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BASEBALL'S EVOLUTION IN THE 21ST CENTURY, AND HOW IT EXEMPLIFIES HUMAN RESPONSE TO CHANGE

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Baseball's Evolution in the 21st Century, and How it Exemplifies Human Response to Change

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***Abstract*—The game of baseball has changed a lot in the past twenty years. It can be primarily attributed to the explosion in data analytics and how they are used to evaluate baseball players. This led to different player profiles being preferred and eventually led to the development of players changing. As a result, the strategies employed have also evolved and turned into a different game than seen only a couple of decades ago. This paper will explore the changes that the game has seen. On the other hand, Major League Baseball has also implemented its own changes to try and counteract the new strategies, which this paper will also cover. Overall this is a look into how new data can quantitatively change the perception of something that has been relatively unchallenged for a long time, how the changes can have unintended consequences, and how humans respond to evolution and change.**

I. Introduction

Baseball has existed for a very long time and has changed a lot since its inception. With so much change over such a long time, its history is usually split up using different boundaries, such as the introduction of the "live ball," Jackie Robinson breaking the color barrier, and the beginning of divisional play, among others. However, a new era has begun within the twenty-first century due to a radical change in how baseball players are evaluated.

Data has allowed looking at things more quantitatively than ever before. It provides access to more statistics than before and can challenge long-standing perceptions, especially in baseball. Within the last ten to twenty years, as computers and technology have advanced, measuring aspects of the game has become easier. Players have been evaluated almost purely based on results for a long time because most statistics were based on that. But with more data, the focus has shifted to predictive models rather than solely the results.

II. High-level Baseball Statistics

In 2015, Major League Baseball unveiled StatCast, which gave teams access to more statistics than ever before. One statistic is the speed at which a baseball is hit, called "exit velocity." Another is the angle at which the ball is hit, called the "launch angle." Yet another is the rotations per minute of a pitch, called "spin rate." These three statistics finally allowed measurement of how hard a player hits the ball, how much they hit it in the air, and how much their pitches rotate. These attributes were all desirable for players to have, but it was hard to compare them against one another. This is why results-based statistics were the most used at the time. However, since the measurements of exit velocity, launch angle, and spin rate don't include whether they resulted in a hit or an out, they can be used to project trends for a player. If a player is hitting into a lot of outs but is hitting the ball hard in the process, he is in an excellent position to get hits sooner or later. Compare this with a player who is hitting into a lot of outs but is hitting the ball softly; he will be less likely to start landing more hits. Another example would be with hitting the ball in the air versus hitting it on the ground. Batted balls on the ground turn into outs way more often than batted balls hit in the air, so it is preferable to have balls hit into the air more often. Regarding pitch spin rate, some pitchers will have pitches that spin tremendously and tend to induce swings and misses from hitters, as the pitch will move much more.

One final new strategy in baseball that StatCast helped popularize is moving position players around to optimal positions. Normally, there will be two infielders on either side of second base. However, with StatCast, it became clear that this wasn't the optimal strategy. When facing a left-handed hitter, it became increasingly common for the fielding team to position one of their infielders a short way out into right field. Now any ground ball that might go between the first and second baseman for a base hit will become an easy out. Since the fielding team is shifting its players around, this strategy has become known as "the shift."

This is just a sample of all the new statistics that StatCast helped introduce. Many more are valuable to determine how well a player projects for the future. While projection-based stats are useful for talent evaluation, the results still matter.

III. Evolution of Baseball Strategies

Baseball has changed dramatically with the introduction of StatCast. Since teams began using these new statistics to evaluate players, the players themselves focused more on improving those aspects of the game. But with these changes to what players prioritized, the game changed dramatically.

With the focus shifting to increasing exit velocity and optimizing launch angle, this was the perfect breeding ground for home runs to increase. That is exactly what happened.

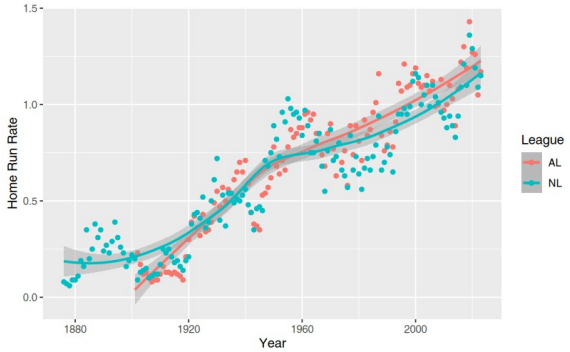

FIG 1. Home Run Rates, 1876-Now [1,2]

Home run rates have steadily increased throughout baseball history, reaching a new all-time high. The 1997 Seattle Mariners set the modern record of 264 home runs hit as a team, but five different teams have since surpassed that; first by the 2018 New York Yankees and *four more teams* in 2019. [3] In turn, with this uptick in home runs, there was

also an increase in strikeouts. When batters prioritize launch angle over merely making contact with the ball, they will miss much more, even if they increase their home run total.

