively efficient, this would lead to the five time All-Star receiving approximately $575,000 extra compensation relative to the no All-Star player, purely on the basis of status induced umpire mistakes.[21]

Furthermore, the effects of status make it more likely that those with status will gain even more status. Using the same estimates of the value of an extra strike (i.e., .133 runs), we can now project how status bias helps players gain further status. We estimated a logit model for the likelihood a pitcher will be selected to the All-Star game based on the count of prior All-Star appearances (i.e., accumulated status), total runs allowed and total batters faced prior to All-Star selection dates in the 2008 and 2009 season.[22] As expected, pitchers with prior status are much more likely to be selected, even controlling for performance, with each additional All-Star increasing the odds of selection by 57.9 percent. Furthermore, the results suggested that an additional run lowers the odds of selection by roughly 5 percent. Assuming 500 pitches are called during a half season, the hypothetical five-time All-Star would have a 3.3 percent[23] increased odds of All-Star selection purely due to mistaken calls, and an overall nine-fold increase of odds considering the prior All-Star effect.[24]

The impact that umpire errors have on pitcher performance further implies that the choice of a particular pitching strategy will be shaped by the status one enjoys. For a high status pitcher, pitching outside the strike zone, or if within the zone, as close to the border as possible is the optimal strategy, as umpires are more likely to call a strike under these circumstances. On the other hand, low status pitchers not only fail to get the outside pitch called a strike, but more problematic is the fact that their high-quality offerings (i.e., strikes) are also more likely to be missed, forcing the pitcher to throw pitches in less ambiguous locations (i.e., closer to the middle) to avoid an error of omission on the part of the umpire. As the likelihood of adverse events (e.g., extra base hits) increases as the pitch is thrown in the middle of the zone, in addition to having weaker skills, low status actors are further constrained by the fact that observers are biased and fail to recognize quality, leading them to engage in more risky actions to compensate for such bias. Thus, low status pitchers find it more difficult to obtain the same results for an at-bat as high status pitchers. The pitchers with the greatest advantage during any given at-bat are high status control pitchers, who receive more leniency from the umpires when throwing the ball on the edges of the strike zone.

CONCLUSION

The analyses in this paper point to the socio-cognitive sources of status bias in evaluative decisions. Although the study of status in sociology has led to an accumulation of knowledge about the origins and consequences of status, our understanding of the mechanisms underlying status influence is still underdeveloped (Lynn, Podolny, and Tao 2009). Some have argued for an information-centric approach, inasmuch as status focuses attention on an actor's quality (e.g., Podolny 1993). But others have argued that status primarily works through the creation and enforcement of expectations, shaping how others view a person's competence or quality (e.g., Berger et al. 1977; Ridgeway 1991). By examining the social psychological underpinnings of status, we offer a bridging perspective that suggests that expectations about performance associated with an actor's status position shape how evaluators interpret information about quality. Expectations are greater for high status actors, which causes evaluators to over-recognize quality in their low-quality offerings. In contrast, evaluators tend to under-recognize quality in low status actors for whom they have lower expectations. In this way, expectations lead to a persistent source of status bias in evaluations, which makes it easier for high status actors to reproduce their positions and more difficult for low status actors to climb the status hierarchy.

The result of these dynamics is that an actor's status leads to two distinct pathways to accrue advantages. First, under-recognition bias implies that high status actors are more likely to get noticed for what they already do well. The burden of proof is lesser for high status actors, inasmuch as evaluators already expect that they will do well. Second, over-recognition implies that high status actors are allowed more flexibility in their performance. They need not perform well every time in order to be rewarded. The high expectations set by their greater status allows them room for error that lower status actors do not have. Thus, evaluators' over-recognition of quality and under-recognition of low quality helps high status individuals begin to accumulate advantages.

Of course, the value of understanding these two socio-cognitive dynamics is that they are manifest in contexts other than baseball. In any context where status characteristics drive future interactions and performance evaluation, status bias contributes to persistence in inequality and the reproduction of status differences (see, for example, Ridgeway 2011 on gender as a status characteristic). Over-recognition of quality by evaluators may underlie the ability of high status actors to stand out among numerous candidates during job recruitment (Rivera 2012), the tendency for high status organizations to receive higher status affiliations (Benjamin and Podolny 1999), and the attractiveness of higher ranked law schools to law school applicants (Sauder and Lancaster 2006). Of course, status bias likely explains for the differential rewards given to the Nobel Prize winners who Merton (1968) studied. Merton believed the Matthew Effect resulted from increased credit given to higher status actors, but he did not delve into the psychological mechanisms that accounted for it. We believe that it is entirely consistent with Merton's findings to argue that Nobel Prize winners get more credit because their peers, grant providers, and university officials expect them to perform at higher levels than their colleagues, which makes their new research seem more interesting, more citable, and worthy of funding. Over-recognition means that fewer of their high quality studies in the future go unnoticed and that even their low quality offerings will receive greater academic respect. We might even hypothesize that once a scientist wins a Nobel, their past papers that were once considered less impressive subsequently generate new appreciation and may suddenly spike in citations. At the same time, our results suggest that low status academics will be constrained from moving up the academic hierarchy because their high quality offerings will be consistently discounted in value, making it more difficult for them to get equal recognition for research findings of similar quality as their high status colleagues. Under-recognition, in this sense, impedes upward mobility in academic status hierarchies.

