The Evolution of Data and Statistics in Baseball

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Abstract

While former New York Yankees pitcher Goose Gossage unleashed his tirade on the deterioration of the unwritten rules of baseball and nerds ruining the sport about halfway through my writing of the paper, sentiments like his were inspiration for my topic: the evolution of statistics and data in baseball. By telling the story of how baseball data and statistics have evolved, my goal was to also demonstrate how they have been intertwined since the beginning—which would essentially mean that nerds have always been ruining the sport (if you subscribe to that kind of thought).

In the quest to showcase this, it was necessary to document how baseball prospers from numbers and numbers prosper from baseball. The relationship between the two is mutualistic. Furthermore, an all-encompassing historical look at how data and statistics in baseball have matured was a critical portion of the paper. With a metric such as batting average going from a radical new measure that posed a threat to the status quo, to a fiercely cherished statistic that was suddenly being unseated by advanced analytics, it shows the creation of new and destruction of old has been incessant. Innovators like Pete Palmer, Dick Cramer and Bill James played a large role in this process in the 1980s. Computers aided their effort and when paired with the Internet, unleashed the ability to crunch data to an even larger sector of the population. The unveiling of Statcast at the commencement of the 2015 season showed just how much potential there is for measuring previously unquantifiable baseball acts.

Essentially, there will always be people who mourn the presence of data and statistics in baseball. Despite this, the evolution story indicates baseball and numbers will be intertwined into the future, likely to an even greater extent than ever before, as technology and new philosophies become increasingly integrated into front offices and clubhouses.

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Doing introductory research on a niche topic like the interplay between baseball, **stats** and **data**, it was easy to come away with the impression that baseball's infatuation with numbers was a new development. It appeared to be a product of the computer age—people now have access to practically any piece of information desired, so our hungriness for statistical analysis was bound to increase. This relatively recent phenomenon was why I initially pegged baseball as experiencing something similar to a Schumpeterian moment[1]—an economic theory derived from the work of Karl Marx that describes a process of destroying an old structure and creating a new one. This theory has consistently been applied to the field of journalism, and it was from Arizona State University professor Tim McGuire and his 21st Century Media and Entrepreneurship class that I was first exposed to the term. His thesis was printed newspapers are being destroyed and digital processes are being created. I applied this rationale to baseball stats—conventional ones like batting average, **slugging percentage**, wins and saves are falling out of favor to more advanced measures like **WAR** (wins above replacement), **wRC**+ (weighted runs created plus) and **FIP** (fielding independent pitching). On the surface, this looked like a plausible stance to take. But now I attack this paper with a different thesis: Ever since its inception, baseball and numbers have been heavily intertwined, and the Schumpeterian moment has been fixed in a never-ending cycle. The destruction of old stats and analytics and the creation of new ones has been incessant and perpetual. It did not stop when the concept of the run batted in was introduced in 1879; it definitely did not stop when computers came along in the 1960s to encourage in-depth statistical analysis; and it will not stop any time in the near future with technological advances like **Statcast** continuing to mold the way people think about baseball. The goal is to tell the story

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[1] Schumpeterian moments are "as destructive as they are creative," according to Tim McGuire in *McGuire on Media*

of the evolution that has taken place and to ultimately forecast what is on the horizon for Major League Baseball. How does the change continue and how will it manifest itself?

Conversations with twelve people in the professional and collegiate baseball community, as well as the text of *The Numbers Game* by Alan Schwarz and *The Hidden Game of Baseball* by Pete Palmer and John Thorn, helped extensively in coming to this conclusion. The thoughts gathered from these sources will be referenced frequently throughout. The following is a brief synopsis of who they are and what they have contributed to the evolution of baseball stats.

1. John Thorn: Major League Baseball's official historian

2. Jeff Sullivan: Writer for *FanGraphs.com*—an advanced analytics baseball website that houses blogs, chats and sabermetric statistics and covers professional baseball

3. Ben Baumer: Accredited professional statistician, the statistical analyst for the baseball operations department of the New York Mets from 2004 to 2012, and now an assistant professor in the statistical and data sciences program at Smith College in Massachusetts

4. Dick Cramer: Co-founder of STATS, Inc., a sports statistics and data company that provides content to multimedia platforms. Cramer was the writer and coder of its basic notation system and the co-founder of the Statistical Analysis Committee for the Society of American Baseball Research, an organization whose goal is to encourage research of the history of baseball.

5. Pete Palmer: Co-author of *The Hidden Game of Baseball*, invented the concept of linear weights and on base plus slugging (OPS) among a myriad of other contributions

6. Gary Gillette: Columnist for ESPN Insider, covering the Detroit Tigers in 2005 and 2006 and the co-author (with Palmer) of the *ESPN Baseball Encyclopedia*

7. Michael Baumann: Formerly a writer at *Grantland.com*, a hybrid sports-entertainment sister site of ESPN, and currently a writer at *D1Baseball.com*, perhaps the most popular website for college baseball content

8. Ken Rosenthal: Insider for MLB Network and lead field reporter for *MLB on Fox*

9. Aaron Fitt: Writer and editor at *D1Baseball.com*

10. Thomas Lenneburg: Sports information director for the Arizona State baseball program

11. Jeff Sackmann: Co-founder of *collegesplits.com*, a site that did pioneering work in assembling a database of close to 10,000 college baseball players

12. Mike Petriello: Stats analyst at MLB Advanced Media, a "full service solutions provider," according to its site, that distributes content through forms of interactive media, where he writes pieces about Statcast

13. Daren Willman: Director of baseball research development at MLBAM

14. Sarah Gelles: Director of baseball analytics for the Baltimore Orioles

15. Yeshayah Goldfarb: Director of minor league operations and quantitative analysis for the San Francisco Giants

16. Dick Williams: General manager of the Cincinnati Reds

17. Kevin Forbes: Product specialist at Kinduct technologies, a company that specializes in fitness testing and player tracking

18. Michael Bentley: Founder of Blast Motion, a motion-capture company that relies on sensors to accrue performance data from a player's bat

19. Jason Sherwin: Founder and CEO at deCervo, a company that creates brain-computer interfacing technology to measure when and why athletes make decisions.

On September 3, I attended a meeting in the Barrett offices in downtown Phoenix that I thought was mandatory. What intrigued me about it was that it promised to give a refresher on important thesis reminders, as well as outline the Institutional Review Board process (the portion I thought was mandatory). Since I was doing research involving human subjects (interviewing the people listed above), I reasoned that this was applicable to me.

It turns out, five people (including myself) attended this meeting—a sliver of the overall number of students who are set to defend their thesis this spring—and not one of them was doing a project remotely close to what I had in mind. Their topics ranged from assessing and addressing childhood trauma in the classroom to proposing legislation on genetically engineered plants. Essentially, they were all topics that actually merited IRB approval. Simply interviewing people over the phone and in person about a topic as harmless as baseball stats apparently does not need the same scrutiny. I left the meeting with a paradoxical feeling: relieved this was one fewer task I had to take care of, but also less confident in the validity of my topic. Someone else was going to help change the world by proposing legislation that attains labeling on genetically engineered foods, and I was going to research why baseball stats have changed. There appeared to be a discrepancy, and I felt my intelligence was being belittled.

Five months later, I enter with a different outlook on my topic. I am certain that the evolution of baseball stats is a worthwhile discussion. Nineteen other people thought so, and it could have been more had scheduling not gotten in the way. It may not change the world like a call-to-action on genetically modified plants, but hopefully this paper will recap and advance the conversation in the baseball community.

Lastly, one of the big challenges in writing and attempting to organize a 60-page paper is ensuring the content is not redundant and ensuring topics do not bleed together. The matter

complicates itself when taking into account the conversational-style, hour-long interviews that were conducted for this paper. But since this issue is similar to one many statisticians face in trying to isolate performance and trying to ensure they are looking at the inherent skill of a player and not how he benefitted from the stellar play of his teammates, there is no room for excuses. All roads, even anecdotes that originally appear unrelated, will lead to one singular thought: Baseball and stats have historically been paired at the hip and will continue to be so, perhaps to an even greater extent, as technology and popular thought evolve.

What do stats do for baseball and what does baseball do for stats?

Logically, it would make sense to start the way most papers do—turning to history and using it as a springboard to a discussion into the present moment. Make no mistake about it, the historical aspect of baseball is regarded with unprecedented zeal in comparison to other professional sports. On a similar note, the history of stats is incredibly important when looking at how they have evolved and what is in store for the future.

But before this paper looks at baseball stats from a historical perspective, it is important to address two overarching questions. What does baseball do for stats? What do stats do for baseball? On a related note: Why have stats been at the hip of baseball for longer than anyone can remember? Why should people and why *do* people care about stats so much?

