

Implementing an Automated Strike Zone in Major League Baseball

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On my honor as a University student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments.

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Major League Baseball may implement some form of automated ball-strike system (ABS) as soon as 2025. Hawk-Eye's ABS combines data from 12 high-speed cameras around the ballpark with player and pitch tracking to determine the ball's release point and subsequent trajectory and rotation. From the results it calls balls and strikes (Jedlovec 2020). Proponents of ABS contend that the system averts the biases and inconsistencies of human umpires. Umpires tend to favor high-status pitchers with more generous strike calls than they extend to lower-status pitchers (Kim and King, 2014). To MLB Commissioner Rob Manfred, ABS is a top priority. He contends that accurate calls will benefit the game (Drellich 2023).

ABS proponents want the system to call every pitch; umpires would merely relay a call they receive through an earpiece. Others, however, argue that human umpires should call pitches themselves, turning to ABS only as backup when a call is challenged. Some say ABS is critical to the accuracy of calls; others say ABS threatens the integrity of the game. To succeed, ABS must be reliable, affordable, and accepted.

In baseball, proposals for an automated strike zone divide fans who value the game's human element from fans who value accuracy more; catchers, pitchers, and hitters who have to adjust strategically; coaches who would have to adapt their training techniques accordingly; umpires whose jobs are at stake; and the league itself, which strives to retain viewers, revenue and loyalty.

Review of Research

Published research reveals patterns of human reactions to new technologies. A study by Petersen-Wagner and Ludvigsen (2023) examined fan reaction to the implementation of video assistant referee (VAR) technology in the 2018 FIFA World Cup, allowing for a useful analogue

for how fans may divide over adoption of an ABS system in the MLB. The majority of fans were negative about VAR in 300,000 comments across 31 YouTube videos. Three main arguments appeared: VAR is killing the beautiful game, it favors the Global North over the Global South, and that the technology is not politically neutral (Petersen-Wagner and Ludvigsen, 2023). The VAR case exemplifies how new technologies in sports that aim to increase accuracy can be seen as threatening to emotions and to power imbalances within the sport.

Wonseok et. al. (2021) found in a study that people tended to view a human umpire's pitch call more trustworthy than that of a robot umpire. When the robot umpire was humanized (e.g., given a name and personality) more trust was developed. These findings can be explained by source bias, where people may believe that pitch calls require human judgment acquired through hands-on experiences rather than through a robot's algorithms (Wonseok et. al., 2021). Castelo et. al. (2019) found in multiple studies using source bias frameworks that humans are less likely to trust algorithms with tasks that seem subjective in nature (e.g., recommending a romantic partner), but are more likely to trust algorithms with objective tasks (e.g., analyzing data). Humans are likely to have suspicion in automated decisions such as ball and strike calls due to lack of an algorithm's subjective judgment. Using human umpires to relay ABS decisions may alleviate this bias.

Historically, resistance to technology has often stemmed from job security fears (Carlopio, 1988). In Spitalfield in 1675, machines that could do the work of 20 men were rioted for three days. Joseph-Marie Jacquard's loom prompted widespread riots and death threats because it threatened "a whole army of helpers." Similarly, the implementation of an automated strike zone imposes a threat to the umpiring profession. In a study by Doris McLaughlin at the University of Michigan, it was found that when emerging technology was perceived as

“necessary” and “inevitable,” human reactions tended to be more accommodating (Noble, 1984). Members associated with the MLB, including umpires, may understand that this new ABS technology is a necessary evolution of the game.

To determine psychological reactions to human versus robot job replacement, Granulo et. al. (2018) found that humans prefer workers to be replaced by other human workers rather than by robots. However, when personally affected by job loss, they prefer robots over other humans to protect their self-worth, despite perceiving a higher economic threat. Accordingly, there are complex psychological reactions to an automated strike zone. Fans and players may prefer the strike zone to be called by human umpires as they disagree with an automation takeover. Conversely, umpires may favor their replacement by an automated strike zone rather than replacement by another umpire.