Over-recognition of quality, then, initiates the Matthew Effect (Merton 1968; Bothner et al. 2010; Correll et al. 2011). Once an individual is marked as high status, other valued qualities become more salient, and their attractiveness as potential partners increases. By shaping the recognition of quality when it's present, status helps differentiate otherwise evenly-distributed differences in quality. It also allows high status actors to be somewhat uneven in their performance without losing credibility or esteem in the eyes of evaluators. By expanding the zone of appreciation for high status actors, evaluators make it possible for them to receive more favors or to be given the benefit of the doubt when performance slacks. This cognitive bias may underlie the "halo effect" often accorded to high status actors (Sine, Shane and Di Gregorio 2003), the tendency of high status individuals to be seen as more competent and powerful (Ridgeway and Berger 1986), or demonstrations of interpersonal deference to high status actors (Sykes and Clark 1975). In contrast, our results also show that under-recognition of quality serves as a barrier to those who lack status. If an actor has not already established his or her position in the status hierarchy, they more likely to be discounted in the future, even when their performance equals that of their high status counterparts. Thus, status bias "unjustifiably victimize[s]" low status actors (Merton 1968: 59), preventing them from being treated as if they were operating in an even playing field.

Our findings extend our understanding of the halo effect by showing that status is especially likely to lead to over-recognition of quality when status and reputation are aligned. The importance of aligning expectations in the evaluator's mind may be one reason that other scholars have found that status has its greatest effect on economic performance advantages when there is consistency among multiple status signals (Zhao and Zhou 2011). Reputation enhances status bias inasmuch as it raises expectations to even greater levels. When a high status actor's reputation creates contradictory expectations, in contrast, the performance advantages of status bias disappear.

An important implication of our analysis is to show that evaluators need not be consciously aware of status differences for these two aspects of status bias to influence evaluations and performance outcomes. Umpires do not approach each at-bat thinking that they are going to evaluate an All Star pitcher differently than they would a rookie pitcher with no All Star appearances. If status bias was deliberate and calculated, one should expect situational factors such as the importance of the situation (i.e., leverage) or scrutiny (i.e., attendance) to moderate the effect of status, yet, our results suggest this is not the case. Umpires believe that they are being completely objective in their assessments. But umpires also evaluate pitches instantaneously and instinctively, which creates opportunities for status bias to creep in and influence their evaluations. Status bias seems to enter the equation, then, in a fairly automatic and unconscious manner. If status bias influences automatic responses even among highly trained and professionalized evaluators, then it is reasonable to expect that other types of evaluators in less high pressure contexts will be equally influenced by status bias. Performance expectations based on status differences are a pervasive feature of social interaction and quality evaluation that lead to the persistence of socio-economic differences associated with gender, race, and other highly salient status differences. Despite changes in changes in laws and organizational rules that are meant to enhance workplace justice and despite individuals' attempts to be "fair," status bias continues to shape evaluations in favor of higher status actors, thereby reproducing status hierarchies.[25] As Ridgeway (2011: 185) argues, differences in beliefs and expectations formed by status differences may be at the very heart of inequality persistence.

In this paper we have focused mainly on the ways in which these differences in evaluator bias lead to performance advantages for high status actors, but it is reasonable to expect that in other contexts the same cognitive tendency could have negative consequences. For example, over-recognition may cause high status actors to become the targets of unwanted attention, as when social movement activists differentially target prominent corporations (King 2011; King and McDonnell forthcoming) or when the high status of an actor turns his or her transgressions into a public scandal (Adut 2005) or the tendency for audiences to give high status actors less leeway when they violate local norms of appropriateness (Phillips, Turco, and Zuckerman 2013). Our results suggest that audiences give greater attention to the transgressions and norm violations of high status actors, in part, because they have strong priors about the kind of behaviors they expect from them. Although we have shown that evaluators tend to under-recognize the poor quality performances of high status actors, high expectations about performances may also lead evaluators to react more negatively when they are perceived to purposefully transgress local norms (e.g., pitchers throwing bean balls at hitters in retaliation). We might also expect that inasmuch as status increases performance expectations, actors may sometimes be put in situations where they cannot meet those expectations (Fine 2001). This is, to some degree, what happens to pitchers who are not known for their control. These pitchers face the pressure of not only being more intensely scrutinized but also of not being expected to precisely pitch around the edges of the strike zone. A bad day for a "wild" pitcher could lead to unfair assessments by umpires who are unwilling to give them close calls.

Despite this potential for backfire, having status leads to more positive outcomes for pitchers because it tends to influence evaluators' assessment of quality in a way that benefits those players. Although we have known by past research that high status actors accumulate advantages of this type, a main contribution of this study is to explain why this is the case. By shifting the focus to the evaluator of status, and the various conditions under which status biases the evaluations of purportedly objective actors, we open a window into the micro-level processes that underpin the advantages that accrue to high status actors.

ENDNOTES

[1] Noting the under-recognition of women scientists, Rossiter (1993) dubbed this the "Matilda Effect" after feminist scholar Matilda Gage, whose work exposed (and also experienced) under-recognition of women's scholarly contribution.

[2] The official Major League Baseball rulebook describes the strike zone in this way: "The STRIKE ZONE is that area over home plate the upper limit of which is a horizontal line at the midpoint between the top of the shoulders and the top of the uniform pants, and the lower level is a line at the hollow beneath the knee cap. The Strike Zone shall be determined from the batter's stance as the batter is prepared to swing at a pitched ball" (Major League Baseball, 2011: 22-23).

[3] In fact, the umpire behind the plate does not make a decision about whether a player swung the bat or not so as not to distract him from assessing the location of the pitch. If there is any question of whether a batter swung the bat at a pitch, the first base umpire makes the call.

[4] . For example, during Game 1 of the 1998 World Series between the New York Yankees and San Diego Padres, pitcher Mark Langston of the Padres appeared to have struck out Yankees batter Tino Martinez on a 2-2 pitch with the bases loaded and 2 outs in the 7th inning of a game tied 5-5. Umpire Rich Garcia missed the strike call, and on the next pitch, Martinez hit a grand slam home run, with the Yankees prevailing by a score of 9-6 in the game, and ultimately going on to winning the World Series.

[5] How does a non-control pitcher get batters out and how would they ever accumulate enough past quality performances to be seen as high status? The answer to this question is by being able to throw the ball very hard or deceptively. Pitchers with high pitch speed or who have sharp movement on their pitches are much more capable of getting batters to swing at bad pitches.