In regards to the former question—why is baseball such pristine ground for stat keeping?—one answer dominates the conversation: Baseball is structurally organized as the most individual of team sports and the game overwhelmingly exists in conveniently organized matchups between batter and pitcher. As Alan Schwarz in the book *The Numbers Game* said, blame and credit can easily be divvied out in a much easier manner than other sports because of

baseball's "double entry personality. Its symmetry leaves every hitting event part of a pitcher's record and vice versa," he said.

John Thorn, the official historian of Major League Baseball, echoed that sentiment in a phone interview.

"Baseball is a game of nine against nine, and football is 11 against 11, and basketball is five against five and hockey is six against six. But in baseball, unlike any of the other sports, it's most often a game of one against one," Thorn said. "So the individual accomplishment can be isolated more easily in baseball than it can in other team sports, which makes it ripe for statistical analysis."

Jeff Sullivan, a writer at *FanGraphs.com*, expanded on this notion.

"I think the obvious point is that unlike any other sport that I guess isn't cricket, baseball is the easiest sport to break down to individual matchups and so you got a lot of repetition. You don't really have the whole team player-to-player dynamic that you get in hockey or football or basketball, etc. And even though you're seeing some in-depth analysis in those sports, in baseball so many things are just player to player. You got pitcher facing hitter. Baseball is the easiest sport to analyze because there are so many repetitions and the matchups are relatively simple to break down. It's a good starting point, a good place for people to get their feet wet with sports analysis."

And lastly, Ben Baumer, the former statistical analyst for the New York Mets, agreed with the points Sullivan and Thorn made, but did so with language that many may associate with mathematical processes more so than baseball.

"The game itself is sort of inherently discrete," Baumer said. "That is, one thing happens and it's either a single or a double or an out or whatever. That play ends and then you have another thing. (Baseball is) sort of just set up as a pretty good, controlled probability model[2]. It's like the manifestation of a probability model, much more so than something like basketball or soccer where you have guys running around and it's just a running clock. In soccer, how do you even measure who has possession of the ball? It's not clear. It's not discrete."

But is baseball actually discrete? Are there not seven other players behind the pitcher and one in front of him that influence the game too? Yes. And we have seen a very recent example in the 2015 Kansas City Royals in which defense played a vital role in a team winning a World Series. The Royals did not play a one-against-one, batter-against-pitcher style of baseball. If they did, their starting rotation of Yordano Ventura, Edinson Volquez and Johnny Cueto (all who struggled for chunks of the postseason) would not have netted them a championship. Even the Royals bullpen of super relievers like Wade Davis and Kelvin Herrerra benefited ever-so-slightly from the stellar defense behind them. How do we know how much was inherent skill of the pitching staff and how much was their above-average defense[3] helping them out? The answer is that it is not a simple answer, but the Royals were the exception not the rule. The game of baseball is overwhelmingly centered on pitcher versus hitter, or discrete, now more so than ever.

Despite the Royals serving as the rebuttal, baseball still looks very similar to a controlled experiment (a test in which only one variable is changed at a time in order to isolate results) and is, at its core, a game of "packets" (as Alan Schwarz calls it in the *Numbers Game*)—a circumstance in which statistical analysis prospers. In fact, studies conducted by Pete Palmer and

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[2] According to Yale University, a probability model is a "mathematical representation of a random phenomenon."
[3] ESPN.com went into full detail about how the Royals were on pace to become the best defensive team ever.

John Thorn in *The Hidden Game of Baseball* showed that since the 1920s defense has improved across the board and average defense has become so ubiquitous and so expected, it now plays much less of a role than it formerly did. In fact, of the three major elements of baseball (hitting, pitching and defense), defense is the least important and least decisive in winning games[4].

The concepts of isolated performance, one-on-one matchups and controlled probability are all examples of what baseball does for stats. The nature of the game gives statistics its time in the limelight. But remember, this is a relationship in which both baseball and stats benefit from each other's existence—it is a mutualistic type of symbiosis. Stats bolster baseball not only by recording history, documenting existence and "encapsulating and comprehending experience" as Thorn said in *The Hidden Game of Baseball*, but also by helping to determine salaries and financial rewards—the livelihoods of those who have made baseball a career.

"I'd say look at the current fascination with stats and all the good it's doing baseball in terms of things the owners care about and the players care about. The financial rewards and the prestige awards of the game," Dick Cramer, the co-founder of STATS, Inc., said.

Cramer also worked extensively with a man named Pete Palmer. Cramer and Palmer exchanged frequent letters with each other in the late 1960s and early 1970s regarding statistical topics in baseball that Cramer now calls "perceived wisdom." Consequently, it is no surprise they agree on the value that stats provide baseball.

"It's a business and the more games you win, the better off you do," Palmer said. "If you're the manager, you might get to manage next year. Competitively, it's important."

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[4] In Chapter 10 of *The Hidden Game of Baseball*, Thorn and Palmer argue that fielding accounts for 6 percent of the game, pitching accounts for 44 percent (because "errors are becoming less frequent, meaning pitchers are taking on a greater share of the responsibility for all runs scored.") and hitting accounts for the other 50 percent.

Palmer then commenced a lengthy discussion regarding a study he did a few years ago on sacrifice flies. For the sake of hammering home the point of the benefits stats provide baseball, his findings run as follows:

On balls hit to the outfield in the air with less than two outs, the runner attempting to tag from third scores 99 percent of the time. He compared that to a runner attempting to steal second base—which he determined rests at a 65 percent success rate on average. He then lamented that people get so bent out of shape when a runner on third attempting to score on a fly ball hit to the outfield gets thrown out at the plate. The team correctly played the percentages, and strictly adhering to those percentage plays will net a team more runs on average than a team that plays percentage baseball only sporadically. Palmer is essentially arguing that percentages will always even out in the end, and people should be more understanding that they do not always play out when we desire them to. Conversely, Palmer believes people blindly accept getting caught trying to steal second base as "part of the game." With a success rate of only 65 percent, should stealing be a widely used strategy? One look at linear weight coefficients (rounded-to-the-decimal-point numbers that assign run values to individual offensive events) and they will suggest getting caught stealing hurts run scoring probabilities (a run value of -.392 in 2015) far more than stealing a base helps run scoring probabilities (a run value of .200 in 2015). Though his point was intended to be interpreted on the micro level of baseball strategy, it also coincides perfectly with how baseball benefits, or how baseball should benefit, from stats. Stats and data lead to enhanced strategy, which leads to a competitive advantage, which leads to more games won and a higher paycheck.

But alas, it is not always so simple. Baseball's conservative background causes some to cringe at the sight of numbers interfering with the pure space the game provides. Many people

flock to baseball to see displays of sheer athletic ability or wizardly strategic tactics that a manager employs only because his gut feeling has been molded by decades of playing experience. Indeed, these people could still recite the all-time mark for home runs in a season[5], or even their favorite player's career batting average, but when on-field decisions become rooted in computerized spreadsheets with the percentage play, the discontentment may escalate. Baseball has been resistant to change in the past (think of elements such as instant replay and pitcher helmets), and for that reason, talking passionately about stats is sometimes dangerous territory.

But former ESPN Insider Gary Gillette sees it differently. He offered an all-encompassing analysis of the benefits stats provide baseball, and shunned those who belittle their importance.

"In terms of stats, I think almost without exception, statistics and arguing about statistics has helped baseball. In fact, I would argue that until very recently, the last 10 years in the NBA, the last 15 years in the NFL, that there's been nothing really equivalent to the reverence and appreciation baseball fans and the media and the clubs have for the stats. It may be true that people who hate **sabermetrics**, it may be true that they hate sabermetrics, but you know what, whenever they're telling (you) how bad sabermetrics are, the first thing they do is quote stats," Gillette said.

Looking at numbers from a historical perspective

As mentioned earlier, baseball's infatuation with numbers is not a new development. One look at baseball's history and that becomes very apparent.

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[5] San Francisco Giants left fielder Barry Bonds hit 73 in 2001

In 1859, baseball writer Henry Chadwick built and published the first box score. In response to this, he was quoted as saying (according to Alan Schwarz in *The Numbers Game*), "In order to obtain an accurate estimate of a player's skill, an analysis, both of his play at the bat and in the field, should be made, inclusive of the way in which he was put out; and that this may be done, it is requisite that all… contests should be recorded in a uniform manner."