The Fans

Pro ABS

One group of fans contends that an automated ball-strike system would bring much needed consistency to pitch calls. In tweets like “All hitters want is consistency with balls and strikes,” (Gray, 2023) and “I’d rather it be consistent via robot, instead of "who's the ump and what's his mood today?"” (brian99xt, 2023), fans express the value of objectivity an ABS could provide over the subjectivity of a human umpire. Nico (2023) highlights that umpires are roughly 93.5% accurate. The 6.5% error rate translates to 1.6 pitches per inning - a number far too high. Nico also highlights that umpires can't effectively call balls and strikes from behind the catcher due to obstructed views and reliance on deceptive catcher framing.

Fans often voice frustration over controversial strike calls that impact game outcomes. For instance, when the Phillies were down 2-0 with bases loaded against the Twins in the seventh inning, Alec Bohm was called out on a pitch clearly outside the strike zone, prompting tweets like “baseball needs a strike-ball challenge system, come on man” (jahiye1, 2023) and “Robot umps can’t come fast enough absolutely a joke” (McLaughlin, 2023). Questionable pitch calls altered the outcome of two separate games in one day, leading a fan to tweet, “I’ve never been in favor of the robot umps, but I’m slowly starting to change my tune...” (McAlpin, 2023).

Among those open to exploring ABS options, views differ on whether to use it for all calls or just as a challenge system. After seeing a challenge system in use at a Minor League game, some fans think it disrupts the flow of the game: “Just make it the entire game, no need to pause the game for a challenge when you can just have auto k zone 100% of the time” (DennProduct, 2022). Others like Nico (2023) suggest that replay “should only be to challenge calls that are egregiously bad” with either immediate player or coach challenges.

Anti ABS

A segment of MLB fans oppose removing the human element from pitch calls. Tweets like “This is bad for baseball, part of the game is the human element of the human umpire” (Sinder, 2023) and “The dynamic between the ump, pitcher and catcher is really one of the most interesting things to watch in this sport” (r/mlb, 2022) reflect the belief that umpires are integral to baseball’s tradition. Allan Kabese argues that “Part of the experience of watching a baseball game is seeing coaches and players yell at umpires.” Many claim the strike zone is a subjective entity through comments like “The strike zone is a living organism and catchers framing and manipulating it is an art form,” (r/mlb, 2022) and “Context is so important, and that’s why humans are needed behind the plate” (Delgado Genzor, 2023).

The Players

Pro ABS

Many players have expressed their support for the automated ball strike system's consistency. Catcher Tony Wolters explained "I wanna swing at strikes and the zone doesn't change. It feels like it stays very consistent, so you can know the zone a little bit better" after experiencing the ABS in the minors (Clayton, 2023). The objectivity of a computerized strike zone appeals to batters who seek clarity on what constitutes a strike. Mets pitcher Mike Vasil supports the challenge system in that it "helps the umpires keep a consistent zone" and "keeps the game true for where it should be" (Mayo, 2022).

Aside from consistency, many players enjoy the excitement of the ABS. After testing the ABS using a challenge system, Red Sox infielder Nick Yorke added that "It gets everyone into it after someone challenges. Everyone is like, 'Ooooh,' after they see the pitch. I think it's been pretty fun" (Mayo, 2022). Minor League coach Toby Gardenhire noted, "The guys were more excited about that than they were about anything all game long. One challenge we win, and they're all jumping up and down and screaming" (Clayton, 2023).

Anti ABS

Some players have concerns about adopting an automated ball strike system. Daniel Fields, an outfielder with both minor and major league experience, noted inconsistencies in strike zones when ABS was tested in the Atlantic League: "When we would travel to different ballparks, the calibrations of the machine were different and sometimes the strike zone was different" (Spedden, 2020). Yankees pitchers Luis Severino and Ryan Weber both expressed complaints about the strike zone when it was being tested in a Minor League game. Severino

thought that the strike zone was “way too small,” and that batters could swing at no pitches and reach a 3-1 count any time they were up. Weber, who excels in pitch control and keeping batters off balance, didn’t think that the ABS accounted for pitches that scraped the edge of the strike zone: “I was ready for [the new system] and figured my slider and sinker would clip the zone and I got nothing” (Martin, 2023). Another concern is that ABS would eliminate player ability to “earn” larger and smaller strike zones in their favor. Legendary hitters like Barry Bonds were able to earn strike zones limited to the size of a “postage stamp” and Hall of Fame pitchers like Tom Glavine could earn an extra six inches in the inside corner of the zone (Rymer, 2014).