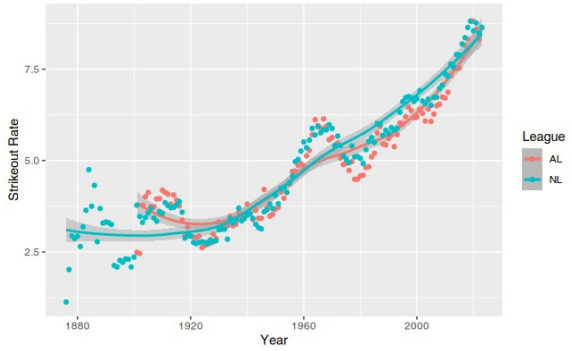

FIG. 2. Strikeout Rates, 1876-Now [1,2]

An increase in strikeout rates also means a decrease in balls in play. As previously mentioned, batters are sacrificing the quantity of contact to maximize the quality of contact.

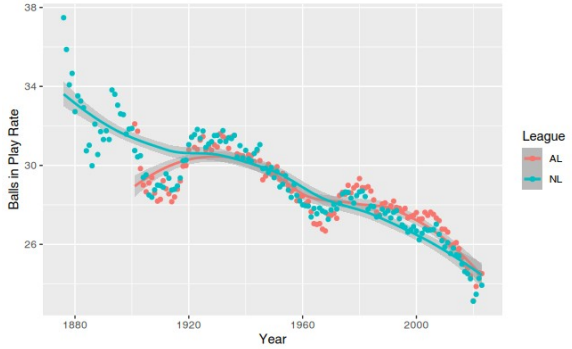

FIG. 3. Balls in Play, 1876-Now [1,2]

These three trends help illustrate the environment of baseball over the last decade. However, there are still some more things to look at. As mentioned earlier, high pitch spin rate has become increasingly sought after. However, pitchers have also begun to throw much, *much* harder.[4]

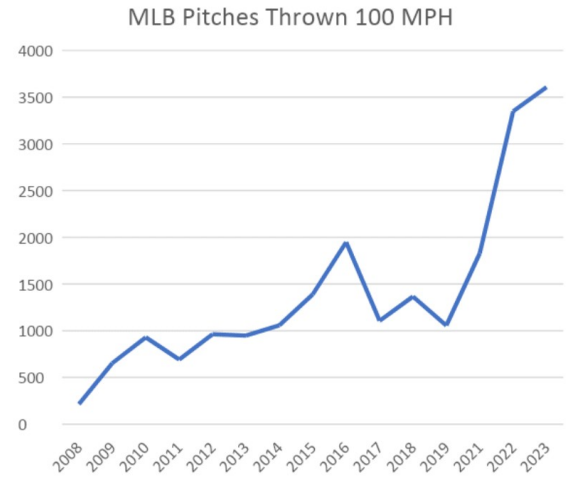

FIG. 4. Pitches thrown over 100 MPH each season

There has been a steady increase in the speed at which pitchers are throwing. As a result, the record number of pitches thrown at 100 miles per hour is broken almost every full-length season; I say "full-length" here because of the short 2020 60-game season, compared to a full-length season, which is 162 games long. With pitchers throwing so hard, it becomes more difficult than ever to make contact, which is also related to prioritizing quality of contact over quantity of contact.

There is yet still one extremely significant change in the game over the last two decades. It is the length of the games increasing by an enormous amount. Pitchers and hitters are taking longer to pitch and hit. This has resulted in the average game time going over three hours for the first time in baseball history. [5,6]

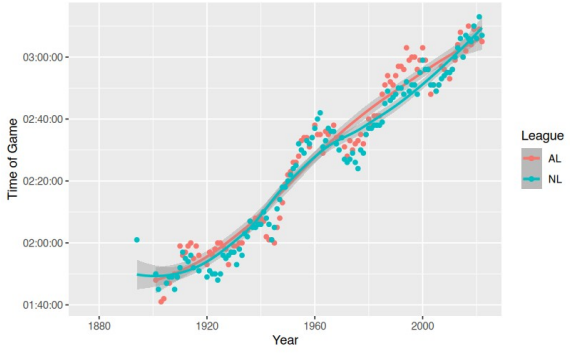

FIG. 5. Time of Baseball Games, 1876-2022

The cause of the game time growing longer than ever before is unclear. As mentioned before, players are dealing with more data than ever before and may require more time to process it all during the game.

