**Don’t judge a hitter by his cover: Pitchers inaccurately stereotype batters by physical appearance.**

Paper ID 5622

**Note:** Dataset and R analysis code are publicly available at Github [url redacted for anonymity].

**Abstract**

Social psychology research on stereotyping finds that people tend to “judge a book by its cover”, relying on physical aspects of an individual to infer underlying traits, even when more diagnostic and accurate information is available. *Do pitchers inaccurately “judge a hitter by his cover”*? We conduct three studies, finding converging evidence that physical stereotyping hassurprisingly large effects on pitcher behavior, and subsequently negative impacts on performance. Analyses reveal that the effects of a hitter’s weight on pitch strategy range from tenpercent to nearly one hundred percentof the effect size found for actual hitter power (depending on the specific behavior; e.g., pitch type, pitch location). Importantly, these effects remain highly significant when controlling for factors known to affect pitch strategy, such as hitter quality, pitch count, and number of baserunners**.** Results suggest that pitchers who rely on physical stereotypes of hitters may be engaging in non-optimal pitch strategy; for instance, increasing pitch distance from the center of the plate (and thus, increasing chances for throwing a walk) when power outcomes are not significantly more likely. These results represent a novel approach to player decision-making in baseball, introducing cognitive effects that may have significant impacts on player outcomes.

**Introduction**

Social psychology research finds that people frequently "judge a book by its cover”, incorrectly relying on an individual's physical appearance to predict his or her underlying characteristics (Todorov et al., 2015; Zebrowitz & Montepare, 2008). This well-established phenomenon can have substantial impacts on a number of outcomes, including elections (candidates with competent-looking faces are elected more; Todorov et al., 2005) and court verdicts (baby-faced individuals judged less guilty of intentional criminal behavior; Zebrowitz & McDonald, 1991). Do athletes "judge opponents by their cover"? In this paper, we investigate whether baseball players—specifically, pitchers—rely on physical stereotypes of opponents during games. We also examine the extent to which this bias can have unexpectedly large, negative impacts on performance.

**Relying on Physical Appearance to Judge Opponents**

At first glance, the claim that baseball players rely on opponent physical appearance when determining strategy may appear implausible. For example, present-day teams are equipped with high-quality data about opponents, making it seem unlikely they would rely on superficial information about opponents. In addition, it is reasonable to predict that if the proposed stereotyping effects did exist, they would have a trivial impact on important outcomes.

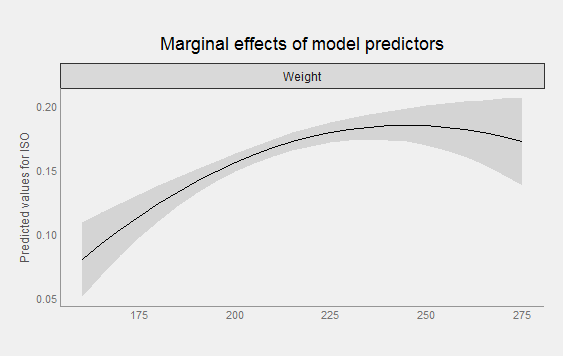
However, these intuitions may be incorrect. Behavioral science research has found numerous instances in which individuals rely on heuristics and “mental shortcuts” over more accurate information—even in domains where accuracy is critical, including medicine, business, and law(Kahneman, 2011). Though the use of heuristics can occur due to lack of motivation or effort, they can also impact deliberate attempts to make decisions, often outside of conscious awareness or control. In these cases, even motivated and highly knowledgeable individuals may fall prey to the use of heuristics.

Here, we focus on the physical appearance heuristic, which has a powerful effect in a number of social judgments, including trustworthiness, competence, and aggressiveness4. For instance, past research suggests that CEOs who look competent and dominant tend to receive higher salaries and are hired by more successful companies (Graham, Harvey, & Puri, 2010; Rule & Ambady 2008, 2009). We propose that physical appearance is likely to impact decision making in Major League Baseball, for two reasons. First, physical characteristics in baseball often contain a “kernel of truth” that make them difficult to dismiss or ignore when facing an opponent. Second, external conditions that are highly common in baseball, such as limited time and high amounts of information, can exacerbate the use of heuristics (Kahneman, 2011). Consider the instance of pitchers when selecting pitch strategy (e.g., pitch type, pitch location) against a batter. Here, pitchers must integrate a considerable amount of information, including situational context (e.g., pitch count, baserunners), current “feel” for pitches, and batter qualities, often in short time periods (i.e., between pitches) and while under considerable pressure.