Catchers who excel at framing pitches strongly oppose an ABS as it would negate their ability to legally “steal” strike calls through deceptive framing - a skill that separates the best catchers. A study showed the difference between the best and worst framers in 2007 equated to 25 wins. Former catcher Jeff Mathis says automated strike zones remove the artistic style of catching, reducing catchers’ role to simply catching or blocking then letting “the robots take over” (Baccellieri, 2023).

The Coaches

Pro ABS

Phillies Manager Joe Girardi recognizes the difficulty of an umpire’s job and sees the ABS as a way to reduce some of the pressure and health risks they face. He also believes umpires would be better positioned behind the pitcher, saying, “I’ve always thought that umpires should be behind the pitcher. I think you’re much better there and you’re more protected” (Salisbury, 2022). Twins catching coordinator Tucker Fawley sees potential for an ABS challenge system to enhance the importance of framing. With a challenge system, “The catcher is

now tasked with not only tricking the umpire but also the hitter in the box and, honestly, the dugout as a whole” (Keyser, 2023). Coaches who have seen the ABS in play in Minor Leagues have noted its benefits in consistency. El Paso Chihuahuas manager Jared Sandberg explains that there has been some frustration with the calls of the ABS, but it has in general “brought some consistency to the game” (Keeley, 2022). As the technology continues its testing and improvement, more coaches may come to appreciate the objectivity and reliability it can provide.

Anti ABS

Some coaches are opposed to implementing an ABS as it would render many of their teaching aspects obsolete. An example returns back to the art of teaching catchers to deceptively frame pitches. Yankees catching director Tanner Swanson was the first to position catchers on one knee to better frame pitches at the bottom of the zone. He argues that with ABS, catchers would shift from framing defense to prioritizing offensive skills (Keyser, 2023). Veronica Alvarez, a player development coach for the Oakland A’s, highlights how ABS affects teaching style to catchers. She explains that remaining adjustable to pitches is taught, “But the framing part, there’s a little less focus on it. We still do it, just less than before” (Keyser, 2023). However, Tucker Fawley continues traditional practices, not wanting catchers to “fall into any traps relative to those systems” because traditional umpiring still dominates in the Major Leagues (Keyser, 2023).

Other coaches side with pitchers who have learned to induce umpire bias through precise location. St. Paul Saints manager Toby Gardenhire contends that if pitchers “hit the spots enough, then the umpire is eventually gonna start calling it a strike” (Clayton, 2023). Pitchers

may also “know what the umpire is gonna call and what he's not gonna call, so they pitch to that,” (Clayton, 2023). This human element is removed with an automated system.

The Umpires

Umpires will be significantly impacted by any implementation of ABS, whether their jobs become obsolete or require major adjustments. Their governing body, the Major League Baseball Umpires Association, agreed in a 5 year labor contract to cooperate with MLB on development and potential rollout of the technology. The deal also provided raises in umpire compensation and retirement benefits, along with provisions allowing earlier retirement (Walker and Blum, 2021).

Umpire Freddie DeJesus was initially taken aback by the idea of an automated strike zone. However, after experience with ABS, DeJesus recognized its potential, stating that “It's a great opportunity and it's good for the game. I can see it down the line getting to the next level” (Acquavella, 2019).