[6] http://gd2.mlb.com/components/game/mlb/

[7] http://www.baseball-databank.org/

[8] http://www.retrosheet.org/

[9] http://www.fangraphs.com/

[10] We recognize that pitchers at times may intend to throw balls and, in those instances a "quality" pitch may indeed be a ball, but an umpire's role is not to judge intent but to simply evaluate whether a pitch qualifies as a strike, Thus, the umpire is perceptually focused on the strike zone as the range of quality in which a pitch counts as a strike. Anything outside that zone, then, would be considered a ball – i.e., a low quality pitch.

[11] See, for example, this analysis of teams that are under- or overvalued in All-Star voting: http://bleacherreport.com/articles/422086-subjectivity-objectified-measuring-mlb-fans-biases-with-all-star-votes.

[12]The Baseball Almanac can be accessed at the following website - http://www.baseball-almanac.com/players/ballplayer.shtml

[13] For a detailed explanation of the leverage index, refer to http://www.hardballtimes.com/main/printarticle/crucial-situations/

[14] The odds of mistake are 1.0778 (=exp(0.075)) times the baseline rate of mistakes

[15] The increased effect for status for high-performing pitchers may be due to the non-linearity of status, or the "Winner-Take-All" effect where the highest status actors enjoy disproportionate returns (Frank and Cook, 1995). We include status as a quadratic term, and find that contrary to the idea of increasing returns to status, the effect of status exhibits a slight *decrease* in marginal returns to status. The peak of the effect occurs at 10 All-Star appearances according to this model. We thank an anonymous reviewer for raising the possibility that the effect of status could be non-linear.

[16] The reduction in under-recognition mistakes for minority pitchers appears to result from minority umpires having a lower likelihood of under-recognition for minority pitchers. In analyses not shown here, we included a dummy indicating whether there is a match between the race of the pitcher and umpire, and find that including this variable pushes the coefficient of pitcher race to zero. In other words, minority pitchers have the same rate of under-recognition mistakes when Caucasian umpires are behind the plate, and lower rates when a minority umpire is calling the game, although the effect is not statistically different from zero (p>.10).

[17] We also included interaction terms between pitcher status and batter status in models not shown here to see if pitcher status becomes more or less valuable when the batter is high status as well. The results were inconclusive, suggesting that the pitcher and batter effects operate independent of each other.

[18] Following work done by *Baseball Prospectus* writer Mike Fast, we first calculated a baseline rate of mistake for each pitcher during the 2007 season by counting the number of extra strikes (i.e., pitches called a strike despite being a ball), subtracting the number of extra balls (i.e., pitches called a ball despite being a strike), and dividing this net mistake figure by the total number of pitches called for that pitcher during the season. We then counted pitcher-catcher dyad specific net mistakes and subtracted the expected number of net mistakes (i.e., total called pitches for the pitcher-catcher dyad times the baseline rate of mistake for the pitcher), which gave us the total number of extra mistakes the catcher gained for the pitcher. We aggregated this figure for each catcher, and divided it by the total number of pitches called, resulting in a rate statistic that captures the catcher's ability to get favorable mistakes, independent of the pitcher's own skills or status.

[19] Noted baseball writer Bill James proposed the "Pythagorean Expectation" formula (i.e., $Wins = \frac{Runs\ Scored^2}{Runs\ Scored^2 + Runs\ Allowed^2}$ to predict wins for a team given the number of runs it scores and the number it allows, and follow up studies using historical data have generally confirmed the relationship with some minor modifications—for example, Davenport and Woolner (1999) find that using 1.85 as the exponent produced a better fit in regressions. This formula suggests that a team that scores 800 runs and allows 800 runs is expected to win half of its games (81 of a 162 game season), while the same team scoring the same amount of runs but allowing 10 fewer runs should expect to win 81.94 wins, and improvement of roughly 1 win. For more details on estimation of wins based on runs, see http://www.fangraphs.com/blogs/win-values-explained-part-five/

[20] Dave Cameron at baseball website Fangraphs (http://www.fangraphs.com/blogs/win-values-explained-part-six/) arrived at this valuation of wins by taking the total dollar amount of free agent contracts that were awarded in 2008 ($396 million) and dividing it by the three year total of wins created by all free agents that were on the market in 2008 prior to that year (i.e., 88 wins).

[21] It should be noted that most pitchers play under multi-year contracts, and “young” pitchers tend to be restricted from the free agent market for a set period of years. As such, not all pitchers can monetize the value they gain from the extra strikes (or reduced balls) they receive in a season.

[22] Regression results are available upon request.

[23] The hypothetical five-time All-Star would have 5 extra mistakes in his favor relative to the no All-Star, and given the expected run value of .133 for each mistake, the odds of All-Star selection would be .9668 (=exp(-0.050636*5*.133)) times the baseline odds.

[24] The selection of All-Stars shows that Matthew Effects can operate in multiple ways and on different audience groups. Voters for the All-Star game (i.e., writers, players, and fans) are clearly more likely to recognize pitchers who were All-Stars before even for the same performance. It is less clear whether this is bias on the part of the audience, given that the “quality” criteria for All-Star selection is not necessarily about performance in terms of lowering runs. Prior All-Star appearances may in fact be correlated with unobserved qualities that are valued by the voters. For example, having well-known and established players in the game may be more beneficial for the game and the sport, and thus the selection of a lower performance pitcher may be justified.

[25] We thank an anonymous reviewer for helping us to recognize this implication.