**Current Paper**

In this paper, we investigate the following question: does an opponent’s physical appearance impact player behavior? We choose one, specific example: the effect of a batter's physical weight on pitcher behavior.

Past and current research suggests that pitchers tend to use more “cautious”[[1]](#footnote-1) strategies against batters who hit for power, such as throwing more offspeed pitches(Arthur, 2014) and pitches farther from the center of the plate. These strategies may be adaptive, such as reducing highly negative, power outcomes. For example, more home runs are hit on fastballs than other pitches(Hale, 2009); thus, pitchers may benefit from avoiding its use against power hitters.

As mentioned, certain physical characteristics of opponents can contain a “kernel of truth”, or some degree of accuracy about underlying qualities. This is indeed the case with physical weight and batter power, which has a significant, positive relationship (see Figure 1). 

Here, we propose that pitchers are affected by a batter’s physical appearance when determining pitch strategy. Specifically, pitchers are more likely to use “cautious” strategies—typically used against power hitters—when facing physically heavy batters, regardless of the batter’s actual ability to hit for power. Notably, these pitch strategies may not only be based on meaningless information, but also negatively impact performance. Specifically we hypothesize that pitch strategies used against physically stereotyped hitters are likely to be less effective than those based on actual performance, such as a batter’s past ability to hit for power.

**Analytic Plan**

Using PITCH f/x and Statcast pitch-by-pitch data from 2015 through 2017[[2]](#footnote-2), we explore the proposed effects in four studies. In Study 1, we investigate the existence of a stereotype effect, by examining whether pitchers tend to use more “cautious” pitch strategies (e.g., more offspeed pitches) against batters who fit the physical stereotype of a power hitter, when controlling for relevant variables, such as a batter’s actual power. In Study 2, we examine the extent that stereotyping negatively impacts pitcher performance. Study 3 investigates the temporal dynamics of stereotyping, estimating the strength of stereotype effects against rookie batters at various points in the season. Lastly, in Study 4, we explore how inaccurate stereotypes, by examining when pitchers successfully adapt (or fail to adapt) to stereotype-disconfirming data about batters during the season.

**Effects of Batter Physical Stereotypes on Pitcher Behavior**

**Introduction**

To begin, we investigate whether batter physical stereotypes affect pitcher behavior. Specifically, we examine whether pitchers are more likely to use “cautious” pitch strategies against batters who physically resemble power hitters (i.e., are physically heavy), while controlling for a number of relevant factors, including a batter’s actual power.

Before conducting the analysis, we introduce our measures of pitch strategy. We focus on three factors: pitch type (fastball versus non-fastball), horizontal pitch location, and vertical pitch location. We chose these factors due to their relevance to the topic of power hitters. Regarding pitch type, pitchers throw fewer fastballs to power hitters (Arthur, 2014); furthermore, home runs are hit less frequently on fastballs than non-fastballs (Hale, 2009). Regarding horizontal location and vertical location, power outcomes are reduced on the outer edges of the plate, and particularly for “low and away” pitches (Fangraphs). Based on these findings, we hypothesized that pitchers would exhibit the following behaviors towards power hitters: decreased fastballs, increased horizontal distance from center of the plate, and decreased vertical location, particularly for pitches thrown on the outer half of the plate.

**Dataset**

For our dataset, we used all regular-season PITCHf/x and Statcast data from 2015 through 2017 (approximately 2 million pitches), which is publicly available on BaseballSavant.MLB.com[[3]](#footnote-3). Pitches that were missing data (e.g., horizontal pitch location) were removed from the analysis. Other notes on data cleanup are provided in the Appendix.

**Models**

We now present mixed-effect logistic and linear regression models that isolate and quantify the effects of batter physical weight on pitch behavior. Using pitch-by-pitch data (i.e., one row equals one pitch), the regression models separately predict three pitch strategy outcomes: pitch type, horizontal pitch location, and vertical pitch location.