From there, baseball and stats took off. Newspapers published so many different, obscure stats that they began to ooze off the page and take over the reader's living room. Chadwick tried to popularize a concept[6] called "Total Bases Average," which was calculated as total bases divided by number of games, that actually represented the first attempt at a weighted average. (One that, unlike batting average, weights extra-base hits differently than singles.) There were less intelligent stats that surfaced as well, such as Total Bases Run—Pete Palmer described it as "sort of an RBI in reverse, from the baserunner's perspective." Palmer also spoke (not too fondly) of the All-American Pitcher Award, a stat in which you add together win-loss percentages, fielding percentages and batting averages of pitchers in hopes of finding the one that is the most fundamentally complete. It was a noble effort, but the shortcomings of each individual stat were drastically magnified when tossed carelessly together. By 1876, professional baseball had adopted counting stats such as games, at bats, runs hits, runs per game and batting average as official statistics. Those not given the official stamp of approval were left circulating with the hardcore stat enthusiasts.

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[6] Schwarz documents this, along with Total Bases Run and the All-American Pitcher Award in chapter two of his work.

For Baumer, this all serves to highlight his earlier point as to why stats benefit so much from baseball and baseball from stats. More available data means more avenues to make that data meaningful and come to life.

"Baseball has a longer history than most other sports, at least sort of the modern era sports," Baumer said. "To have all this data lying around that provides all this historical perspective, I just don't think you have that in other sports."

In the late 1800s, stats were becoming widely accepted and nationally adopted. New ones continued to sprout. The issue was never quantity, but it quickly became quality—both in concept and in keeping. As it turns out, baseball's record books were shaky and discrepancies were everywhere. Part of the issue was the differences in stat-keeping eras, as detailed by Schwarz in *The Numbers Game*: There was 1871 until 1903 (American League) and 1905 (National League) when the league office began keeping day-by-day sheets for every player; the 1930s when this data was consistently kept but with many errors due to a non-universal scoring policy among official scorers; a 15-year period when sheets were checked but not by heralded statistician Seymour Siwoff and the Elias Sports Bureau; and 1948 and after where Elias came to dominate.

One of the most notorious examples of baseball's formerly poor stat-keeping habits involved Detroit Tigers' center fielder Ty Cobb and Cleveland Naps' second baseman Nap Lajoie in the race for the 1910 batting title. Pete Palmer recounted the story and his discovery in 1981 of the many errors that were made.

The story has many complexities, but it boils down to the fact that Cobb sat out the last game of the season, reasoning that his seven-point lead in the batting average department was

enough to win him the batting crown (and also a new car that the Chalmers Auto Company had promised to the winner). Lajoie had a doubleheader against the St. Louis Browns on the last day of the season and proceeded to go 8-for-8 with five bunt singles—facilitated by the Browns' rookie third baseman being placed on strict orders to play practically in shallow left field. The coaches framed it as he would be killed by a Lajoie line drive if he did not do so, but it was more than likely done out of a league-wide dislike of Cobb. A series of ripple-effect official scoring blunders ensued, namely Lajoie not being credited with an at-bat when he should have and one of Ty Cobb's two-hit games allegedly not being recorded. Cobb was awarded with the batting title crown, but fast forward 71 years and Pete Palmer enters the discussion to say that Cobb's game had indeed been recorded, and Lajoie's 1910 batting average was thus greater.

"I think that they really didn't intentionally fudge the figures to put Cobb ahead," Palmer said when asked him about the experience. "They made an honest mistake. It just happened to have that effect. What they did was, the car company gave them each a car, which was a good idea I think. (But) there's never been a situation like that that I can think of, where somebody basically kind of threw the opportunity to get somebody out and I think they would've come up with something. (American League president) Ban Johnson was a very strong supporter of Cobb, and I don't think they would've let the Indians get away with it… If they had not made the error, and Lajoie had come out ahead, it seems to me like they would have done something because it was not a legit situation."

While this example serves to illustrate the unreliability that baseball's record books can sometimes exhibit, John Thorn (again, the official historian of Major League Baseball) views it differently, actually as a blessing for people in his position.

"All history is unreliable. All history is wet cement. You make a mistake when you think that everything is settled. If we knew everything, then historians would be out of business and they'd all be driving cabs. The idea behind history is to re-examine the common wisdom, the perceived wisdom, and re-examine the evidence, and not really repeat the opinions of those who came before. That in fact is the sabermetric method. (The) sabermetric method is not merely an approach to numbers, it's an approach to analysis, and you've got to do your own."

Much of the importance of detailing the history of baseball stats is to demonstrate just how much of a history there actually is—regardless of the accuracy of the data that was kept. Still, the resistance to embrace change, such as more sophisticated ways of measuring performance, runs deep. The game of baseball has been historically conservative out of fear of disrespecting tradition. Traditionalists today cling to stats like earned run average, runs batted in and slugging percentage without realizing that at one point those stats were considered the radical new measures that posed threats to baseball's traditional stat keeping. As proof, the RBI was introduced in 1879 and did not become officially accepted by Major League Baseball until the early 20th century. Earned run average and slugging percentage were both introduced in 1876 and did not become accepted for nearly 50 more years. Dick Cramer acknowledged this theme as an initial blockade when he first began to try to make a career out of interpreting baseball numbers.

"The resistance to change is so great when I started even my family thought I was crazy to spend time working with a little calculator," Cramer said. "People would talk about how tradition-pointed the game was, and if you look at the social structure of baseball's intershappings, a bunch of family businesses that sort of hung together up until corporations started buying in. People don't like their hobbies to change… Still, on the other hand, (stats are)

such a big staple and it's so much a part of American culture… It's obvious on the face of it that baseball prospers from numbers."

Perhaps it is not a premise that is entirely accepted by everyone, but the fact of the matter is, statistics are as much baseball tradition as hot dogs and beer. Talking about stats is not introducing anything new. Attempting to recollect first memories of baseball fandom underscores the overall message: It quite often begins with an infatuation with baseball stats.

"One of the interesting things about baseball I think just as a cultural phenomenon is for many people get interested in baseball young," Cramer said. "People don't naturally think statistically. That's just not the way people think, we're not programmed that way. But baseball is probably people's first chance."

Granted, not everyone grows up to be a professional statistician or the programmer of software that keeps stats in real time. However, receiving two nearly identical responses after asking "What is your first recollection of baseball fandom?" merits at the very least an acknowledgement.

"Ever since I was a kid, I collected baseball cards and played baseball and things like that and I was good at math," Ben Baumer said. "To me, it's just sort of like applying a numerical, scientific, quantitative approach to something that interests you. It's just sort of how you would do anything, just happens to be baseball. So it was very natural, but I never thought of working for a professional team literally before I read *Moneyball*[7] and I was like, 'Oh, wow, people actually do this for a living.'"

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[7] Published in 2003 and written by Michael Lewis, *Moneyball: The Art of Winning an Unfair Game* detailed how the Oakland A's and general manager Billy Beane evened the playing field by incorporating sabermetrics and analytics into decision making processes.

The Sabermetric Revolution: Why did baseball change? In what ways did baseball change?

Baumer's final comment serves as the perfect segue into arguably the most important section of this paper. Yes, baseball and stats have been intertwined since day one, but something noticeable changed starting in the 1980s and spanning up until the dawn of the Internet in the early 2000s. Baseball stats and went from the hobby of a few hardcore enthusiasts to an obsession and a lucrative business. They went from simple counting stats like home runs and strikeouts to complex ones like **wOBA** (weighted on base average) and **SIERA** (skill interactive ERA). As Baumer mentioned, *Moneyball* provided a key jumpstart for this time period known as the "Sabermetric Revolution." But the transformation had begun much earlier with the innovative work of notable researchers.

Bill James was not available to comment for the purpose of this paper, but his contributions obviously cannot go without mention. His *Baseball Abstract* books in the 1980s showcased his finest work and an outward challenge to the baseball authority. He brainstormed concepts like **Runs Created** (a factor of how often a player gets on base and hits for extra bases to equal a player's contribution to runs scored), **Range Factor** (the idea that total chances are more indicative of fielding skill than the percentage of successful plays executed), **Pythagorean Winning Percentage** (which applies the Pythagorean Theorem to the relationship of wins and losses and runs scored and runs allowed), not to mention the buzz he created[8] during fantasy baseball drafts in the mid-90s, when he geared the Bill James Baseball Book towards the fantasy-playing crowd with his player ratings.

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[8] "There would have been a huge demand for Bill James to tell people which players are going to be a good bet," Gary Gillette said in regards to Bill James gearing his player rating books towards the fantasy crowd.