Table 1. Distribution of Biased Call in Called Pitches During MLB Games, 2008-09

	Called Ball	Called Strike	Total
Actual Strike	Under-Recognition (18.8%)	No error (81.2%)	250,156
Actual Ball	No error (87.1%)	Over-Recognition (12.9%)	533,823
Total	506,692	250,156	

Table 2. Descriptive Statistics and Correlations of Variables

		Mean	Std Dev	Obs	1	2	3	4	5	6	7	8
1	Over-Recognized Pitch (Call: Strike; Actual: Ball)	0.091	0.28	756848	1.00							
2	Under-Recognized Pitch (Call: Ball; Actual: Strike)	0.055	0.22	756848	-0.08**	1.00						
3	Home Team	0.508	0.50	756848	0.01**	-0.00*	1.00					
4	Attendance (10K)	3.148	1.16	752210	0.01**	-0.00*	0.02**	1.00				
5	Total Distance from Border (ft)	0.730	0.51	741681	-0.33**	-0.06**	-0.00	0.00*	1.00			
6	Leverage	0.964	0.84	752379	0.00**	0.00*	-0.02**	0.00**	-0.01**	1.00		
7	Run Expectancy	0.490	0.35	752379	0.00	0.01**	-0.01**	-0.00	-0.01**	0.39**	1.00	
8	Inning	4.959	2.68	756848	-0.00*	-0.00	0.04**	0.00	0.02**	0.12**	0.00**	1.00
9	Pitcher Tenure	5.065	4.40	756848	0.02**	-0.01**	-0.01**	0.08**	-0.01**	0.04**	-0.01**	0.02**
10	Pitcher Career BBs per Batter Faced	0.089	0.02	756724	-0.02**	0.00**	0.01**	-0.00	0.02**	0.01**	0.02**	0.13**
11	Pitcher is Non-Caucasian	0.266	0.44	756848	-0.00	-0.00**	-0.00	0.02**	0.01**	0.02**	0.01**	0.08**
12	Pitcher All-Star	0.446	1.20	756848	0.02**	-0.01**	-0.01**	0.08**	-0.01**	0.04**	-0.02**	-0.06**
13	Batter BBs per PA	0.084	0.03	755995	0.01**	0.00**	-0.00**	0.03**	-0.02**	0.02**	0.02**	-0.00
14	Batter is Non-Caucasian	0.457	0.49	756848	-0.00**	-0.00	-0.00	0.05**	0.00**	0.00	-0.01**	-0.01**
15	Batter All-Star	0.924	1.98	756848	-0.01**	0.00	0.00	0.11**	0.00**	0.01**	0.00	-0.03**
16	Catcher All-Star	0.792	2.22	743825	0.00	-0.00	-0.01**	0.07**	0.00	0.01**	0.01**	0.00
17	Catcher Framing Ability	0.000	1.00	648380	0.01**	-0.02**	-0.01**	0.07**	0.00	0.01**	-0.01**	0.01**

Table 2. Descriptive Statistics and Correlations of Variables (Continued)

		9	10	11	12	13	14	15	16
9	Pitcher Tenure	1.00							
10	Pitcher Career BBs per Batter Faced	-0.13**	1.00						
11	Pitcher is Non-Caucasian	-0.05**	0.09**	1.00					
12	Pitcher All-Star	0.52**	-0.19**	-0.00	1.00				
13	Batter BBs per PA	-0.00	-0.00**	0.00**	0.00	1.00			
14	Batter is Non-Caucasian	-0.01**	-0.00**	-0.01**	-0.01**	-0.14**	1.00		
15	Batter All-Star	-0.01**	-0.01**	-0.01**	-0.00*	0.22**	0.16**	1.00	
16	Catcher All-Star	0.07**	-0.02**	0.03**	0.06**	0.00	0.00	-0.01**	1.00
17	Catcher Framing Ability	0.02**	-0.01**	-0.02**	0.05**	-0.01**	0.00	0.00	0.05**

**p<.05 **p<.01*

Table 3. Determinants of Over-Recognized Pitch *(Actual Ball that was mistakenly called a Strike)*

	(1)	(2)	(3)	(4)	(5)	(6)
Situational						
Home Team	0.075**	0.074**	0.074**	0.074**	0.074**	0.069**
	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.011)
Attendance (10K)	0.026**	0.024**	0.024**	0.024**	0.026**	0.022**
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.005)
Total Distance from Border (ft)	-8.291**	-8.292**	-8.291**	-8.290**	-8.297**	-8.325**
	(0.120)	(0.120)	(0.120)	(0.120)	(0.120)	(0.130)
Total Distance X Total Distance	-2.226**	-2.224**	-2.224**	-2.221**	-2.233**	-2.222**
	(0.134)	(0.134)	(0.134)	(0.134)	(0.134)	(0.145)
Leverage	0.015*	0.012	0.013*	0.012	0.013*	0.009
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.007)
Run Expectancy	-0.025	-0.020	-0.020	-0.020	-0.018	-0.013
	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.017)
Inning	0.006**	0.007**	0.007**	0.007**	0.007**	0.006**
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Batter stands Right-handed	-0.532**	-0.532**	-0.532**	-0.532**	-0.546**	-0.533**
	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.011)
Year is 2009	-0.034**	-0.031**	-0.030**	-0.031**	-0.032**	-0.039**
	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.011)
Ballcount (Balls-Strikes)						
0-1	-0.593**	-0.594**	-0.594**	-0.594**	-0.595**	-0.595**
	(0.017)	(0.017)	(0.017)	(0.017)	(0.017)	(0.018)
0-2	-0.966**	-0.970**	-0.970**	-0.969**	-0.970**	-0.976**
	(0.034)	(0.034)	(0.034)	(0.034)	(0.034)	(0.037)
1-0	0.110**	0.110**	0.110**	0.110**	0.113**	0.117**
	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.016)
1-1	-0.401**	-0.401**	-0.401**	-0.400**	-0.398**	-0.396**
	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)	(0.020)
1-2	-0.726**	-0.728**	-0.728**	-0.728**	-0.728**	-0.725**
	(0.026)	(0.026)	(0.026)	(0.026)	(0.026)	(0.028)
2-0	0.260**	0.261**	0.261**	0.261**	0.265**	0.247**
	(0.023)	(0.023)	(0.023)	(0.023)	(0.023)	(0.025)
2-1	-0.243**	-0.242**	-0.242**	-0.242**	-0.236**	-0.248**
	(0.024)	(0.024)	(0.024)	(0.024)	(0.024)	(0.026)
2-2	-0.566**	-0.567**	-0.567**	-0.567**	-0.562**	-0.562**
	(0.027)	(0.027)	(0.027)	(0.027)	(0.027)	(0.029)
3-0	0.401**	0.402**	0.402**	0.402**	0.407**	0.398**
	(0.033)	(0.033)	(0.033)	(0.033)	(0.033)	(0.036)
3-1	-0.171**	-0.170**	-0.170**	-0.170**	-0.166**	-0.201**
	(0.033)	(0.033)	(0.033)	(0.033)	(0.033)	(0.036)

