Effects of Pitch Location and Count on Professional Baseball Umpires' Ball/Strike Decisions

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ABSTRACT

In baseball, home plate umpires' perceptual-cognitive skills are tested with each pitch as they are required to judge, with accuracy, whether the ball passed through the imaginary region above home plate known as the strike zone. Home plate umpires must visually track the flight of a pitched ball as it leaves the pitcher's hand and travels over the home plate region in order to accurately determine whether a pitch should be called a strike or a ball.

This study applied literature related to judgment and decision making among expert sport performers to the professional baseball umpire population. Using generalized linear mixed modeling with secondary data generated by the *PITCHf/x* pitch tracking system, umpires' ball/strike decisions were measured over the course of the 2016 season. Emphasis was placed on accounting for the effects of pitch location and ball--strike count on umpires' accuracy in making ball--strike decisions.

QUESTIONS

1. How accurate are individual umpires over the season?
2. After controlling for ball--strike count, is pitch location associated with MLB umpires' accuracy of judging pitch outcomes
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METHOD

Data for the current study are generated by a camera system, known as *PITCHf/x* (Sportvision, Inc., 2013), installed inside each MLB team's stadium for the purpose of capturing and measuring the flight path of pitched baseball trajectories (Nathan, 2008; Sievert, 2014). *PITCHf/x* data consist of all pitch-outcome decisions made by home plate umpires over the course of a single season.

Data for the current study were collected using the `pitchRx` package (Sievert, 2014) in the **R** statistical computing software application (R Core Team, 2017) representing all pitches delivered over the course of the 2016 season.

To test for the effects of pitch location and ball/strike count on the probability of umpires' accuracy in judging pitch outcomes, a generalized linear mixed model with interactions between fixed and random effects was estimated.
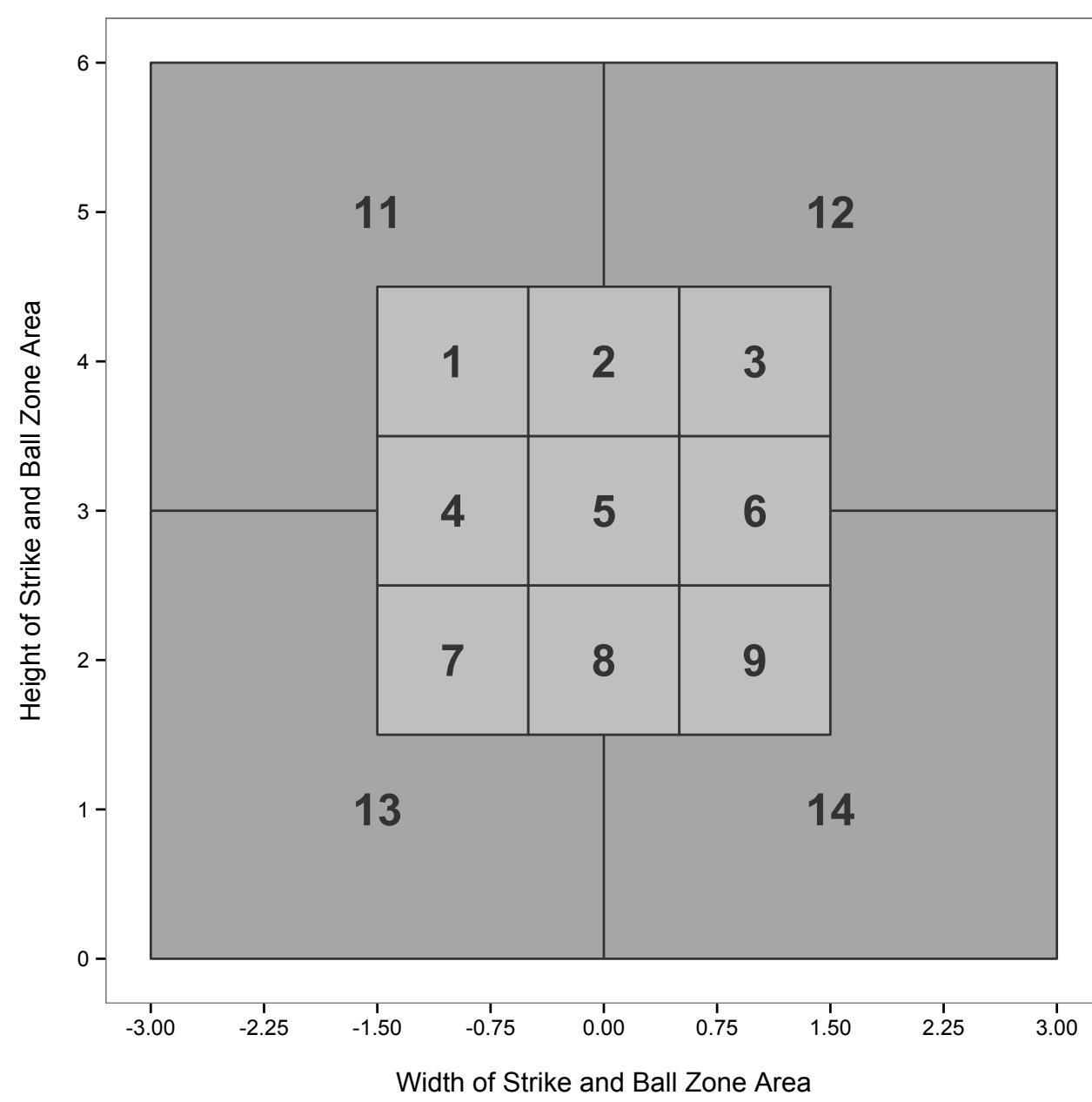