In the models, we include predictor variables known to affect pitch strategy, such as hitter characteristics (e.g., power, overall quality), pitch count, and number of baserunners. These variables can be separated into two, general categories: batter and situation. We begin by outlining each batter variable, shown below:

1. **Batter weight** (symbol) and **height** (symbol) were recorded from yearly listings on MLB.com (e.g., batters have different weights across seasons). To account for possible nonlinear effects, we included a quadratic term for batter weight (symbol) and height (symbol).
2. **Batter power** (symbol), as measured by Isolated Power (ISO), a highly used metric that assess a batter’s “raw power” (see Fangraphs)[[4]](#footnote-4). Our intent was to accurately represent a batter’s power ability *at the current plate appearance*. To calculate this for each batter, we relied on two sources of information: preseason ISO projections[[5]](#footnote-5) and in-season ISO, up to the current plate appearance. To optimally weigh both factors, we used a linear regression model (using all 2015-2017 data) that predicted ISO during an upcoming at-bat, given a batter’s preseason ISO, in-season ISO, and specific number of in-season plate appearances. Other relevant effects were included; for example, an interaction effect between in-season performance and plate appearances (i.e., in-season performance is more predictive of at-bat power as number of in-season plate appearances increase). Predicted values from the regression model were used as our measures of batter power. For example, the predicted power of batter with .200 preseason ISO projections, .220 in-season ISO, and 300 in-season plate appearances.

1. **Batter overall quality** (symbol), as measured by Weighted On-Base Average (wOBA; see Fangraphs), a frequently used metric that assesses a batter's overall offensive contribution8. Unlike ISO, wOBA considers non-power outcomes, such as singles and walks, as positive contributions. Similar to our method for predicting batter power, we predicted batter overall quality by creating a regression model with at-bat wOBA as an outcome, and a) player projections, b) in-season performance, and c) number of in-season plate appearances as predictor variables (see Appendix). As before, we computed predicted batter overall quality values prior to each at-bat, for each batter.

In order to ensure that results were not primarily driven by batters with unreliable measures of power or overall quality, we removed rookies and batters with less than 100 projected plate appearances from the dataset. Previous research indicates that projection systems may have especially poor predictive accuracy for players without substantial recent, historical performance (Druschel, 2017), which includes batters from the above two groups. For further discussion of stereotyping effects with rookies, see Study 3.

The situational factors included in the regression models are the following:

1. **Pitch count** (symbol), represented as an indicator variable (e.g., 3-2, 0-2). Previous research has found that pitch behaviors, such as fastball rates, are affected by pitch count; for example, with pitchers ahead in the count (e.g., 0-2) tending to throw more offspeed pitches.
2. **Baserunners** (symbol) represented as an indicator variable (e.g., runners on first and third base). Previous research finds that baserunners impact pitch strategy, such as fastball rates (Bogarty, Duncan, & Benz, 2017). Furthermore, power hitters and physically heavy hitters may be more likely to have baserunners during at-bats (e.g., are in center of lineup).
3. **Pitcher** (symbol), represented as a random effect.
4. **Game** (symbol), represented as a random effect

As previously mentioned, we include three models that separately predict the three outcome measures: pitch type, horizontal pitch location, and vertical pitch location. We begin by further describing our first model.

Our first model (pitch type) was a mixed-effect logistic regression. Pitches were coded as 1 or 0, for fastballs (four-seam or two-seam) or non-fastballs, respectively. Our specific model was the following,

[Model goes here]

In our second model (horizontal distance), we examined whether batter weight significantly predicts a pitch's horizontal distance from the center of the plate. Horizontal plate distance was measured as absolute distance from the center of the plate (in feet). In addition to measuring absolute horizontal plate distance, we also included a dummy value indicating whether the pitch was thrown on the inside versus outside part of the plate (1 for inside, 0 for outside). We included this factor because pitchers may exhibit specific tendencies to throw on the inside versus outside part of the plate to batters with certain qualities; for example, throwing more often on the outer half of the plate against power hitters versus other hitters.

The specific model is the following,

[Model goes here; it is very similar to the previous model, but includes the “inside/outside” variable]

Our third model specifically examines pitch vertical distance as the outcome variable. It is identical to our second model measuring vertical location, and thus will not be presented below.

**Results**

As expected, batter power was a significant predictor of pitch behavior, along the three measures. Namely, increases in batter power predicted decreased fastballs, increased horizontal distance from the center of the plate, and decreased vertical location on pitches on the outside (but not inside) part of the plate.

[main regression results]

[graphs showing main results]

[ideal types]

[situational examples? Example: Aaron Judge with bases loaded]

**Summary**

Using 2015 through 2017 PITCHf/x and Statcast data, we found that pitchers exhibited more cautious behavior against batters who fit the physical stereotype of power. Notably, these effects were significant even when controlling for a number of factors known to affect pitch strategy, such as actual batter power. Furthermore, stereotyping effects were quite large, with effects between x and x% the size of measures of [need to finish]…

**Effects of Stereotyping on Outcomes**

The above section provides evidence that pitchers stereotype opponents by physical appearance, exhibiting more cautious strategies against batters who physically resemble power hitters. Importantly, these effects were significant when controlling for a batter's actual power, as well as other factors known to influence pitch strategy (e.g., pitch count, baserunners).