3-2	-0.749**	-0.748**	-0.747**	-0.748**	-0.740**	-0.775**
	(0.037)	(0.037)	(0.037)	(0.037)	(0.037)	(0.040)
Pitch Type						
Breaking pitch	-0.139**	-0.138**	-0.138**	-0.138**	-0.136**	-0.137**
	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.013)
Offspeed Pitch	-0.227**	-0.225**	-0.225**	-0.225**	-0.225**	-0.235**
	(0.017)	(0.017)	(0.017)	(0.017)	(0.017)	(0.018)
Unknown Pitch	2.898**	2.906**	2.908**	2.906**	2.932**	3.074**
	(0.614)	(0.614)	(0.614)	(0.614)	(0.616)	(0.748)
Pitcher						
Pitcher Tenure in League	0.021**	0.014**	0.014**	0.014**	0.014**	0.013**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Pitcher BBs per Batters Faced	-2.787**	-2.477**	-2.600**	-2.480**	-2.498**	-2.526**
	(0.209)	(0.211)	(0.218)	(0.211)	(0.211)	(0.225)
Pitcher is Non-Caucasian	-0.018	-0.024*	-0.023*	-0.024*	-0.023*	-0.004
	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.012)
Pitcher is Right-handed	0.046**	0.054**	0.051**	0.054**	0.050**	0.050**
	(0.011)	(0.011)	(0.012)	(0.011)	(0.012)	(0.012)
All-Star						
Pitcher All-Star Appearances		0.047**	0.038**	0.045*	0.047**	0.047**
		(0.005)	(0.006)	(0.019)	(0.005)	(0.005)
Pitcher All-Star X BBs per Batter			-0.520*			
			(0.231)			
Pitcher All-Star X Distance				-0.061		
				(0.087)		
Pitcher All-Star X Distance ^2				-0.104		
				(0.100)		
Batter						
Batter BBs per Plate Appearance					-1.024**	
					(0.170)	
Batter is Non-Caucasian					0.005	
					(0.010)	
Batter All-Star Appearances					-0.013**	
					(0.003)	
Catcher						
Catcher All-Star Appearances						-0.004
						(0.002)
Catcher Framing Ability						0.067**
						(0.005)
Constant	-4.379**	-4.377**	-4.378**	-4.377**	-4.293**	-4.363**
	(0.053)	(0.053)	(0.053)	(0.053)	(0.056)	(0.057)
N	489264	489264	489264	489264	488814	421530

**p<.05 **p<.01*

Table 4. Determinants of Under-Recognized Pitch *(Actual Ball that was mistakenly called a Strike)*

	(1)	(2)	(3)	(4)	(5)	(6)
Situational						
Home Team	-0.036**	-0.036**	-0.036**	-0.036**	-0.035**	-0.041**
	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.013)
Attendance (10K)	-0.008	-0.007	-0.007	-0.007	-0.000	-0.003
	(0.005)	(0.005)	(0.005)	(0.005)	(0.000)	(0.006)
Total Distance from Border (ft)	-3.320**	-3.320**	-3.319**	-3.320**	-3.319**	-3.312**
	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)	(0.023)
Total Distance X Total Distance	-0.825**	-0.824**	-0.822**	-0.824**	-0.823**	-0.784**
	(0.057)	(0.057)	(0.057)	(0.057)	(0.057)	(0.061)
Leverage	0.017*	0.019*	0.019*	0.018*	0.018*	0.024**
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.009)
Run Expectancy	0.153**	0.150**	0.150**	0.150**	0.147**	0.143**
	(0.019)	(0.019)	(0.019)	(0.019)	(0.019)	(0.021)
Inning	0.005*	0.005*	0.005*	0.005*	0.005*	0.006*
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Batter stands Right-handed	-0.047**	-0.047**	-0.047**	-0.047**	-0.029*	-0.037**
	(0.012)	(0.012)	(0.012)	(0.012)	(0.013)	(0.013)
Year is 2009	-0.191**	-0.192**	-0.192**	-0.193**	-0.192**	-0.193**
	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.013)
Ballcount (Balls-Strikes)						
0-1	0.673**	0.674**	0.673**	0.674**	0.673**	0.668**
	(0.020)	(0.020)	(0.020)	(0.020)	(0.020)	(0.022)
0-2	1.095**	1.097**	1.097**	1.097**	1.105**	1.094**
	(0.041)	(0.041)	(0.041)	(0.041)	(0.041)	(0.045)
1-0	-0.097**	-0.097**	-0.097**	-0.097**	-0.101**	-0.097**
	(0.019)	(0.019)	(0.019)	(0.019)	(0.019)	(0.021)
1-1	0.482**	0.482**	0.483**	0.482**	0.477**	0.482**
	(0.023)	(0.023)	(0.023)	(0.023)	(0.023)	(0.024)
1-2	0.827**	0.828**	0.828**	0.828**	0.825**	0.838**
	(0.034)	(0.034)	(0.034)	(0.034)	(0.034)	(0.036)
2-0	-0.352**	-0.352**	-0.352**	-0.352**	-0.355**	-0.336**
	(0.031)	(0.031)	(0.031)	(0.031)	(0.031)	(0.033)
2-1	0.275**	0.275**	0.275**	0.275**	0.266**	0.259**
	(0.030)	(0.030)	(0.030)	(0.030)	(0.030)	(0.033)
2-2	0.769**	0.770**	0.770**	0.770**	0.764**	0.782**
	(0.035)	(0.035)	(0.035)	(0.035)	(0.035)	(0.038)
3-0	-0.749**	-0.749**	-0.750**	-0.750**	-0.759**	-0.768**
	(0.044)	(0.044)	(0.044)	(0.044)	(0.044)	(0.048)
3-1	0.006	0.006	0.005	0.005	-0.002	0.010
	(0.041)	(0.041)	(0.041)	(0.041)	(0.041)	(0.044)
3-2	0.693**	0.693**	0.693**	0.693**	0.681**	0.693**
	(0.046)	(0.046)	(0.046)	(0.046)	(0.046)	(0.050)
Pitch Type						