James is irrefutably the most well-known sabermetrician, and yet he was not alone in pioneering the way people began to think about baseball. Because his work is so well known, it is important to dig deeper into the contributions of Dick Cramer and Pete Palmer. Independently, Palmer was doing his own revolutionary work just like James, choosing to concentrate his efforts on **linear weights**.

"I started doing that stuff in the early 60s, but it really took a while to get it out there," Palmer said. "I mean I was just kind of playing around with it, you know."

Linear weights is a concept that seeks to assign each individual offensive or defensive event a run value. While the "runs scored" statistic fails to measure a player's skill accurately—it is driven so much by external forces, such as lineup placement or success of the team's offense—run values will forever be at the heart of baseball because they demonstrate how much each offensive contributes to the chances of scoring a run. A single, for example, has a run value of 0.881, and a home run has a run value of 2.065. Over the course of the season, the run values serve as coefficients that enable statisticians to multiply them by the number of singles, doubles, triples, home runs, stolen bases, caught stealing, walks and hit by pitches. Add all those resulting values together and the resulting number is how many runs a player contributed to his team. Divide this number by ten and it is a rough estimate of the amount of wins a player contributed to his team. Palmer then credited the work of ahead-of-their-time thinkers like George Lindsey (who, according to Schwartz, was the first to actually assign run values to events) and Earnshaw Cook (who wrote a book called *Percentage Baseball* that was the first of its kind to receive national media attention) in the department of linear weights, but said nobody thought of the concept of ten runs per win (essentially WAR before WAR existed) until he did.

"I was looking at the difference in runs scored and runs allowed and wins minus losses, and I went through all the stats back to the 20s, which is about as far back as that data went at that time. I'm not sure what inspired me to get started on it… But I noticed then that the more runs were involved, it took a little more runs per win to win an extra game. It pretty much varied between nine and 11 for pretty much anybody. It's a pretty useful stat because you can compare individual performances to how it affects the team."

Palmer then continued with an impassioned discussion about the merits of his method and the shortcomings of the similar method James had devised.

"I got a big kick out of the rise of Bill James, and this is one of my real annoyances, is everybody uses the Pythagorean Theorem, which is runs scored over runs scored plus runs scored squared over runs scored squared plus runs allowed squared. You needed a calculator to do it and runs scored minus runs allowed divided by ten works almost exactly as well, and it's a lot easier to calculate… That's one of my crusades is to try and get people to drop the Pythagorean Theorem," he said.

Later on, Palmer became acquainted to Cramer through Bob Davids, who founded the Society for American Baseball Research in 1971. Now working in tandem, Cramer took Palmer's idea of linear weights and jumpstarted another one of Palmer's inventions in **OPS** (on base plus slugging). With how universally beloved batting average had become, the reasoning was that OPS could have success in a way linear weights could not. It was easier to digest for the average fan and easier to put into context. Though Palmer and Cramer disagreed about the calculation at the time—Cramer wanted to multiply the two numbers while Palmer wanted to add them—they eventually settled on adding on base and slugging. Cramer marveled at how mainstream—from broadcasts to jumbotrons—OPS has become.

"I had no idea it was becoming of interest to people," he said. "They had OPS on the scoreboard in Fenway and I said, 'Pete, my gosh, this is extraordinary.' To him it was old news; to me it was a revelation. To me, it was like a childhood fantasy coming to life. Childhood fantasies never come to life, and here's one that did. That was a great moment."

Cramer, Palmer and others regard OPS as the most successful pet project that has arisen from the advanced stat revolution.

Cramer was also instrumental in dispelling notions about clutch hitting (which will be discussed more in detail later) and was the co-founder and the coder of the basic notation system of STATS, Inc., a sports statistics and data company that provides content to television broadcasts and multimedia platforms. To Gary Gillette, this laundry list of accomplishments between Cramer and Palmer goes far too unnoticed.

"People like Pete Palmer and Dick Cramer, who deserve a lot of credit, a huge amount of credit, get way too little credit. I'm not saying that Dick or Pete deserve the reputation or fame that Bill does, but I am saying that Dick and Pete and some others have gotten far less recognition than their accomplishments deserve," Gillette said.

"It would be nice to be a consultant of some team, but nobody ever asked me," Palmer said. "I do okay. I do a lot of books; I do a lot of work with stats, and we provide data for Baseball-Reference and ESPN and STATS (Inc.) and some other companies out there, so I'm doing okay. It would be nice to get some amount of publicity. But I never really care. Like I invented OPS, but nobody knows it, you know."

Despite the desire for more credit, Palmer and Cramer were also quick to credit the rapid development of technology that affected not just baseball, but broader society as well. Most significant was the invention of the personal computer.

Cramer related that he and Pete Palmer had access to computers and computer programs for professional reasons. In fact, Palmer was a radar defense programmer, a "rocket scientist in a real sense" according to Gary Gillette. At a time in which having access to computers was scarce, Cramer and Palmer had the luxury of having access to programs, and more importantly, access to data. According to Palmer, up until the mid-1980s, fans had access to newspaper daily box scores and leaders in batting average, home runs and RBI, but had no access to the season total of a batter's tallies until the guide books came out the following year. Cramer and Palmer were able to unleash and unchain the data thanks to personal computers.

"My feeling was quite different," Cramer said. "Holy sh***. This is amazing. Here's a machine where you can take to a ball game and have data on it. You can write a real-time play-by-play system… You're saying, 'Did I think how primitive it was?' No I felt how powerful it was."

"Why did it change? It changed because the tools and the data became available. It's very clear to me what happened," Cramer concluded.

While the rise of computers certainly aided prominent researchers like Cramer and Palmer in affording them more ability to manipulate the data, jump ahead 20 years when computers became paired with the Internet, nurturing an environment of amateurism and inclusivity, and the data could then be manipulated by practically anyone. The days of newspapers being the gatekeepers of information were starting to deteriorate. Bloggers, fans and

amateurs, some with more sophisticated backgrounds than others, were now given a platform, and creativity flourished as a result.

"Part of what's accelerated the revolution has been that so many of these older baseball writers have been put on the pasture by newspapers," Gillette said. "As newspapers have gone from being the dominant providers of original journalism, to being struggling themselves… the ranks of the senior writers and columnists who have been on the beat or been writing for 20 years or more have been really depleted. I would say that part of the transition between sabermetric hostility to sabermetric accepting, if not friendly, has been that the newspaper writers have gone about this tremendous transformation. The ranks of the hard-bitten baseball writer who has no use for any stats besides RBIs or ERA or wins or losses or saves have really taken a hit."

Speaking with Ken Rosenthal, an insider for MLB Network, at the conclusion of a SABR Analytics Conference panel he moderated, he echoed Gillette's analysis.

"There's not even a shadow of a doubt that it's much different," he said. "In fact, there are entire websites devoted to writing about sabermetrics in baseball that didn't exist. Even for us, so-called 'mainstream writers,' what these guys call us, I definitely incorporate more. I read up about it. I'm trying other ways to learn more about it. It's definitely a bigger part of my writing than it was. Now, I'm not ever going to write, I don't think, sabermetric-type articles where I'm analyzing that way, it's not what I do. But, I do use that stuff to enhance what I'm trying to tell in the story."

Debating whether or not this has helped or hurt baseball coverage is a worthwhile discussion to have. Has the proliferation of information that the Internet provoked been a public benefit or disservice? Does more speech heighten the overall level of speech or does it just make

it impossible to figure out who is credible? Gillette seemed to have his finger on the pulse of the issue.

"It's a double-edged sword because the attitude in the teams and Major League Baseball for so long has been, 'Why should we give a credential or pay any attention, even help anybody who is basically blogging out of their bedroom, out of their mom's basement?' So I will say it's hurt in some ways because the unprofessionalism and lack of knowledge of a host of enthusiastic bloggers who aren't especially knowledgeable but have now a platform to publish their stuff. Lowering the barrier of entry is both a good thing and a bad thing. There are a ton of really enjoyable, interesting, informative and knowledgeable blogs written by people who are not in the remotest sense professional, and I love reading them. There are also a lot of people who should be spending their time with other things than writing about baseball," he said.

But there is also the other side of the argument. The arrogance and complacency many legacy media companies displayed during the advent of the Internet was a prime reason why many are in the process of crumbling. Gillette acknowledged this, and suggested that three decades ago, there were many baseball writers who should have been "selling cars at their father-in-law's used car dealership," instead of writing about baseball.

"It wasn't like 30 years ago, every baseball writer was a god," he said. "There were a lot of them that weren't any good. I'm not pretending things are worse."