To summarize, baseball has changed in many ways over the last twenty years. There have been more home runs, more strikeouts, fewer balls in play, and longer games. All this is more or less a result of the huge influx of data players and team front offices now have access to. This data challenged previously held ideals of what made a good baseball player. For the ideals that have remained true, it has become easier to measure them, in the case of how hard batters hit the baseball and to what angle it's hit, and for pitchers, how much they can spin the ball. But the consequences are that there is now a more significant imbalance between how often the ball is in play versus how often strikeouts happen. While increased strikeouts are considered a worthy trade-off to hit more home runs, it has resulted in a potentially less entertaining product. The data has encouraged players to optimize and specialize in one aspect of the game but cuts down on other factors. Baseball is still a game meant to entertain, so while the data has improved it in some ways, it has resulted in unintended consequences.

IV. Major League Baseball's Response

At this point, it was time for Major League Baseball to evaluate what the game had become. It is clear that more data changed the game's strategies. Therefore, it was time to look at data from those results. The subsequent move was the league deciding to implement some rule changes to force some of the aspects of the game to be closer to what they were before.

Before the 2016 baseball season, the league implemented a new rule that required any visits with the pitcher not to exceed thirty seconds. If a pitcher struggles, one of the team's coaches will often go out to go over strategies. However, teams would often abuse this, and take as long as possible on the pitcher's mound, usually to buy time for a relief pitcher to warm up, for example.[7]

Two seasons later, a maximum number of mount visits was instituted, limiting teams to six mound visits for the game, with one additional mound visit for each extra inning played. While a long-standing rule required the pitcher to be removed if he was visited a second time, pitchers were still being visited more often than necessary, and the game was slowing down as a result. One year later, the mound visit maximum was reduced to five, and it has remained as such since then.[7]

One year after that, now for the 2020 season, a rule was implemented that required any pitcher to face a minimum of three batters, except for an injury. Another exception allows for removing a pitcher at the start of the next inning, even if he hasn't faced his required three batters. There had been an increased focus on having pitchers face batters of the same handedness, but this would sometimes result in pitchers being removed after facing just one or two batters. This new rule encourages versatility and massively cuts down on pitching changes in the middle of an inning, thereby further speeding up the game.[8]

These rule changes so far are notable less significant than those introduced for the 2023 season. There are three big rule changes, but I'll only address two. The first one is to do with banning the aforementioned "shift." The fielding team is now required to position two players on each side of second base, with their feet touching the dirt. As a result, infielders will need to travel farther to get a batted ball hit to the right side of the field, for example, instead of moving a player from the left side over to the right side. Removing the shift makes hitting a ball in play more viable since it will be impossible for three infielders to be positioned on one side of the infield.[9]

The other significant rule change for the 2023 season is the introduction of a clock into baseball. Once the pitcher receives the baseball back from the catcher, he will have 15 seconds to throw the ball if there are no runners on base and 20 seconds if there are runners on base. The batter needs to be in the batter's box with eight seconds left and can take one timeout per at-bat. The pitcher is limited to stepping off the pitching rubber twice and can only step off a third time if he can get a baserunner out. [9] The game times have been reduced dramatically in only a month of the baseball season.[5,6]

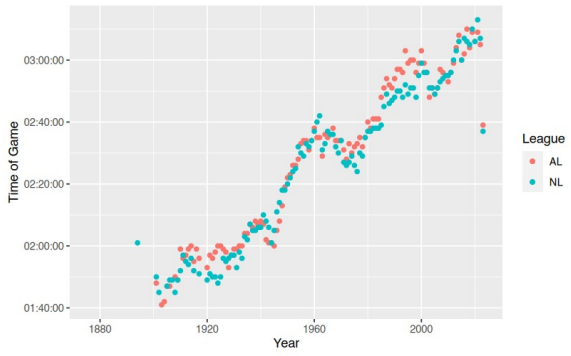

FIG. 6. Time of Game Graph, 1876-Now

While reducing the length of games may sound like fans are getting less baseball, they're really getting less downtime. As mentioned before, batters and pitchers were taking more and more time between pitches for seemingly no reason. Watching certain batters and pitchers go through their routines before each pitch was becoming ridiculous. Now with the pitch clock, the game's length is down to an average that hasn't been seen in over forty years.[5,6]

These rule changes attempt to counteract the unintended consequences of the data and advanced statistics in the sport. However, Major League Baseball admits these rule changes were made with the fans in mind. Plenty of fans grew up with a faster-paced game and became discontent with the slowness at which the game was being played and the lack of balls hit in play.