Breaking pitch	-0.109**	-0.110**	-0.110**	-0.110**	-0.114**	-0.101**
	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.016)
Offspeed Pitch	0.209**	0.208**	0.208**	0.208**	0.205**	0.192**
	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)	(0.023)
Unknown Pitch	2.245**	2.245**	2.230**	2.244**	2.250**	2.034*
	(0.798)	(0.798)	(0.793)	(0.798)	(0.800)	(0.870)
Pitcher						
Pitcher Tenure in League	-0.013**	-0.010**	-0.010**	-0.010**	-0.009**	-0.011**
	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Pitcher BBs per Batters Faced	1.211**	1.068**	1.064**	1.142**	1.086**	1.190**
	(0.248)	(0.251)	(0.251)	(0.265)	(0.251)	(0.268)
Pitcher is Non-Caucasian	-0.033*	-0.030*	-0.030*	-0.031*	-0.029*	-0.041**
	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.015)
Pitcher is Right-handed	-0.056**	-0.060**	-0.061**	-0.060**	-0.057**	-0.073**
	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.015)
All-Star						
Pitcher All-Star Appearances		-0.028**	-0.039**	-0.024**	-0.028**	-0.027**
		(0.006)	(0.008)	(0.008)	(0.006)	(0.007)
Pitcher All-Star X BBs per batters faced				0.270 (0.317)		
Pitcher All-Star X Distance			0.032			
			(0.018)			
Pitcher All-Star X Distance ^2			0.150**			
			(0.046)			
Batter						
Batter BBs per Plate Appearance					1.353**	
					(0.209)	
Batter is Non-Caucasian					-0.013	
					(0.013)	
Batter All-Star Appearances					0.013**	
					(0.003)	
Catcher						
Catcher All-Star Appearances						0.007*
						(0.003)
Catcher Framing Ability						-0.102**
						(0.007)
Constant	-1.108**	-1.111**	-1.111**	-1.110**	-1.220**	-1.161**
	(0.055)	(0.055)	(0.055)	(0.055)	(0.059)	(0.059)
N	221291	221291	221291	221291	220925	190583

**p<.05 **p<.01*

Table 5. Summary Statistics of Umpire-Specific Regressions

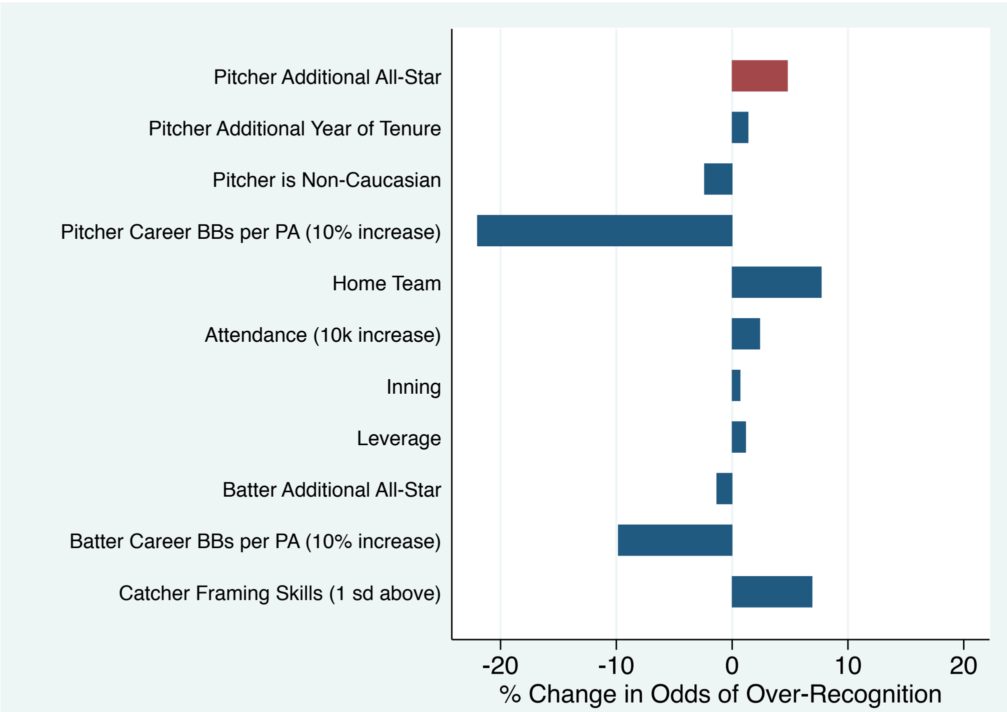
Type of Status Bias	Obs	Mean of Coeff.	Std. Dev.	Min	Max	% > 0
Over-Recognition	81	.0454	.054	-.097	.196	79.01%
Under-Recognition	81	-.0308	.082	-.381	.199	35.80 %

Table 6. Determinants of Outcomes of an At-Bat: Winning Percentage Added (WPA) and Total Bases