Fig. 1. Pitch location zones. Zones 1-9 considered within strike zone.
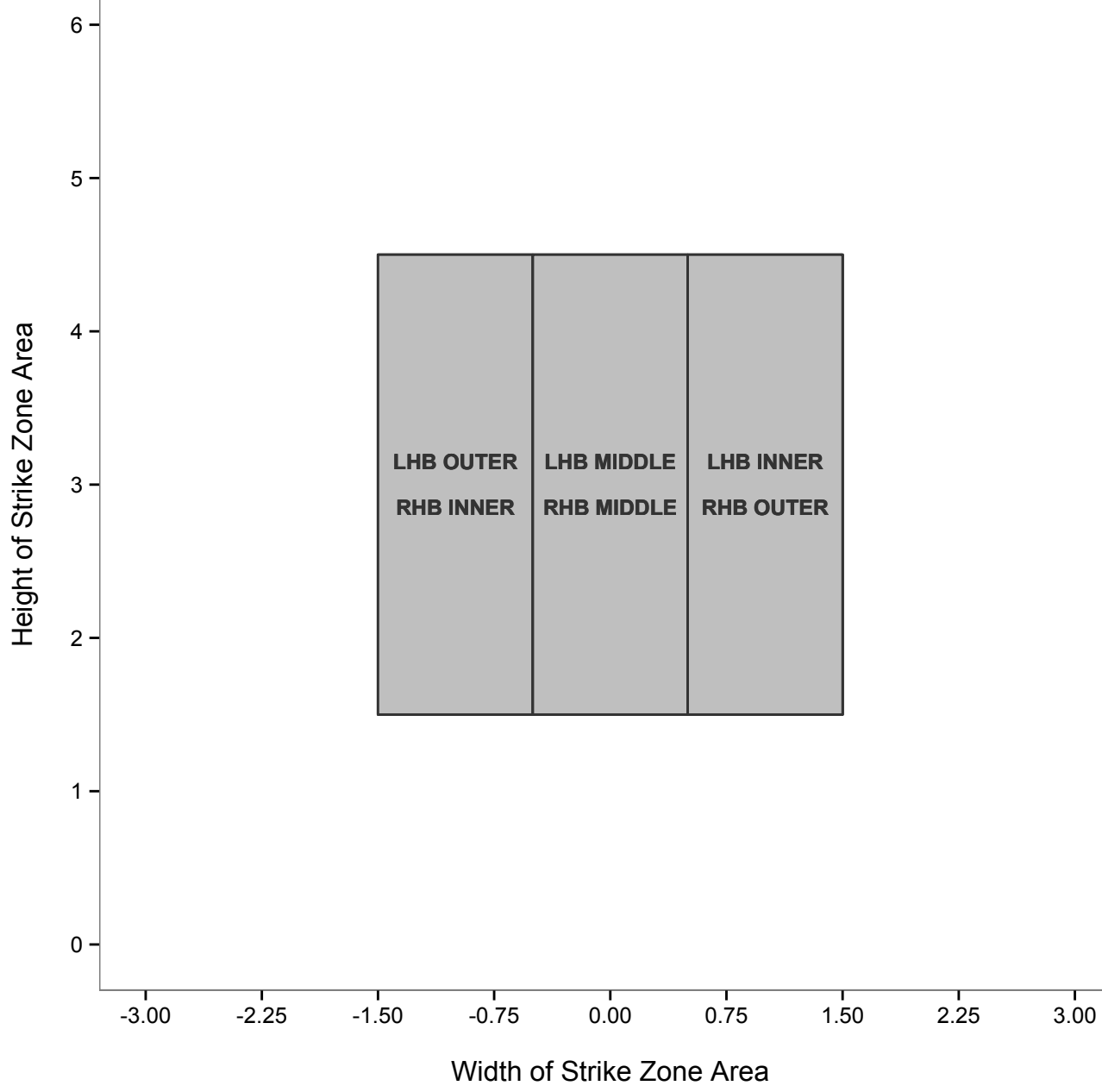