This is an understandable point of view. Humans are resistant to change. A new style of play is something different than the older fans grew up with. Watching a game that is loved turn into something different can be a hard pill to swallow. Major League Baseball has attempted to counter the change and evolution of how baseball is played with some rule changes. This is an avenue that is not available to everyone when something changes in their life. Change can come in different forms, from something as simple and trivial as shopping at a different grocery store to something as catastrophic as losing a loved one. Since baseball is a game, implementing rules to counteract the change in how the game is played is an easy solution. But with real-life changes, they often can't be reversed. They have to be adapted to, dealt with, and coped with in a healthy way. This is an intricate part of life that everyone experiences many times. But overcoming change can give a gratifying feeling.

Major League Baseball had an option that often isn't there in the real world. So far, it appears that they are going to work. But the players now have to deal with changes of their own. Having less time to prepare between each pitch will result in an adjustment period for everyone. Less variability between defensive positioning on each pitch will require more movement when fielding batted balls. While the rule changes at the outset seem like a simple

reversal of the trends in the past twenty years, the players will now have to adapt to these rule changes themselves.

V. Conclusion

The advanced statistics in baseball are here to stay. The changes in strategy and results are undeniable, but it doesn't have to remain that way. The rule changes made in response to the changes in strategy will modify the game's results and help restore it to how it was played before the introduction of advanced statistics without removing them altogether. While the league's response to the evolution of strategies is not a realistic one to emulate, the players' period of adjustment very well can be, as humans are re-challenged time and time by instances of change.

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Appendix
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The game of baseball has been played professionally for well over a century, and has changed a lot in that time, especially in the last twenty years. With the evolution of technologies, it's become easier to measure statistics that can help evaluate players more accurately. While players were evaluated almost solely on results for a long time, new data enables more predictive models.

In 2015, Major League Baseball introduced StatCast, which allowed teams and fans alike to look at more in-depth stats than ever before. One popular one is the speed at which a batted ball leaves the bat, called "exit velocity." Another popular stat is the angle at which the ball leaves the bat, called "launch angle." One for pitchers measures the number of rotations per minute for a specific pitch type, called "spin-rate." These three stats have been largely influential into the modern game. While hitting the ball hard and in the air has almost always been preferred, there was now a real way to measure it. It can also be easier to determine which player projects better for the future. For example, take two players who are both hitting into a lot of outs. One of them hits the ball softly, but another very hard, based on their exit velocity. The player with the higher exit velocity will be considered more likely to get more hits. Another example is with launch angle. A player who hits the ball on the ground more, so a negative launch angle, is less desirable than someone who hits the ball in the air, or a positive launch angle. Lastly, pitchers with higher spin-rates are preferred, because of how much pitches can then deceive the hitters due to how much they appear to move.

One other new strategy that StatCast helped popularize is moving fielders around to play in optimal positions, so more ground balls result in outs. Normally, there are two infielders on either side of second base. However, left-handed hitters will hit the ball to the right side of the field more often. So for most left-handed hitters, the defending team will put a third fielder on the right side of the infield,

leaving only one on the left side. This also happens in the opposite way for right-handed hitters, though to a lesser extent.

These changes in strategy have drastically changed the product. With the focus on increasing exit velocity and optimizing launch angle, it created a perfect storm for a home run explosion, which is exactly what happened. Home run rates have steadily increased throughout baseball history, reaching a new all-time high. The 1997 Seattle Mariners set the modern record of 264 home runs hit as a team. Since then, five different teams have since surpassed that; the 2018 New York Yankees broke the record, and four more teams in 2019 broke that record.

Since players are now more focused on hitting the ball out of the ballpark, that results in less contact overall. The focus has shifted from quantity of contact to quality of contact. As a result, strikeouts have gone way up and balls in play have gone down. Another cause of the high strikeout rate is that pitchers throw much, much harder than before, along with generally having higher spin-rates, as I mentioned earlier. The total number of pitches thrown 100 miles per hour has increased each of the last few years.