From the authors’ viewpoints, there are no clear reasons why pitch strategies that are determined by physical weight would be effective. However, it is critical to directly test this possibility, examining whether the observed strategies (e.g., throwing fewer fastballs to physically heavy batters) tend to increase or decrease overall pitchers success.

To measure pitcher success, we assess a variety of outcomes, including home runs, strikeouts, and walks. We had two, main hypotheses. First, pitch strategies that were based on actual, batter performance, such as power, may increase pitcher success. For example, batters tend to hit more home runs on fastballs (Hale, 2009); thus, it may be beneficial to throw fewer fastballs to power hitters. Second, we hypothesized that, in contrast, pitch strategies based on physical weight would not increase pitcher success.

**Models**

We use regression models to assess whether the success of various pitch strategies depend on batter attributes, such as power and physical weight. Before presenting the models, we make two notes, presented below.

First, for outcome variables, we use several measures of pitch “success”, including home runs, singles, walks, and strikeouts. We chose to examine a variety of outcomes because they may reveal distinct advantages or disadvantages for specific pitch strategies. For example, throwing farther from the center of the plate may reduce home runs, but increase other negative outcomes, such as walks. We also examine success on pitches that do not result in the end of the plate appearance, by examining whether the specific pitch strategy increased balls or strikes.

Second, for predictor variables, we include three, general categories: batter, situation, and pitch strategy. Batter and situation categories are identical to those used in Study 1, including factors as batter power, pitch count, and baserunner situations. Unlike Study 1, however, pitch strategy is examined as a predictor, rather than outcome variable.

Our regression models take the following general form,

[regression models here]

[We will

**Results**

Due to the large number of models, we focus on relevant results only (all results are available in Appendix). We summarize results in three parts: effects of pitch type, horizontal pitch location, and vertical pitch location on pitcher success.

We begin by reporting the effects of pitch type (fastball or not) on success towards specific types of batters.

[results]

[example: fastballs increase home runs, increase strikes, reduce balls…]

We now report effects of horizontal pitch location.

[results]

We now report effects of vertical pitch location.

[results]

**Summary**

Results from this study reveal that stereotyping opponents by physical appearance can negatively impact performance. Specifically, cautious pitch strategies reduce negative outcomes (e.g., home runs) towards power hitters. Notably, however, cautious strategies did not have similar outcomes towards batters who merely fit the physical stereotype of power hitters.

**Dynamics of Stereotyping Processes**

While the above sections investigate an overall stereotyping effect, it is also possible to examine more fine-grained processes.

Physical stereotyping may provide insights into the underlying dynamics and processes of several well-studied phenomena, such as “hot streaks” and “earning respect” as rookies.

Hot Streaks

Consider an opponent batter in the midst of a “hot streak”. In this instance, pitchers must judge whether the opponent’s recent improvement indicates an actual, underlying change in ability, or merely occurred due to randomness or luck. Recent research on hot streaks suggest that pitchers frequently select the former, responding to “hot” batters as if they have changed in underlying ability. For example, pitchers tend to throw more walks to “hot” batters, suggesting they are “pitching around” more frequently(Green & Zwiebel, 2016). Interestingly, these judgments appear to be adaptive, with “hot” batters exhibiting increased success in upcoming at-bats (Green & Zwiebel, 2016).

Here, we examine whether physical stereotypes can bias how pitchers respond to recent batter behavior—namely, hot streaks. Social psychology research finds that when individuals observe new behaviors from others, they tend to attribute stereotype-inconsistent behaviors to external causes (e.g., situational factors, luck), and stereotype-consistent behaviors to stable, internal causes (e.g., ability; Weiner, 1985; Bodenhausen & Wyer, 1985; Deaux & Emswiller, 1974). In the case of “hot streaks”, pitchers may be more likely to consider them “real” when they come from a batter who fits the physical stereotype.

To increase relevance to previous studies, we focus on a specific type of hot streak: “power surges”, here defined as increases in power (rather than overall quality). We hypothesize that pitchers will be more likely to change strategies against batters experiencing “power surges” who physically resemble a power hitter.

**Dataset**

We used the same dataset as Study 1 and 2.