Fig. 2. Categorized pitch location regions. RHB = right handed batter. LHB = left handed batter.
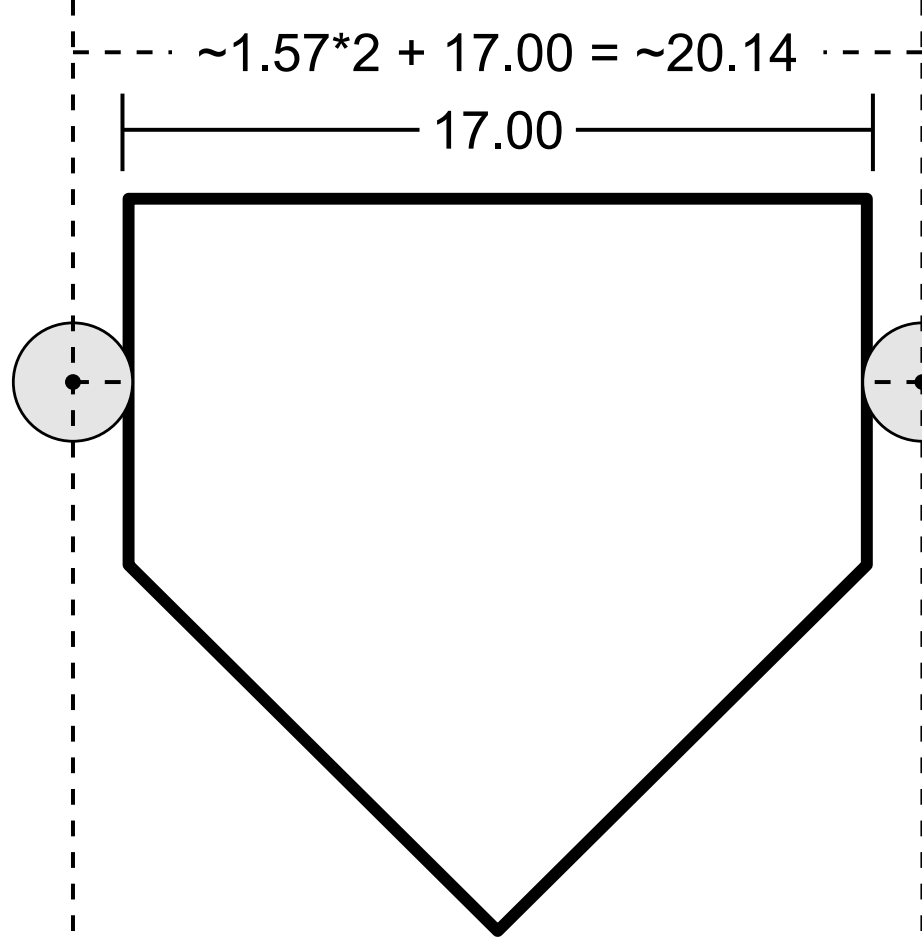