Lastly, it begs mentioning that without talented amateurs, baseball's statistical revolution would have been either delayed until professional journalists ventured out of their comfort zones and were given the leeway from their editors to discuss more advanced forms of measuring performance, or it would not have happened all together. Pete Palmer's side job was baseball

statistics. He was not a professional baseball writer and was not hired by the league to be a professional statistician. The same held true for most of the career of Bill James until he was hired by the Red Sox in 2003.

"I think that it helps to be an amateur because you have, in many cases, a better perspective," Gillette said. "Professionals tend to get realistic about things. 'Can I get money for this? If I can't get money for this, who gives a f***?' Whereas amateurs say, 'You know what, this is interesting. I'd like to do it.' The whole flowering of SABR and sabermetrics in a real sense springs from amateurs."

With the "Why did baseball change?" portion now answered, digging into the "In what ways did baseball change?" part requires consulting someone who experienced the change first hand. Ben Baumer's statistical work with the Mets qualifies perfectly, as he began in 2004, ended in 2012, and now is able to reflect on the strides that have been made even more recently.

"I think like a lot of teams, they obviously decided to hire someone in part because of what was reported in *Moneyball*," he said. "At the time I got there, there was no statistical infrastructure as far as data bases and servers and things like that."

In what goes against the consistent stats-versus-scouts image portrayed in *Moneyball*, Baumer relayed he did not sense any hostility when he was hired, as he had a pretty clear understanding as to why general manager Jim Duquette had brought him on board. In fact, Baumer went as far as to say that there was some collaboration between him and scouts. After all, despite the stark differences in job descriptions, the ultimate goal is to analyze talent accurately and create a winning team.

"Again, not every single scout was dying to talk about stats, but there were more than a handful of scouts over the years that I had great conversations with and continue to talk to," he said. "(Former Mets' scout and current Toronto Blue Jays' scout) Bryan Lambe took me out on scouting trips a few times and tried to actually teach me how to scout. It was an uphill struggle. I think also (they) learned from me some of the things that I was thinking about."

As far as working with players and coaches, Baumer said that that is one area that has changed since his departure. The Pittsburgh Pirates, for example, are very forward-thinking in having a technical person in the clubhouse, he said. But during his time with the Mets, he felt as if he were stepping across boundaries if he tried to relay information to players.

"The theory was that the coaching staff—that was part of their job—was to translate ideas that the front office might be interested in manifesting on the field, and then to communicate that to the players in whatever way they thought was going to work best," he said.

All told, Baumer's experience in the Mets' front office encapsulates the transformation that Major League Baseball was undergoing in this time period. The advanced statistics that were devised by figures like James, Palmer and Cramer, combined with the advanced ways of gathering data enabled by computers and team-hired statisticians like Baumer were starting to become more standard.

"We went from my first day on the job no servers, no data sources to within a few years we had a fairly sophisticated infrastructure with dedicated servers and maybe a dozen data sources coming in every day. We had an internal website that hundreds of people in the front office were using. The reports that we were doing for the coaching staff were almost fully

automated or in many cases fully automated. I think we were able to do quite a bit. The nature of the conversation changed," Baumer said.

In a recent study done by Baumer for ESPN that assesses and ranks each Major League team's statistical analysis department, he categorized the Mets as "Believers" (along with the Orioles, Royals, Dodgers, Padres, Blue Jays and Nationals), thanks in large part to general manager Sandy Alderson and his analytic background. The advanced stat revolution had made a lasting impact.

From advanced stats to advanced data, how baseball has changed recently

The nature of the conversation has continued to change. While the 1980s through the early 2000s brought about a paradigm shift that altered the way Major League Baseball viewed data, the 2000s and beyond has only expanded the scope and complexity of analytics.

The Internet's influence did not stop with the aforementioned blogs and decentralization of information. Adding to the pool of resources, amateurs began to assemble massive databases of play-by-play box scores and house them online. Sites like *Baseball-Reference.com*, founded in 2000, and *Retrosheet.org*, whose website was founded in 1996, stuck out to Palmer and Gillette.

"If you go to *Baseball-Reference.com*, which is the biggest baseball reference site on the web, (it) really is the logical extension of *Total Baseball* or *ESPN Baseball Encyclopedia*," Gillette said. "It really does have all those stats and more and in fact Pete Palmer and I license our baseball stats to *Baseball-Reference.com*… In my mind, the encyclopedia still lives, it just lives on a different medium."

For Palmer, who spent the bulk of his career keeping a by-hand database, the difference resides in the speed at which data can be located.

"I went through all the official data of stolen bases and caught stealing against every team from the microfilm," Palmer said. "Now, with *Retrosheet*, in ten minutes I can get that data for 100 years, but it took me probably five or six hours to just do one year. The availability of all this data is just amazing."

As Alan Schwarz details in *The Numbers Game*, these sites capitalized on the shortcomings of the Elias Sports Bureau. Though Elias was the leader in disseminating proprietary statistics to professional sports, they were also the leader in haughtiness, as they refused to grant access to outside-the-establishment figures like Bill James. *Retrosheet.org* and *Baseball-Reference.com* thus operated under a different premise—one that focuses on open and free information.

Sites like these with the philosophy of information-for-all set the stage for the implementation of Statcast across every MLB ballpark in 2015. A tracking technology[9] that relies on strategically placed radar cameras to gather hordes of data on MLB players, the new technology was ironically unveiled on Opening Night at baseball's second oldest stadium, Wrigley Field, in a matchup that featured two of the oldest rivals in baseball, the Cubs and Cardinals. Vince Gennaro, the president of the Society for American Baseball Research, postulated at the SABR Analytics Conference in March in Phoenix that out of the approximate 100,090,000 professional baseball games ever played, this one represented 98 percent of the history of baseball information in terms of file size, simply because the Statcast file had tracked so many previously untracked baseball events.

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[9] MLB Advanced Media does a nice job of explaining their product here

Statcast was ushered in with mind-numbing expectations—some of which it fell short[10], and some of which it reached (another opportunity for coverage to expand to unprecedented depth). Nevertheless, it is clear it changed the conversation to be less about mind-numbing statistics that only a few people understand and more about powerful data that is accessible to anyone. This sentiment was reiterated at the SABR Analytics Conference, and according to Mike Petriello, a stats analyst at MLB Advanced Media, the Statcast data is unlike any other type of data baseball has ever experienced.

"Really, the idea is, it's this incredibly complicated data set but I think it's looking very accessible to the fan. It's hard to watch a baseball game and say, 'Wow, I just saw a win above replacement,' because you can't really see that. But you can see an outfield throw, you can see a guy running to first and you want to know fast can he do that. If you were in Houston last year and you saw (Astros' center fielder) Carlos Gomez throw out (Twins' first baseman) Joe Mauer with a 103 mph throw, you can say, 'I saw the best outfield throw of the entire year.' It's really going to be consumable to the fans and also, as we get deeper into it, usable for teams as well."

Daren Willman, the director of baseball research development at MLBAM, chimed in to discuss how he has converted the data and the events into visualization charts to show concepts ranging from an outfielder's range to launch angles off a hitter's bat. Willman foresees these charts being on broadcasts in the near future—ones that will include the ability to place transparent range charts on the player that will move with the player when the ball is hit his way.

Sarah Gelles, the director of baseball analytics for the Baltimore Orioles, and Yeshayah Goldfarb, the director of minor league operations and quantitative analysis for the San Francisco

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[10] *FanGraphs.com* uncovered a flaw and showed how the system tends to record every type of hard hit ball, but not necessarily weaker contact

Giants, focused their praise on how Statcast has converged analytics and scouting. Once thought to be arch rivals and in constant disapproval of what the other argues to be fact, Statcast places both back on the same team.

"One thing I really like about it is I think it helps bridge the gap between analytics and some other areas of baseball operations (and) scouting," Gelles said. "It really makes it easier to explain... It lets you really break out overall performance into its different components in a way more similar to how scouts have thought about things for a long, long time."

"You have the explanatory power with what you're saying is much closer to something that anyone can understand," Goldfarb said. "As opposed to like, 'Hey, we've got a model where we bucket different segments of the ballpark and we ran a linear regression, and these are the run values associated with this sort of batted ball... ' I think your coaches and many other people sort of glaze over. But, when you say, 'This guy started here and it took him five seconds to get here. Most guys traveled this far in five seconds. His range isn't very good.' They're like, 'Well that makes sense.' In a lot of ways, the Statcast data has unlocked a much more logical conversation with the people that you want to understand this information because they're applying it on the field."