Conversely, Major League Baseball Umpire Harry Wendelstadt expressed concerns about replacing human umpires with machines, implying that regardless of whether it is a human or automated system making the calls, there will still be the same amount of player pushback: “If they did get a machine to replace us, you know what would happen to it? Why, the players would bust it to pieces every time it ruled against them” (Lister, 2010). Rich Garcia, a former major league umpire and umpire supervisor, criticizes ABS for not accurately analyzing the strike zone the way human umpires do. Garcia argues that television strike zone graphics mislead fans in that “the box on the screen is not the same box that the umpires get graded on and that the box on the screen is supposed to be used for entertainment only.” Due to the ambiguity between what

umpires and players see as the strike zone and what ABS sees, Garcia believes that implementing ABS “Could be one of the dumbest things baseball could do” (Blum, 2023)

The MLB

For MLB leadership, adopting an automated ball strike system is viewed as a potential solution to multiple issues facing the sport’s viewership and appeal. Commissioner Rob Manfred has explicitly called an ABS the “next big thing on the agenda” for the league to pursue (Drellich, 2023).

One driving factor is a desire to increase pace of play and shorten game times. Data from ABS trials in the minor leagues showed that their use took off 9 minutes from the average total game time (DeGeurin, 2022). With society’s limited attention span and unlimited entertainment options, a faster game may aid in reestablishing MLB’s viewership numbers. Declining popularity has become a concern for Major League Baseball. In a poll by the Washington Post (2022), only 11% of U.S. adults listed baseball as their favorite sport to watch, far behind the 34% who listed football. Only 7% of Americans under 30 listed it as their favorite, placing it behind football, basketball, soccer, and “something else” (DeGeurin, 2022). Rob Manfred emphasizes that integration of ABS would benefit broadcasting, not just the players. Manfred aims to enhance the viewing experience for fans, explaining that ABS “obviously has broadcasting uses. That same technology can be used in our broadcasts, which has value to our fans” (Saunders, 2022).

Operating expenses is a major concern with implementing an automated ball strike system. Rob Manfred explains that the MLB has “spent a lot of time and money on the technology,” (Saunders, 2022) suggesting the upfront investment has been substantial. With

significant financial costs, there is concern whether the benefits of an automated strike zone would outweigh the expenses in implementing the system (Ciriaco, 2023).

Conclusion

This research has examined the perspectives and concerns of the key participant groups - fans, players, coaches, umpires, and league leadership. Different groups tend to divide based on their internal values, roles and perceived threats or opportunities presented by the new technology. Fans split between accuracy and preserving baseball's human elements. Players were divided by whether ABS provided clarity or obsoleted mastery. Coaches, depending on their traditional or progressive foundations, either rejected new practices or embraced new strategic learnings.

This aligns with patterns repeatedly seen when new technologies are introduced - social groups driven by legacy mindsets will resist reinvention, while those more adaptive tend to welcome new capabilities, even if they may seem disruptive. These divides are amplified when people's identities are related to skills the new technology seems to devalue. Human need for self and economic worth creates a tendency to resist.

There are complex sociotechnical challenges that companies and industries face when introducing technologies that could reshape human roles. Overall, technology integration is more effective when presented as a collaborative advancement allowing for human judgment and oversight, reducing perceptions of an existential threat.