There is one more significant change I'd like to mention, and weirdly enough, it really doesn't have to do with any of the factors that have been mentioned already. Baseball games have gotten increasingly longer, for seemingly no reason. Both batters and pitchers are taking more time between each pitch to get ready. The average game time has increased to being, on average, over 3 hours for the first time in baseball history. Perhaps players are dealing with too much data to process too quickly, and are taking longer between pitches.

This is just a general summary of how baseball has changed over the last couple decades. There are other factors that I didn't get into. But it's become pretty noticeable when watching how much the game has changed. While the strategies have been optimized tremendously, it's important to remember that baseball is still a sport meant to entertain. Playing it in the most optimized way possible isn't always the most entertaining for viewers. While home runs are exciting, strikeouts are not. Getting the

ball in play will yield variable results, and that is happening less frequently than ever. There are clearly some unintended consequences with these changes.

With all this evolution in the game, Major League Baseball decided to start implementing rule changes. For the 2016 season, there was a rule implemented to limit a visit to the pitcher to a maximum of thirty seconds. Coaches would often visit pitchers on the mound for longer than that, usually to buy time for a new pitcher to warm up in the bullpen before coming into the game. This was the first rule change to directly address the lengthening of game times. In 2018, the number of visits to the mound was limited to six per game, with one additional mound visit for every extra inning played. While a long-standing rule required a pitcher to be removed if he was visited a second time in the same inning, pitchers were still being visited more often than necessary. The following year, in 2019, this maximum was reduced to five and has remained as such since then.

For the 2020 season, a rule was implemented that required a pitcher face at least three batters before he could be removed, with exception of an injury. A pitcher could also be removed before the start of the next inning, even if they hadn't faced their minimum three hitters. This was another move with speeding up the game in mind, as mid-inning pitching changes were becoming very common, breaking up the pace of the game.

While these rule changes are useful in speeding up the game, they're not really things the viewer will notice. For 2023, perhaps the biggest rule changes were implemented. One of them requires teams to position two fielders on each side of second base when the pitch is thrown. This essentially eliminates the aforementioned shift, allowing more ground balls to turn into base hits. While this doesn't really affect the length of games, it does bring back that variability of a ball hit in play that the game had been lacking. The other big rule change I'll mention is the introduction of a clock into baseball, called the pitch timer, or pitch clock. With the bases empty, the pitcher has fifteen seconds to throw the pitch, and twenty seconds with runners on base. The batter needs to be in the batters box with eight seconds remaining and must make eye contact with the pitcher. Pitchers have two opportunities to

step off the mound each at bat, and can do so a third time if they are attempting to get a baserunner out. The batter can have one timeout per at bat. If the hitter isn't ready, a it's an automatic strike, and if the pitcher isn't ready, it's an automatic ball.

Despite being less than forty games into the 2023 season, the pitch clock has made a dramatic impact on the game, reducing game times by about thirty minutes on average. Games haven't been this short in forty years. There isn't even less baseball being played either, there's just less dead time between the action. Major League Baseball said they made these changes with fans in mind, as some of the older generation grew up with a faster-paced game, and younger generations simply consider baseball to be too boring.

These rule changes help exemplify the resistance to change as humans. We like to stick with what we know, so older fans who watched the game change and slow down grew discontent with the product. The league countered these changes by simply changing the game's rules. However, this isn't a realistic avenue for regular people when encountered with change in their everyday life. We have to adapt to change and try to deal with it in a healthy way. While the league was able to change the game itself, that now requires the players to adapt to these changes, as many of them have not played under these rules before. While the elimination of the shift was made in mind to benefit hitters, that now is a detriment to pitchers who relied on the ground ball to get outs. Now they have to respond back with adjustments. The pitch clock will also cause a big difference in how players play. Most of them will likely adapt just fine, but others will need more games to settle in. While it's far too early to tell, you wonder if the pitch clock will affect any player enough to make them worse over the long-term.

The change in player evaluation shows how some previously held ideals were now challenged by this new found data. Results-based stats, in terms of getting out or getting on base, didn't tell the full story. The new data and statistics challenged the ways baseball players were evaluated. While the old stats are still used, the new ones help give context to the old-school ones. While two players with an

equivalent batting average may have likewise been considered equally good players, that idea has now been challenged by these peripheral stats.

In conclusion, the evolution of baseball in the last two decades exemplifies how data can challenge previously held ideals and can bring on new breadths of knowledge. As a result, the changes in the game have been responded to differently by the different parties involved, showing how difficult it can be to adapt to chance due to our human nature. As a common adage in baseball goes, “it’s a game of adjustments.”