This is an important point and should not go by the wayside. To emphasize, the reason Statcast has many people eager about the possibilities of its data is because of its innate simplicity. Yes, analytics-minded people still have to be the ones to initially vet the data and mold it into digestible form. But it is the ultimate meaning of the data that anyone can understand. How many feet does this outfielder cover? What is this hitter's bat speed? What is his **exit velocity**, and how does that compare to the league average? Once rated by scouts simply through the eye test, these skills can now be accurately measured. Dick Williams, the general

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manager of the Cincinnati Reds, agreed on all fronts, and summed up the general tone regarding

Statcast that was present for much of the conference.

"You had this wave of analytics and there were a lot of scouts who were skeptical of the

information," he said. "There were a lot of decisions that were made around this age that were

made based on more of the event-driven numbers. Now that we're getting qualitative descriptive

statistics, more of the spin rate of the ball, more of the exit velocities, more of the range

information, the decisions that are being made statistically are now starting to line up again with

the scouts. The scout can say, 'Hey, you're telling me this guy isn't getting on base, but I'm

watching this guy, he's really good.' Now, we're able to say, 'This guy wasn't getting on base, but

he was hitting the ball really hard.'"

Petriello and Willman concluded their presentation by asserting that the possibilities that

Statcast unleashes are endless. The duo has already learned much about spin—what is an elite

spin rate and what is not—and are now able to deduce that fly-ball pitchers tend to have high

spin rates on their four-seam fastballs, while low-spin pitchers generate more sink and induce

more ground balls. There are also areas that still remain open to research. Does Statcast say it is

faster to hit the cut-off man and concede his transfer time for the increased velocity of a shorter

throw? Or should the cut-off man let the ball go through? Willman wondered if a defensive

metric would arise in the near future to put a number on range. (Range Factor does this but does

so based on outcomes, rather than raw data that would come from Statcast.) Gerrano was

interested in whether or not WAR could be replaced with a metric that incorporates launch

angles and exit velocities. To that end, will exit velocity start impacting official scoring and help

with determining outs or hits? How about Gerrano's other recommendation of modifying the

concept of **Park Factors** by placing every batted ball's launch angle and exit velocity in every park and forecasting results that way instead of teasing out a number based on actual outcomes?

Questions like these are all made possible by a multitude of factors. The Internet, computers and programs like Statcast are big players, but an open-mindedness to change and experimentation is also at play. This was not always the case.

"Baseball's culture is resistant to change, and we see that in clubhouse behavior, but certainly at the coaching and front office level, we've seen some pretty dramatic shifts in the last 10 or 15 years to where now, every team can almost be considered an analytical team," Jeff Sullivan said. "They're making it a priority for their coaches to be able to convey these complicated ideas to the players, who I think are becoming increasingly open to these ideas."

Sullivan then singled out the omnipresence of teams employing shifts, concluding that it signaled just how much baseball continues to change.

"Every season I think shifts have pretty much doubled league-wide, and so almost every team is shifting now; almost every team is shifting more than they ever have. And this is something players would've been resistant to because it's unfamiliar, but it's happened, and it's happened pretty fast, and it's happened even more. I think that's a pretty good little indicator of how baseball is changing faster than it ever has before," he said.

Gary Gillette pointed out a similar phenomenon in reporters' increasing willingness to be embracive of change and advanced stats. Whereas Sullivan focused his statement on playing style and strategy, Gillette directed his towards the coverage of Major League Baseball from journalists and their opinions on advanced stats.

"You had some writers who were accepting of analytic stats and others who weren't. Right now, I would describe the prevailing ethos as only the troglodytes, and the dinosaurs just completely blow off analytic stats and sabermetrics. There's a vast middle ground of people who accept some of them but aren't really well-versed or really look suspicious (using sabermetrics), and then there's a growing convoy of people who understand how truly valuable these stats are," he said.

To provide concrete examples, fans and people within baseball understanding how valuable advanced stats are has led to a better understanding of the incompleteness of traditional ones. Win-loss records for pitchers are starting to be viewed increasingly as supremely misleading, evidenced by former San Francisco Giants pitcher Tim Lincecum winning the 2009 Cy Young Award with only 15 wins on the season—the lowest for any pitcher in a non-shortened season until Felix Hernandez did so with only 13 wins the following year. Lincecum and Hernandez demonstrate how good pitchers on bad teams that supply little in the way of run support or sterling defense get short-changed by the statistic. Runs and RBI are nearly entirely situation dependent and in the present baseball landscape reveal little about a player's true skill because so many other factors come into play. Moreover, thanks to the rise of advanced calculations, the argument could be made that these marks are no longer even stats, but simply raw data from which stats can be derived. Even the most universally beloved stat in batting average is also (sometimes begrudgingly) being acknowledged as fundamentally incomplete—yes, it is convenient and understood by the most casual fan, but as many are aware, treats all forms of hits (whether it be single, double, triple or home run) as equal. **Slugging percentage** tries to compensate for this, but mistakenly assumes that a double is twice as valuable as a single, among its other inaccurate weights applied to offensive events.

Pete Palmer spoke on many of these statistics, voicing his disagreement with a few and also attributing their relevance to a different era of baseball that has come and gone.

"In the early days, runs for individuals was the important—if you go back to the 1860s—that was the most important stat for players," he said. "But then it kind of got out of favor. In batting, runs are a little complicated because they get shared among players, and the guy who scores the run isn't necessarily the most important guy in the process. That might have something to do with it. I really think RBIs are overrated because the guy who drives in the run gets all the credit. One thing really annoys me is batting average with runners in scoring position. They ought to give some credit to the guy who got in scoring position! You can see how many runs a guy drove in or how many you score, but that doesn't necessarily tell you how it affects the team."

When the Red Sox hired Bill James in 2004, it was done with an experimental attitude according to the accounts given by Gillette and Palmer. They believed they had the front office of the future but also had the lingering fear of becoming labeled as a stat geek, data driven organization. This was beautifully underscored after James insisted on ditching the idea of a "closer" and instead employing a strategy of pitching the team's best reliever at the most critical juncture of the game, not necessarily for the ninth inning. The idea backfired a few times—perhaps a case of randomness and small sample size—and then the higher-ups quickly shunned the concept.

This idea is one that still struggles to gain acceptance in mainstream thought despite its sound logic according to James, but even so, today's baseball atmosphere—12 years after James was hired—is one that encourages innovative thinking more so than ever before. Though he has

no plans of returning to the Mets at this point, the ideas that Ben Baumer has developed over years of mathematical work showcase the potential for data within baseball.

"If I could go back now, I'd be doing things differently," he said. "I think a lot of the work I did with the Mets was again trying to develop that kind of infrastructure where we didn't have to spend man hours doing data work, it was all automated… The part that I would like to do more with is statistical modelling. We built forecasting models that would try to give us a sense of what we thought players were likely to do in the future. I've learned a lot since then, and the kind of models that I built might be different and more sophisticated. I'm sure that's what other teams are doing and the Mets included."

In January, the Philadelphia Phillies hired Andy Galdi away from Google and made him head of their recently constructed analytics department. The hiring made it so that all 30 Major League Baseball teams have full-time stats gurus in house, underscoring just how far the progress has extended.

Strategy and nuances that advanced analytics convey

So what does all this revolutionary development mean? It is hollow just to say that there have been sweeping changes in the way people consume and cover baseball if there have not been concrete examples of change on the playing field. Nevertheless, a divide between what goes on in the statistical analysis office and what goes on in the clubhouse sometimes exists. It is because of this divide that while the thinking has progressed, the strategic execution of it remains a work in progress.

Up for debate are the merits of tactics that have been ingrained in baseball since day one. Is intentionally walking the number eight hitter to get to the pitcher strategically sound? Does

calling for a sac bunt with a runner on first and nobody out increase the chance of scoring in the inning? Does taking risks on the basepaths reward a team in the long run? Are there natural selection forces in play that mandate closers be nothing short of mentally strong? Was former New York Yankees shortstop Derek Jeter above average defensively? Palmer began with intentional walks.

"One thing with intentional walks is they walk the eighth place hitter to get to the pitcher when there's a runner on second and first base is empty. And jeez, looks like a good play because you reduce the number of runs scored in that situation because the pitcher's now up with two outs and a runner on first and second—he's probably not going to get a hit… What happens is the eighth guy is the next-to-worse hitter on the team, right? So if you pitch to him and get him out, then you got the pitcher leading off the next inning. So it turns out you reduce the team's scoring by about (one) twentieth of a run when you walk the eighth guy to get to the pitcher, but then the next inning they get twice as much back from (the leadoff hitter) leading off instead of the pitcher leading off," he said.