**Model**

Similar to Study 1 and 2, we use regression models to estimate how various factors affect pitch strategy, as measured by three outcomes: pitch type (fastball or not), horizontal pitch location, and vertical pitch location.

Predictor variables included in our models are identical to Study 1, which measured the effects of two general categories—batter and situation variables—on pitch strategy. However, Study 3 includes one, new factor: recent power (batter’s ISO in past *x* at-bats). Our primary research question is how the effects of “power surges” on pitcher strategy are moderated by batter qualities. To measure this effect, we include 2-way interactions between recent power and all batter qualties (e.g., power, overall quality, weight).

Similar to previous studies of “hot streaks” (Green & Zwiebel, 2016), we examine several different streak lengths for power: 1, 3, 10, and 50 at-bats. We measure each streak length in separate regression models.

Our general model is presented below,

[model goes here]

**Results**

For parsimony, we present only relevant results (full results are available in Appendix).

**Summary**

Study 4 examined how physical stereotypes influence how pitchers integrate new information about opponent batters. Pitchers were less likely to adapt to an opponent’s recent increase in power ("power surges") when the opponent did not physically resemble a power hitter. Results only confirmed this effect for one of our two measures of pitch strategy (pitch type).

**Dynamics of Stereotyping Processes**

First, we begin with

**General Discussion**

In four studies, we present converging evidence that pitchers inaccurately "judge an opponent by his cover", stereotyping hitters according to physical appearance. Study 1 found initial evidence of a stereotyping effect: pitchers throw more cautiously to batters who fit the physical profile of a power hitter, regardless of their actual power. Study 2 examined how stereotyping impacts performance, finding that modified pitch strategies towards power hitters were successful, but not towards batters who were physically stereotyped as power hitters. Study 3 examined a subset of batters—rookies—finding that stereotyping was exacerbated when pitchers lacked other information about hitters (e.g., past performance). Lastly, Study 4 found evidence that stereotyping can negatively affect how pitchers process new information about opponents. Specifically, pitchers were less likely to discard cautious strategies against “cold” batters if the batter physically resembled a power hitter.

Intriguingly, we generally found that the impacts of stereotyping on behavior were quite large, with effect sizes representing nearly x to x % of the effects of actual performance. [note about how effects of ISO and wOBA on behavior were also “low”?]

One may ask: how can a seemingly inaccurate and trivial piece of information, such as a batter’s physical weight, have such strong influences on behavior? We provide two reasons. First, prior research in social cognition finds that using physical appearance during judgments can be automatic and highly difficult to control, even in domains that are highly important (e.g., elections). Second, physical appearances can contain a “kernel of truth” about underlying qualities, thus making it more difficult to dismiss. This is especially true in baseball, where physical weight reasonably predicts actual power, particularly when not considering other information (e.g., past power).

**Applications**

An important aspect of this research is understanding how it can be used during competition. One possibility is to implement simple decision rules. For example, when pitchers are ambivalent about using cautious or aggressive pitch strategies versus power hitters, they may consider the rule “go against the stereotype”. We do not suggest that simple decision rules are a novel or unique approach; rather, we merely suggest it may be a useful way to reduce inaccuracy or bias.

**Limitations**

Our findings have at least three limitations. First, measurements of batter physical features may not be accurate. To reduce concerns of inaccuracy, we utilized MLB.com batter data, which updates yearly (i.e., players change weight between seasons). However, reported physical weights may not be accurate, in certain cases.

Second, it is possible that the observed effects in our three studies can be explained by factors other than physical weight. While we attempted to control for theoretically relevant factors, alternative factors could explain the obtained effects.

Third, we have often assumed that pitchers are primarily responsible for the phenomenon in question. However, it is important to note that catchers and other individuals (e.g., coaches) can also determine pitch strategy. As a result, it may be inappropriate to target pitchers as the locus of stereotyping effects.

**Conclusion**

**Study 3: Effects of Contact on Stereotyping**

What factors determine whether a batter’s physical appearance will affect pitcher behavior? One straightforward claim is that physical stereotyping will occur most strongly when pitchers lack other information about the batter, such as past performance. Study 3 examines this hypothesis by specifically investigating rookie batters, who were excluded from Study 1 and 2.

We hypothesize two, primary effects. First, physical stereotyping will be especially large when facing rookie batters who do not have many plate appearances. Second, stereotype effects should reduce as pitchers gain more information about rookie batters (i.e., more plate appearances). Parallel effects are commonly found in social psychology research, where contact with stereotyped group members typically reduce stereotype endorsement (Pettigrew, 1998).