References

- Acquavella K. (2019, August 30). Robot umpires: How it works and its effect on players and managers in the Atlantic League, plus what's to come. *CBS Sports*.
www.cbssports.com/mlb/news/robot-umpires-how-it-works-and-its-effect-on-players-and-managers-in-the-atlantic-league-plus-whats-to-come
- Baccellieri, Emma. (2023, Mar. 28) "Beware, Catchers: The Robots Are Coming." *Sports Illustrated*. www.si.com/mlb/2023/03/28/pitch-framing-robo-umps-daily-cover.
- Blum, R. (2023, July 10). What is a strike in baseball? robots, Rule book and umpires view it differently. *AP News*.
apnews.com/article/mlb-robot-umpires-strike-zone-40ec7285ae4d1ccaf2621adcb8d72b02
- [@brian99xt]. (2023, Jan. 12). *I'd rather it be consistent via robot, instead of "who's the ump and what's his mood today?"* [Tweet]. X. twitter.com/brian99xt/status/1613760620289003524
- Carlopio, J. (1988a). A history of social psychological reactions to New Technology. *Journal of Occupational Psychology*, 61(1), 67–77. Web of Science.
- Castelo, N., Bos, M. W., & Lehmann, D. R. (2019a). Task-dependent algorithm aversion. *Journal of Marketing Research*, 56(5), 809–825. Web of Science.
- Clayton, R. (2023, May 3). St. Paul Saints play first home game with New Automated Strike Zone. *CBS News*.
www.cbsnews.com/minnesota/news/st-paul-saints-play-first-home-game-with-new-automated-strike-zone
- Ciriaco, D. (2023, Feb 19). "Robo UMPS in baseball: Pros and cons of automated calls on the field." www.theskipperview.com/p/robo-umps-in-baseball-pros-and-cons
- DeGeurin, M. (2022, July 15). Baseball fans might be ready for robo umpires. *Gizmodo*.
gizmodo.com/baseball-robo-umpires-robots-1849184228
- [deleted]. (2023). *The dynamic between the ump, pitcher and catcher is really one of the most interesting things to watch in this sport* [Comment on a Major League Baseball forum] Reddit.
www.reddit.com/r/mlb/comments/yb3kcm/i_despise_the_idea_of_an_automated_strike_zone/
- [deleted]. (2023). *The strike zone is a living organism and catchers framing and manipulating it is an art form* [Comment on a Major League Baseball forum] Reddit.
www.reddit.com/r/mlb/comments/yb3kcm/i_despise_the_idea_of_an_automated_strike_zone/

- Delgado Genzor, M. [@DeGenZGZ]. (2023, Jan. 12). *Context is so important, and that's why humans are needed behind the plate. On that example, any baseball person (ump, pitcher, hitter, catcher, fan, coach, etc) knows damn well it's not a strike, but the robot zone only knows yes or no. So limiting.* [Tweet]. X.
twitter.com/DeGenZGZ/status/1613716574866661378
- [@DennProduct]. (2022, Oct. 20). *Just make it the entire game, no need to pause the game for a challenge when you can just have auto k zone 100% of the time. What's the argument for the challenge system?* [Tweet]. X.
twitter.com/DennProduct/status/1582964612860850176
- Drellich, E. (2023, March 29). How MLB is considering Automated Strike Zone. *The Athletic*.
theathletic.com/4362682/2023/03/29/rob-manfred-automated-strike-zone/
- Granulo, A., Fuchs, C., & Puntoni, S. (2019). Psychological reactions to human versus robotic job replacement. *Nature Human Behaviour*, 3(10), 1062–1069. Web of Science.
- Gray, Z. [@GrayZack22]. (2023, Jan. 12). *All hitters want is consistency with balls and strikes. I believe this is a net positive for baseball. Too many subjective calls by umpires, especially with 2 strikes* [Tweet]. X.
twitter.com/GrayZack22/status/1613736348606660608
- [@jahiyel]. (2023, Aug. 13). *baseball needs a strike-ball challenge system, come on man.* [Tweet]. X. twitter.com/jahiyel/status/1690813299091251201
- Jedlovec, B. (2020, July 20). Introducing statcast 2020: Hawk-Eye and google cloud. *Medium*.
technology.mlblogs.com/introducing-statcast-2020-hawk-eye-and-google-cloud-a5f5c20321b8
- Keeley, S. (2022, August 12). Minor League Baseball manager reacts to robot umpires. *The Comeback: Today's Top Sports Stories & Reactions*.
thecomeback.com/mlb/robot-umpires-umps-el-paso-minor-leagues.html
- Keyser, H. (2023, Jan. 4). What do robo-umps, Challenge System mean for catchers? some coaches are concerned. *Yahoo! Sports*.
sports.yahoo.com/what-do-robo-umps-challenge-system-mean-for-catchers-some-coaches-are-concerned-005531648.html?guccounter=1
- Kim, J. W., & King, B. G. (2014a). Seeing stars: Matthew Effects and status bias in Major League Baseball umpiring. *Management Science*, 60(11), 2619–2644. Web of Science.
- Lister, R. (2010). *The third team: NFL officials. their lives, their stories*. NYLA.
- Martin, D. (2023, May 24). Yankees pitchers have nothing but complaints about Automated Strike Zone: “it sucks.” *New York Post*.
nypost.com/2023/05/24/yankees-pitchers-have-complaints-about-automated-strike-zone