Palmer did not express overt discontentment with stealing bases, but as was mentioned earlier, it is advisable to know that getting caught stealing is close to twice as detrimental as it is helpful to successfully steal a base, according to the 2015 run values from *FanGraphs.com*. Palmer related that if a team never attempted a stolen base, not much would be lost, and if a team that steals hordes of bases does so with only an average success rate, it will not extensively help the team.

His view on the usage of relief pitchers was much more impassioned.

"The main thing they do wrong is the stupid relief pitchers," he said. "The problem with it mainly is that you have your best relief pitcher, who's probably making ten million dollars or something and he only pitches like 60 innings a year. And you never bring him in with the score tied or before the ninth inning and he hardly ever comes in with runners on base. If you go back into the 80s and 70s, the top relief pitcher used to go over 100 innings half the time. Now it happens about once in ten years. You got this guy making tons of money and you hardly ever use him except when the game's already won and you got two or three other pitchers who probably wouldn't even be on the team who you're bringing in in the eighth (inning) with the score tied and the bases loaded because you don't want to use your closer until the ninth (inning)."

The strict usage of a closer remains steadfast throughout all levels of baseball. In fact, the 2015 season produced only two pitchers considered "closers" (Pittsburgh Pirates right hander Mark Melancon and New York Mets right hander Jeurys Familia), who ranked in the top 12 in innings pitched among relief pitchers.

The same steadfast mindset exists regarding how former New York Yankees shortstop Derek Jeter is perceived as an other-worldly defender by most casual fans. That did not stop Palmer from detailing what sabermetrics reveal.

"One of my pet peeves is what a terrible fielder Jeter was," Palmer said. "When I look at Jeter, his fielding almost cancels out his hitting. On my player ratings system[11], I do wins over average. If you got 40 or 50 wins, you should be an automatic Hall of Famer; if you're in the 20s and 30s range, you're probably a good bet, but Jeter is at +10 for his whole career because he's

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[11] Pete Palmer's player rating system, "Total player rating" or "Batter-Fielder/Pitcher Wins," is founded on linear weights and is designed to measure the value of a baseball player in similar fashion to WAR. It should also be noted that the fielding component of Palmer's ratings is somewhat flawed and superior metrics have surpassed it over time.

like plus-50 in hitting and minus-40 in fielding. In fact, his fielding rating is the worst of any player in the history of baseball even on a per game basis."

Another on-field nuance that sabermetrics and advanced analytics reveal is the presence of luck. On the one hand are sabermetricians arguing about its overwhelming influence and on the other are those who cite stats like batting average with runners in scoring position and claim it reveals clutch ability and skill. Perhaps somewhere in between is where the truth lies.

Pete Palmer delved deep into the mathematics of the sabermetric side of the argument, saying that after each season, one can calculate the total amount of success or failure that can be attributed to chance alone.

"Say you take the distribution of the number of wins by teams over the course of a season and the standard deviation is like nine or ten. And you can calculate, if every game were a coin-flipping event, then you can calculate exactly what the variation due to luck is. In other words, it's a binomial distribution and the standard deviation is one half times one half times the number of games, the square root of that and so that's one half times one half is a quarter times 162 is 40, and the square root of that is a little over six. So, you know the total variation and you know variation due to chance, and you can calculate the variation due to skill. It's just the chance squared plus the skill squared equals the total squared. And if you look at that, they're not that far apart, even over the course of a full season. The variation due to chance is like six games, and the variation due to skill is like eight games, and that's your good old three-four-five triangle, so the average total is ten. So, you're never going to get rid of the six, so there's an awful lot of luck involved. People don't like it when I say that," he said.

It is not necessary nor possible to explain every aspect of Palmer's calculations, but a more relatable example exists with Dick Cramer. Cramer made the concept of luck his personal crusade and centralized his focus on how it impacted the notion of clutch ability. Cramer said his inspiration began when he was in attendance for Boston Red Sox Hall of Famer Ted Williams's penultimate game, a time in which he was a "John Wayne-type of individual." But this sentiment was also accompanied by the local press saying Williams did not excel in "clutch" situations. Cramer was skeptical and set out to disprove its validity based on the fact that those perceived as career-long "clutch" hitters were not necessarily clutch hitters on a year-by-year basis.

"I used the year-to-year comparisons to kind of pound it home," he said. "If it's an ability how come there's no correlation between the guy's clutchness in (19)69 compared to his clutchness is 1970? It struck me that clutch hitting was… How could you be a clutch hitter? That would basically say you're a lazy bastard the rest of the time."

To determine whether or not you agree with this logic and whether or not you think clutchness exists, the central question you must answer is: Would you rather have a very talented player, potentially perceived as "non-clutch," either pitching or hitting with a World Series on the line or an average player who has historically been clutch in the same situation? Would you rather have Los Angeles Dodgers left-handed pitcher Clayton Kershaw, someone who has struggled in limited postseason action, or former Oakland A's right-handed pitcher Dave Stewart, who has excelled in the most important situations, but also had a career ERA 1.52 runs greater than that of Kershaw? The answer according to most sabermetricians is Kershaw because great players do not morph into inferior players when the game is on the line—his struggles have simply been due to a small sample size and randomness.

"What people don't appreciate is baseball's a whole lot more random than most people recognize," Cramer said. "If you can imagine flipping a coin 160 times, the course of a baseball season, you wouldn't find it extraordinary that many of the coins came up heads in some sequence, but of course that's like having 90 wins. 90 wins gets you a playoff berth a lot of the time."

Or, to be parallel with the Kershaw-Stewart example, the coin showing up on heads could equate to a 4-0 record in the 1989 postseason and a World Series MVP (which Stewart achieved). It is not meant to diminish Stewart's accomplishments and claim he was the recipient of favorable chance: it is meant to underscore the painfully low sample size and caution about drawing career-enveloping conclusions from postseason success or lack thereof.

"There's luck involved everywhere, and you need a big sample to eliminate the luck," Palmer continued. "A season isn't really long enough. (Even for) 1,000 games, there's still a fair amount of luck. That only would reduce the luck factor by about 2.5. You can never get it to go to zero. Like (former New York Yankees pitcher and five-time World Series champion) Lefty Gomez, he said, 'I'd rather be lucky than good.' Good is more important than luck, but it's not a lot more important."

The effect this knowledge can have is robust, and Jeff Sullivan's thoughts on it will be included later because they are significant. But for now, one fundamental question lingers: How do we know what is real and what is not? How do we know for certain that the players we deem to be stars really are stars and the ones who are average really are average? It starts with pairing standard stats like batting average and home runs with ones that account for randomness like **BABIP** (batting average on balls in play) and **HR/FB %** (ratio of home runs to the number of fly

balls hit), and ends with accepting a player for what his standard numbers and peripherals indicate by the end of his career.

"I think a player is his record," John Thorn said. "You may say that the sample is too small. You may say that he had a weak year. But over the course of a career, a player's record will reflect who he is as a batter or a pitcher or a fielder."

The debate between the Old Guard and Sabermetricians

Though not directly related to the relationship between stats and baseball, the altercation in 2015 between Washington Nationals closer Jonathan Papelbon and outfielder (and reigning National League MVP) Bryce Harper provides a glimpse at one of baseball's ugly undersides.

A few days before the incident took place, Papelbon served up a home run to Baltimore Orioles third baseman Manny Machado and then proceeded to drill him with a fastball in his next at bat, complaining Machado gazed at his home run for too long. When asked by the media about his pitcher's decision to do so, Harper said baseball's unwritten rules—the military-esque code of conduct that compelled Papelbon to purposely hit Machado—were "tired."

After a few days to boil over his teammate's comments, Papelbon again chose the way of brute force and strangled Harper as he entered the dugout after failing to run out a routine ground ball at top speed.

A nationwide debate ensued among the baseball community. Was Papelbon excessive in his punishment of his own teammate? Was Harper a "spoiled brat" hotshot who was long overdue to be humbled and brought back down to earth by a veteran who had served his time, and thus had the authority to punish as he saw fit?

He did not comment specifically on the Harper-Papelbon situation, but it would be easy to guess where former New York Yankees closer and Hall of Famer Goose Gossage stands on the issue. He sounded off to ESPN in March in an expletive-laden rant, bemoaning the deterioration of baseball's unwritten rules.

"(Toronto Blue Jays outfielder Jose) Bautista is a f***ing disgrace to the game," Gossage said in reference to Bautista provocatively flipping his bat after hitting a go-ahead three-run home run in the American League Division Series last season. "He's embarrassing to all the Latin players, whoever played before him. Throwing his bat and acting like a fool, like all those guys in Toronto."

Gossage was not done.

"The game is becoming a freaking joke because of the nerds who are running it," he said. "I'll tell you what has happened, these guys played Rotisserie baseball at Harvard or wherever the f*** they went and they thought they figured the f***ing game out. They don't know s***."