Fig. 3. Adjusted width of strike zone according to MLB rule book specifications.
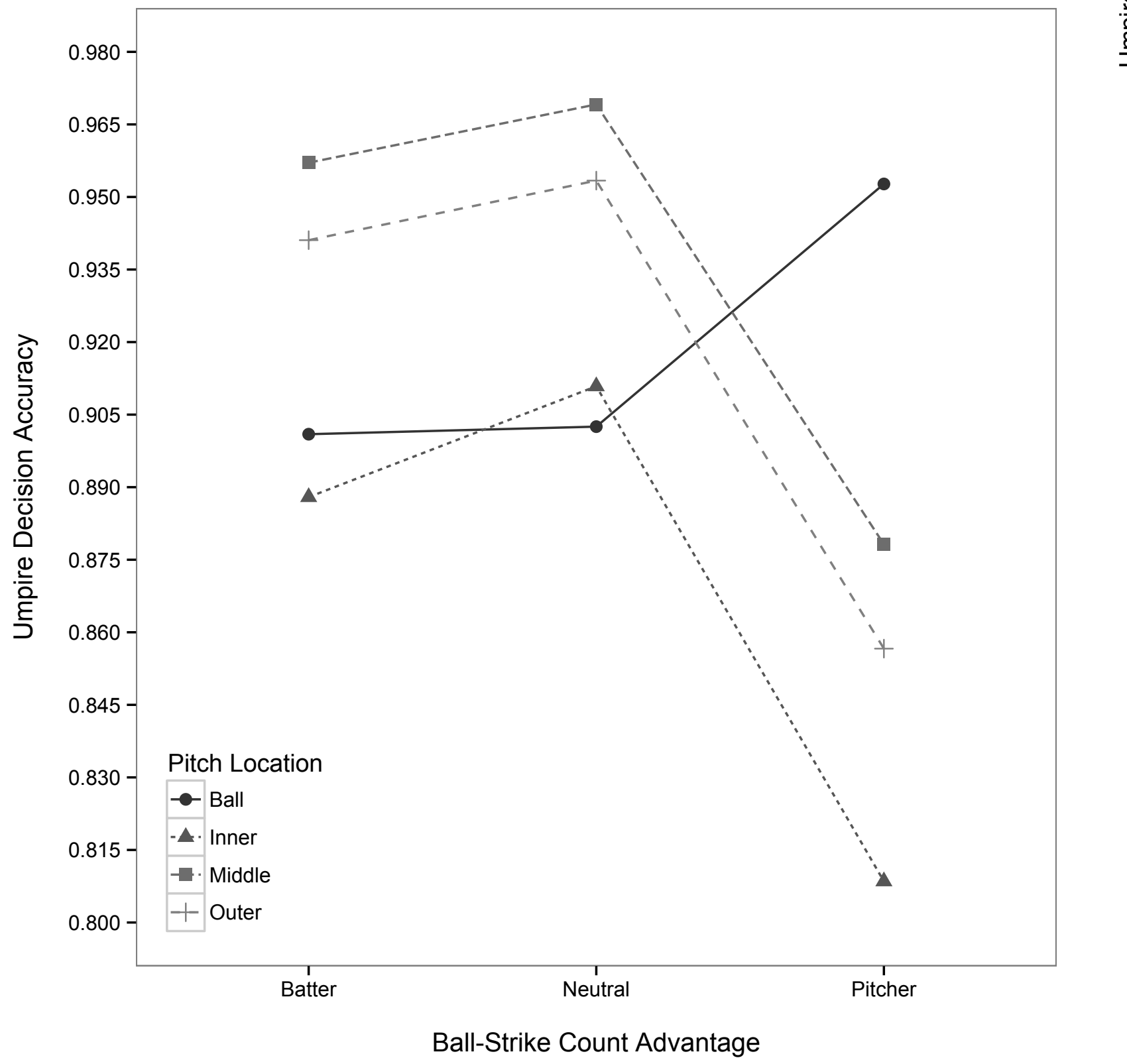
$\sim 1.57*2 + 17.00 = \sim 20.14$
17.00