**Dataset**

Only rookies from the Study 1 and 2 dataset were used in the analysis.

**Model**

The models for Study 3 are identical to Study 1, which measured pitch behavior (pitch type, horizontal location, vertical location) towards batters with specific qualities (e.g., weight, height, power). However, Study 3 has an additional factor: number of plate appearances. We hypothesized that the effects of physical appearance (e.g., weight) on behavior is moderated by the batter’s number of plate appearances; for example, with effects of physical weight decreasing as number plate appearances increase. To measure this effect, we include a main effect of plate appearances and interaction effects between plate appearances and batter qualities, such as weight and power (see Appendix for full model).

**Results**

**Summary**

Notably, these effects do not discount the overall stereotyping effects found in Study 1. As previously mentioned, Study 1 found that stereotyping effects were significant for non-rookies. Thus, it appears that

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[work in progress]

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**Appendix**

Data cleanup

We performed the following data cleanup for Studies 1-3:

1. Invalid pitch counts were removed (e.g., 4-2).
2. Unidentified pitch types were removed.
3. Pitchouts and intentional walks were removed. Wild pitches and hit-by-pitches were included, due to their theoretical relevance to pitch distance from the center of the plate (i.e., wild pitches and hit-by-pitches are less likely when pitchers are aiming for center of plate).
4. Rookie batters and batters with less than 100 projected plate appearance (e.g., rookies) according to Steamer projections were removed from analysis. We chose these exclusion criteria because accurate measures (i.e., predictions) of batter qualities (e.g., power) can highly inaccurate without a significant amount of previous season(s) data (e.g., Druschel, 2017)

Study 1

[ignore this; old stuff]

Certain pitch strategies (e.g., pitch type, pitch location) can effectively reduce power outcomes. For instance, batters tend to hit for less power on offspeed pitches versus fastballs; on pitches that are horizontally farther from the center of the plate (inside or outside); and, on low, outside (but not inside)5.

Physical appearance can similarly influence judgments, often in ways that are difficult to notice or control. It is rapidly and unconsciously processed by perceivers, often within 100 milliseconds of exposure to another individual4. Furthermore, it is often a somewhat reliable indicator of underlying qualities, in certain circumstance

Previous research on decision-making find that heuristics are most likely to bias deliberate, rational processing when external conditions are met; for example, when individuals have limited time, or are required to process noisy or large amounts of information. Notably, these conditions are highly common in baseball, where players are required to integrate numerous sources of information using limited resources (e.g., time), and under considerable pressure. For this reason, players may be influenced by an opponent’s physical appearance, often outside their conscious awareness.

Teams have successfully used simple decision rules to improve performance. For instance, the Los Angeles Dodgers have encouraged pitchers to focus on “when the count is 1-1, throw a strike”15.

1. this measure, we Isolated Power (ISO), which measures a batter's "raw power"[[6]](#footnote-6). To accurately represent a batter's power at the specific at-bat, we included two factors: *preseason projections*[[7]](#footnote-7) (symbol), and the batter's *in-season performance*, prior to the at-bat (symbol). Our rationale for including both factors was to provide the most accurate representation of a batter’s expected power, at that specific point in the season. Because early in-season data less predictive of performance (i.e., due to low sample size), we multiply the initial weights of (regression coefficient multiplied by square root of current number of in-season plate appearances), in order to

Previous research in stereotype maintenance (see Study 3) also finds that individuals tend to interpret new information as consistent with prior stereotypes. As a result, it may be difficult for perceivers to notice any inaccuracies surrounding the role of weight on judgments of power.

**Study 4: Effects of Stereotypes on Interpreting New Opponent Behavior**

1. We use “cautious” to label pitchers’ behaviors towards power hitters (e.g., more offspeed pitches, more pitches farther from center of plate), because they are proposed to prevent highly negative power outcomes (e.g., home runs). [↑](#footnote-ref-1)
2. Statcast officially replaced PITCHf/x in the 2017 season. [↑](#footnote-ref-2)
3. Data was scraped using baseballr package in R (Petti, 2017). [↑](#footnote-ref-3)
4. Season ISO is calculated by (((2B)+(2\*3B)+(3\*HR))/AB). [↑](#footnote-ref-4)
5. We used Steamer, a projection systems that has high levels of predictive accuracy, on par with competitors (Druschel, 2017). [↑](#footnote-ref-5)
6. [↑](#footnote-ref-6)
7. [↑](#footnote-ref-7)