- Mayo, J. (2022, Oct. 25). New Automated Ball-strike system a hit in the AFL. *MLB*.
www.mlb.com/news/automatic-balls-strikes-robot-umps-challenge-system-a-hit-in-afl#:~:text=%E2%80%9CPersonally%2C%20as%20a%20pitcher%2C,umpires%20keep%20a%20consistent%20zone.
- McAlpin, K. [@KevinMcAlpin]. (2023, May 20). *I know it's a four run game in the bottom of the ninth, but good grief, how in the world is this a strike? I've never been in favor of the robot umps, but I'm slowly starting to change my tune...* [Tweet]. X.
twitter.com/KevinMcAlpin/status/1660105220746014722
- McLaughlin, J. [@justinmcl1414]. (2023, Aug. 13). *Robot umps can't come fast enough absolutely a joke* [Tweet]. X. twitter.com/justinmcl1414/status/1690812764434976771
- Nico. (2023, Jan. 14). Why this vehement “Anti replay” fan supports Robo Ball-STRIKE UMPS. *Athletics Nation*.
www.athleticsnation.com/2023/1/14/23555046/why-this-vehement-anti-replay-fan-supports-robo-ball-strike-umps-angel-hernandez-a-blind-man
- Noble, D. F. (1984). Forces of production: A social history of industrial automation. Transaction Publishers. Web of Science.
- Petersen-Wagner, R., & Lee Ludvigsen, J. A. (2022). The video assistant referee (VAR) as neo-coloniality of power? Fan negative reactions to VAR in the 2018 FIFA men’s World Cup. *Sport in Society*, 26(5), 869–883. Web of Science.
- Rymer, Z. D. (2017, Sep. 19). Should Major League Baseball Ever bother with a robotic strike zone? *Bleacher Report*.
bleacherreport.com/articles/1942413-should-major-league-baseball-ever-bother-with-a-robotic-strike-zone
- Salisbury, J. (2022, April 25). Umpire Angel Hernandez Angers Phillies, makes case for Automated Strike Zone. *NBC Sports Philadelphia*.
www.nbcsportsphiladelphia.com/mlb/philadelphia-phillies/umpire-angel-hernandez-angers-phillies-makes-case-for-automated-strike-zone/203144
- Saunders, P. (2022, August 20). Baseball edges closer to implementing automatic strike zone in Major Leagues. *The Denver Post*.
www.denverpost.com/2022/08/21/automatic-strike-zone-baseball
- Sinder, S. [@SinderSam]. (2023, Jan. 12). *Only a matter of time until this hits the majors. This is bad for baseball, part of the game is the human element of the human umpire* [Tweet]. X. twitter.com/SinderSam/status/1613706400449941504

Spedden, Z. (2020, Feb. 20). Atlantic League reaction to ABS technology mixed: Ballpark digest. *Ballpark Digest - Chronicling the Business and Culture of Baseball Ballparks--MLB, MiLB, College*.
ballparkdigest.com/2020/02/20/atlantic-league-reaction-to-abs-technology-mixed

Walker, B., & Blum, R. (2021, April 20). AP Exclusive: Computer Plate UMPS allowed in new Labor deal. *AP News*. apnews.com/article/d8760e52b8ced5b8436c60891ea6e877

Wonseok (Eric), Jang, et al. (2021, Nov.) “Who made the decisions: Human or robot umpires? the effects of anthropomorphism on perceptions toward robot umpires.” *Telematics and Informatics*, vol. 64. Web of Science.