Fig. 4. Predicted probabilities of umpire decision accuracy by ball/strike count and pitch location.
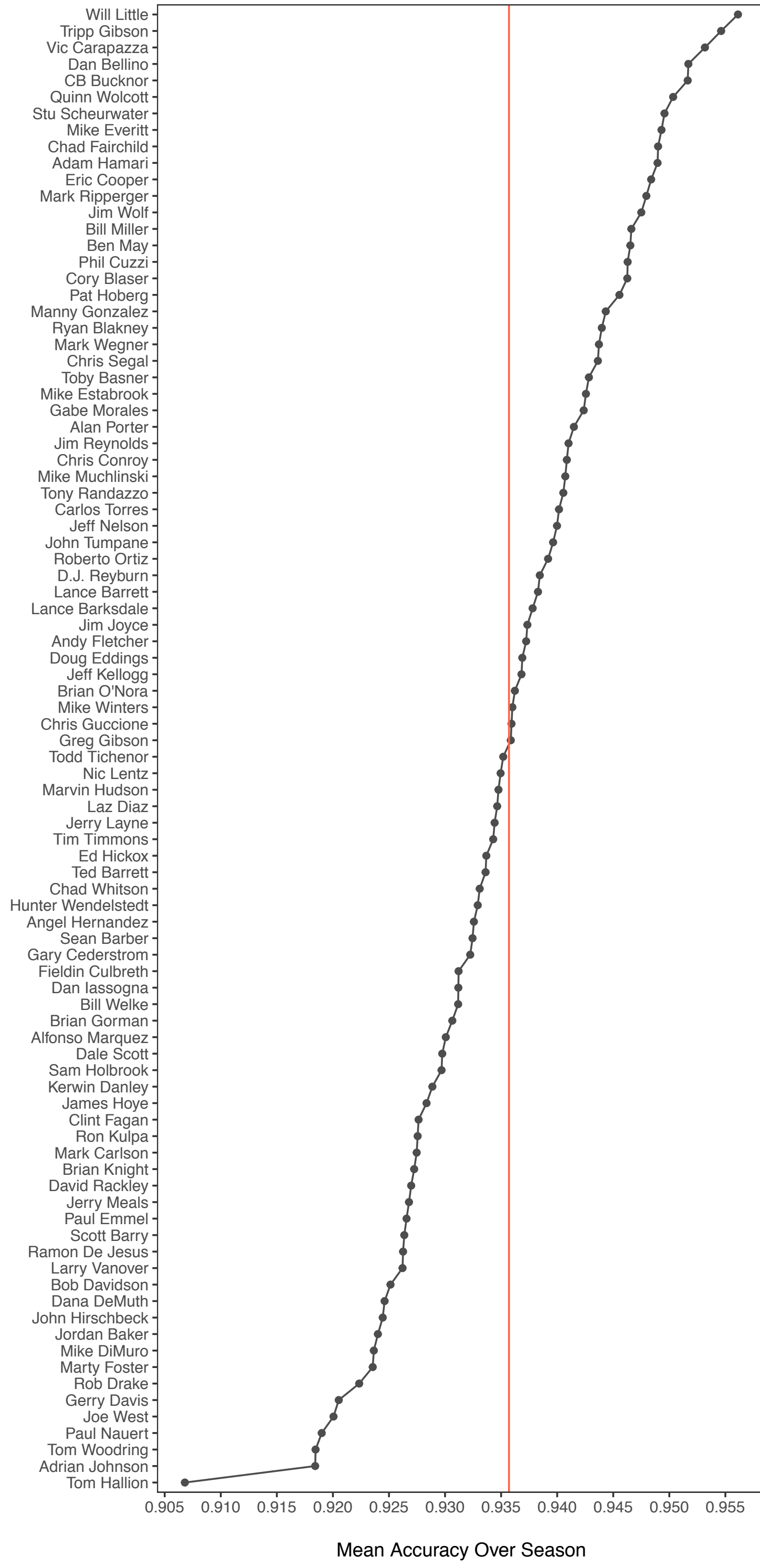
Fig. 5. Predicted individual umpire accuracy rates for 2016 season.