	WPA		Total Bases	
	(1)	(2)	(1)	(2)
Pitcher Career Era	-0.00172**	-0.00166**	0.02841**	0.02709**
	(0.00012)	(0.00012)	(0.00180)	(0.00180)
Batter Career OBP+SLG	-0.00966**	-0.00972**	0.24903**	0.25031**
	(0.00069)	(0.00069)	(0.00974)	(0.00972)
Leverage	0.00732**	0.00731**	-0.02074**	-0.02065**
	(0.00012)	(0.00012)	(0.00169)	(0.00168)
Home Team	0.00095**	0.00091**	-0.01688**	-0.01602**
	(0.00021)	(0.00021)	(0.00296)	(0.00295)
Outcount (1 out)	0.00198**	0.00201**	0.00144**	0.00079**
	(0.00024)	(0.00024)	(0.00344)	(0.00343)
Outcount (2 out)	0.02623**	0.02611**	-0.44295**	-0.44030**
	(0.00027)	(0.00027)	(0.00377)	(0.00377)
Under-Recognized Pitch (Call: Ball; Location: Strike)		-0.00324**		0.07440**
		(0.00023)		(0.00408)
Over-Recognized Pitch (Call: Strike; Location: Ball)		0.00326**		-0.06741**
		(0.00029)		(0.00321)
Cons	0.00732**	0.00683**	0.16969**	0.17905**
	(0.00081)	(0.00081)	(0.01141)	(0.01142)
F	2555.8	1962.77	3094.02	2428.8
R-Square	0.0655	0.067	0.0783	0.0816
N	218621	218621	218621	218621

**p<.05 **p<.01*

Figure 1. Effects of Selected Variables on Odds of Over-Recognition



Note: All effects based on Table 3 Model 2, with the exception of Batter (Model 5) and Catcher (Model 6) effects

Figure 2. Interaction between Reputation and All-Star Appearances on Probability of Over-Recognized Pitch

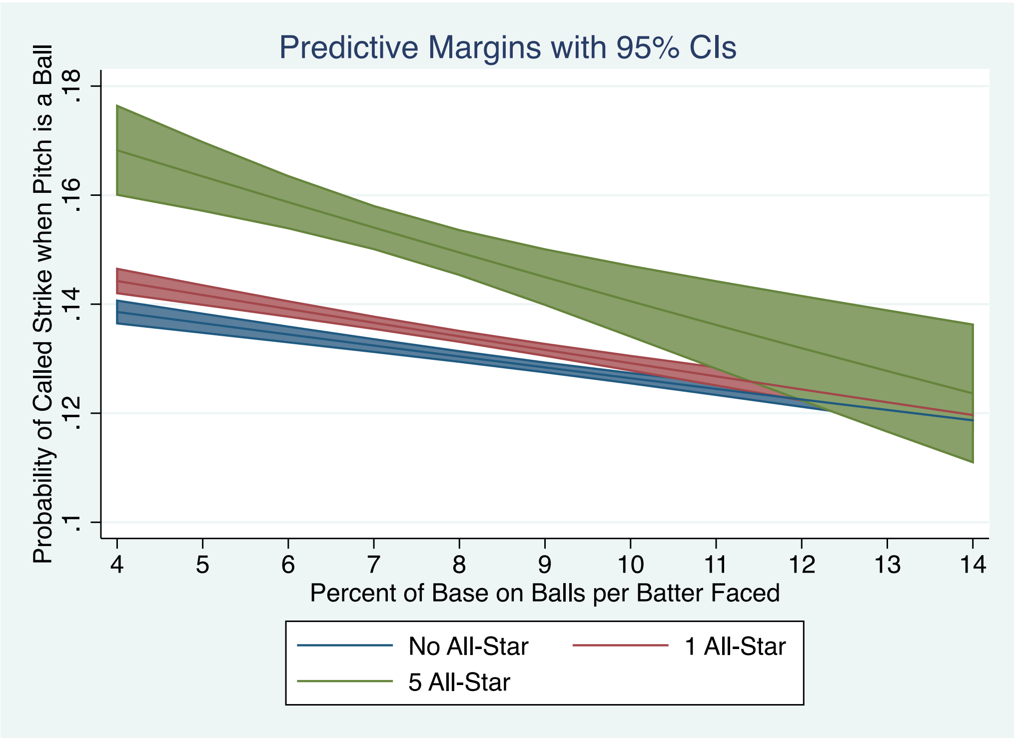


Figure 3. Effects of Selected Variables on Odds of Under-Recognition

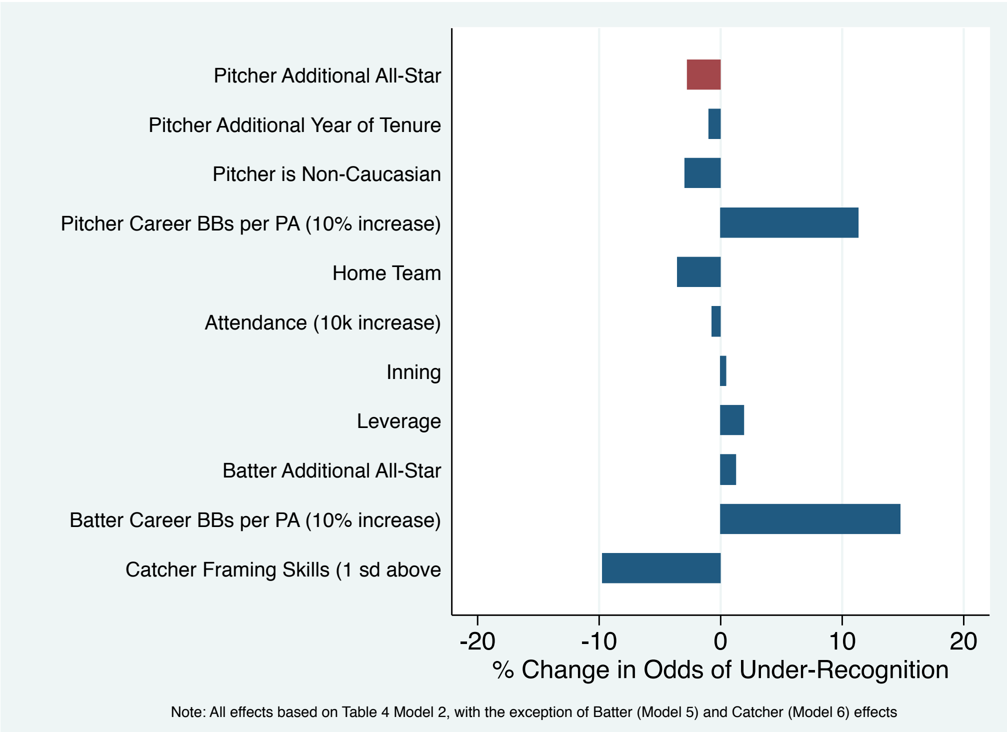


Figure 4. Interaction between Distance from Border and All-Star Appearances on Probability of Under-Recognized Pitch

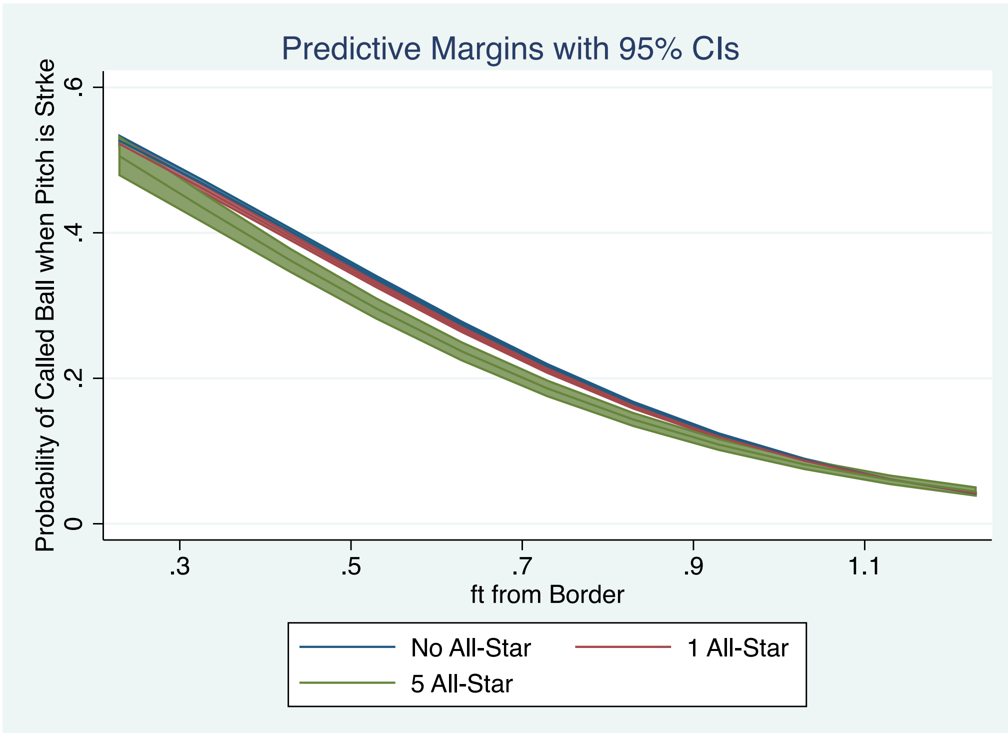
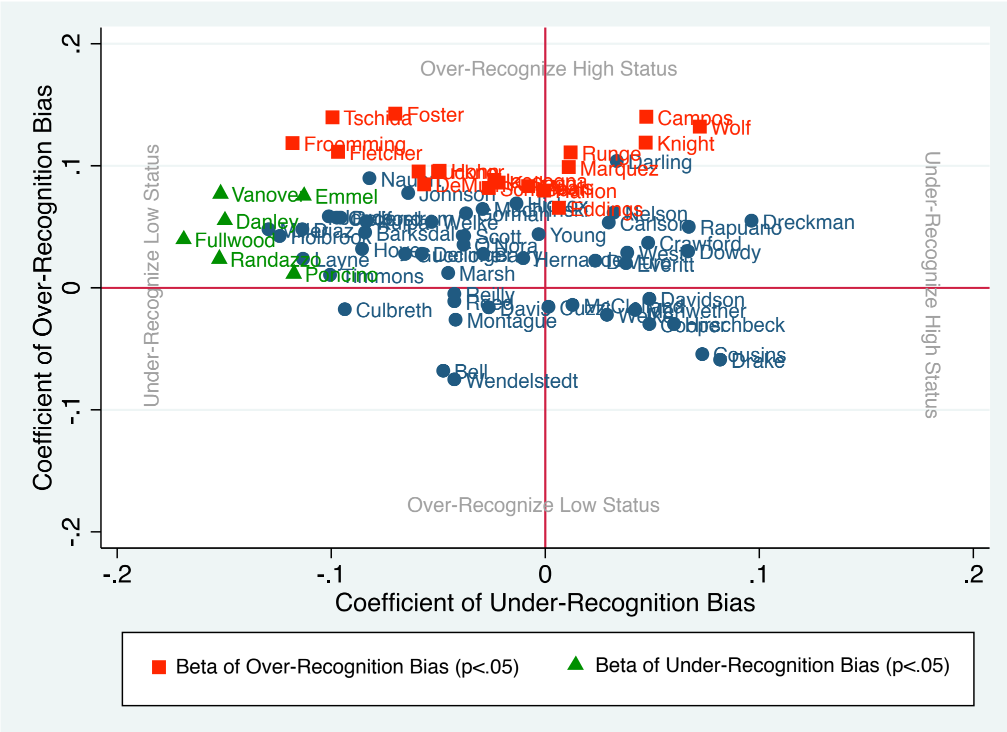


Figure 5. Umpire-Specific Regression Coefficients



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