Table 2

Umpire Accuracy Rate Across Ball/Strike Count Advantages

Advantage	M	SD	SE	95% CI
Batter	92.62	26.14	0.138	[92.35, 92.89]
Pitcher	95.19	21.39	0.064	[95.06, 95.32]
Neutral	92.83	25.78	0.055	[92.73, 92.95]

Table 3

Umpire Accuracy Rate Across Pitch Location Regions

Advantage	M	SD	SE	95% CI
Ball	93.50	24.64	0.047	[93.41, 93.59]
Inner	90.11	29.85	0.195	[89.73, 90.50]
Middle	96.26	18.96	0.110	[96.05, 96.48]
Outer	93.73	24.24	0.123	[93.48, 93.97]

RESULTS

A total of 754,362 pitches were delivered to batters during the course of the 2013 regular and post-season. Umpires were required to make a total of 362,152 decisions, of which 122,469 (34%) were called strikes and 242,706 (66%) were called balls. On average, home plate umpires made decisions on approximately 149 pitches per game (SD = 5.89).

Table 1 presents summary statistics for umpire accuracy across all umpires over the course of the 2016 season. Umpires made 341,559 (93.57%) correct decisions. Table 2 presents summary statistics for umpire accuracy across three categorized ball/strike count advantages. Umpires demonstrate more accuracy (95.19%) when the pitcher holds the ball/strike count advantage.

Table 3 presents summary statistics for umpire accuracy across pitch locations. For pitches located within the strike zone (i.e., inner, middle, outer), umpires are more accurate when pitches are delivered in either the middle (96.26%) our outer (93.73%) regions, compared to those in the inner region (90.11%). For pitches located in the ball region, umpires are approximately 93.5% accurate.

Figure 4 displays a noticeable interaction between predicted probabilities for pitch location and ball–strike count—particularly during counts in which the pitcher holds the advantage over the batter and pitches are located in either the middle, outer, or inner regions. Interaction effects between pitch location and ball–strike count were estimated in the generalized linear mixed model.

Table 1

Summary of Umpire Accuracy Rate Across all Umpires Over Entire Season

	M	SD	SE	95% CI
Umpire Accuracy	93.57	24.45	4.92	[83.72, 98.49]

DISCUSSION

Results from the current study indicate umpires explain approximately 0.48% of the variability in pitch outcomes. Both pitch location and ball/strike count were observed to be associated with umpires' accuracy of judging pitch outcomes.

Although noticeable differences were observed during certain ball–strike count and pitch location conditions, umpires appear to be able to accurately distinguish when a pitch is located inside our outside of the imaginary strike zone area. Moreover, umpires are required to make these decisions in a relatively rapid sequence of judgment and decision making, even in spite of the ways in which the strike zone parameters change from batter to batter. Umpires may also be forced to adjust to the varying conditions in which pitches are delivered. For example, pitchers routinely vary the speed, trajectory, and location of pitches, which may combine to make it difficult for umpires to accurately view and judge the pitch outcome.

Finally, current umpire training curriculum and instruction materials recommend home plate umpires position themselves directly behind the inner region of home plate in order to view the area between the catcher's shoulder and the batter's hands (Moore, 2013). From the umpire's perspective this area would be the left side of home plate for right handed batters. For left handed batters, umpires would be positioned over the right side of home plate. It is possible that as batters try and position themselves to better reach pitches delivered to the outside region of home plate they obstruct the umpire's view of the inner region, thus preventing him from making an accurate decision.

Data and R Code:
http://bit.ly/aps-2017