Gossage's reactionary stance is not uncommon in the baseball world. He was not the first to voice opinions like these, nor will he be the last. Change is viewed as unnecessary by many. Tradition is viewed as sacred by more. Gossage's criticism of "nerds" ruining baseball serves to highlight just how passionate the "Old Guard" is in ensuring power stays in the hands of those with first-hand experience. But armed with certainty of truth and a platform to make sure everyone knows it, the pushback by the sabermetric community has been fierce.

"No one's ruining baseball. Not nerds, not people flipping their bats, not people doing their hair a certain way," Ken Rosenthal said at the SABR Analytics Conference a few days after

Gossage's rant. "A sport is a sport, and I have a lot of respect for Goose, but I didn't agree with his opinions. Frankly, I didn't even think they were worth writing about."

Additionally, Gary Gillette has been at the forefront of the impassioned arguments and singled out two baseball writers in particular for failing to be embracive of advanced analytics. For the sake of not creating unnecessary enemies, their names will be substituted with "Writer 1" and "Writer 2."

"It's like sabermetrics f***** his daughter before she was married," Gillette said. "His daughter was going to get married to the right guy, and then she jolted from the right guy at the altar and ran away and went to Guatemala in despair... If you Google (*Writer 1*), you'll also find he's penned many pieces decrying the end of western civilization because sabermetrics has become accepted now. It's like we're all going down the tubes."

"(*Writer 2*) has gone on his horse about sabermetrics and stats to the point where I'm surprised he hasn't decided to make war against the Internet. I do really admire (*Writer 2*). He was a great reporter on his beat. Just when he gets into statistical analysis he's a simpleton... If you look in the dictionary under 'curmudgeon,' they have a picture of those guys."

Perhaps Gillette's view is justifiable. The arrogance of many old-school writers in refusing to be open minded and acknowledge new ways of thinking is alarmingly similar to the arrogance many of their employers showed, opting to rest on the laurels of being a legacy news organization and shunning the digital means of storytelling that the computer and Internet brought along. It is of no coincidence that newspapers and simplistic stats are being exposed as flawed and inadequate.

But Ben Baumer expressed concerns with this eye-for-an-eye way of reasoning. After all, the root of any true statistician or sabermetrician is critical thinking and challenging notions we view as fact.

"One thing that I have come across is sometimes some sabermetricians are very vehement in the correctness of their point of view," he said. "I think that that is usually misguided. As a statistician, you accept that there is always uncertainty. There's always, always uncertainty. If you're not being honest about the amount of uncertainty in your results, you're really not doing good work."

Others were in agreement to Baumer's down-the-middle sentiment by referencing the current balance of scouting and stats. Cries from both parties about the worthiness of their area of expertise were frequent at the advent of advanced analytics. But currently, there's little animosity between the two groups, as both view each other as important cogs in building a winning team.

"The stats versus scouts debate that was popular 10-20 years ago around the *Moneyball* era, it was valid then," Jeff Sullivan said. "But at this point, I don't think at this point almost any team would tell you that there's much of a conflict."

"So much of statistics is basically scouting anyway," he continued. "We talk about PITCHf/x[12] and pitch velocities and pitch movement and stuff, but all that is basically scouting information that we've quantified… You're going to have numerically inclined scouts down the road and there's always going to be room for some eyes to be in the game and certainly for prospects that you want to draft. But as we get more and more information, so much of it is about

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[12] A pitch tracking system that was installed in 2006 and was essentially the predecessor to Statcast.

the actual direct statistical quantification of the scouting skill. They're coming together in essence."

John Thorn voiced a similar thought.

"Sandy Alderson, someone who was at the forefront of statistical analysis in practice at the Major League level, will tell you that the numbers are great, but you cannot eliminate the human factor, cannot eliminate scouting reports. The two complement each other and work hand in hand… The weakness of one is the strength of the other."

In fact, Pete Palmer argued on multiple occasions that, "The difference between the analytical decision and the traditional decision is not a huge amount." Have sabermetrics and statisticians been misconstrued in a way that mistakenly makes them the antithesis to traditional thought when in reality the knowledge gleaned from their work is simply designed to serve as another tool to understand baseball? This argument was proposed in the *Hidden Game of Baseball* and then given an ironic twist. John Thorn spoke about it in an over-the-phone interview.

"In the end, sabermetrics comes back to the original notion that outs and runs are really the currency of baseball—what matters most. Dividing outs and runs into component parts, that's the trick," he said.

The irony is that outs and runs are two of baseball's most simple offerings. Anyone with an interest in the game knows how they work and what they mean. Sure enough, sabermetric statistics, viewed by most as math equations better left for an Algebra II classroom, are almost universally intended to frame performance in terms of outs and runs. Linear weights does it. Wins above replacement does it. So do weighted runs created plus and weighted on base

average. On the pitching side, fielding independent pitching and skill interactive earned run average fit the mold. For defense, **defensive runs saved** is a convenient stat for measuring the impact of one's play based on runs prevented.

In their initial quest to measure performance, statisticians strayed from baseball's origins of outs and runs. Upon what are standard stats like batting average for hitters and wins for pitchers founded? In reality, these are the complex stats because both have little to do with measuring performance as a factor of outs and runs. Some will view these stats as part of baseball's tradition, but ironically, they are the opposite—a slap in the face to baseball's roots.

As Pete Palmer and John Thorn wrote in the *Hidden Game of Baseball*, sabermetric thought is "simplicity arising from complexity." The end product is a fine-tuned stat anyone can understand. The complex part is the calculation, which should be a non-issue because does the average person probably does not care. Could the average person recite the formula for a standard stat like slugging percentage?

Old-school thought still wins out at lower levels of baseball

Since the NCAA is chock-full of players striving to embark on their professional careers in the near future, you would expect it to also be the perfect grounds for experimentation with data, stats and technology, right? Well, not exactly.

Based on conversations with Michael Baumann (a writer at *D1Baseball.com*), Aaron Fitt (also a writer at *D1Baseball.com*), Thomas Lenneburg (the sports information director at Arizona State University) and Jeff Sackmann (the founder of *collegesplits.com*), it is clear college baseball lags behind pro ball in many important areas.

The analytical age that has hit MLB coverage with full force is entirely absent from college baseball. Though the reason for this could be a lack of understanding both in calculation and comprehension of sabermetric stats, we will give the NCAA and its stat keepers a pass. The sample size for college players is too small to make the deduction their (advanced) numbers will translate to pro ball. And yet, even at a basic stat keeping and stat disseminating level, nagging issues are evident. This, of course, cannot be given a free pass according to Baumann and Fitt.

"The most obvious thing for me is it doesn't track plate appearances," Baumann said. "I was covering a Louisville-Florida State series last year, and I wanted to find out the walk rate for Florida State's team because they're incredibly patient—they usually lead the nation in walks. Not only did I have to do the division myself, I had to add up all the hits, errors and hit by pitches, all that stuff… Maybe there is just not enough of a demand, but that's just the simplest, easiest thing."

Whereas Baumann's issue was negotiable (given he was eventually able to calculate the stat by hand), Fitt's biggest complaint is insurmountable. It concerns a particular hitter's success against left-handed and right-handed pitchers, otherwise referred to as splits, and the impossibility of calculating it in a timely manner.

"That is one particular piece of information that I've always found frustrating that it's hard to find," Fitt said. "It's such a pain in the butt to get to. It's so bizarre because that information is so commonly available in the big leagues and also the minor leagues… But the college coaches do guard that stuff like the nuclear code. It's insane."

Lenneburg, who is on the other side of this issue given his position as a sports information director, said college coaches and athletic departments safeguard splits because they

perceive a competitive disadvantage if they were to make it publicly accessible. Their thought process goes that other teams could access the information and then turn around and use it as in-game strategy when the two teams play. In an effort to provide a glimpse of how Arizona State (and likely every Pac-12 school) records and shares data regarding the baseball team, he detailed the basic protocol.

"It's just like scoring on a piece of paper," Lenneburg said. "It's just inputting it, and at the end of the game you'll input winning pitcher (and) attendance… From there, you just create a pack file and then from there, StatCrew (stat keeping software that Arizona State and other universities use) handles turning the information into the situational stats or the by-player (stats). You have to create a roster file so then every play that gets recorded by that player gets tagged by them. Really, all you're doing is inputting what happens and the computer is creating the rest of the stats from that, whether it's as simple as batting average or as complex as WHIP."

Lenneburg's closing sentence underscores another issue that college baseball faces: WHIP is considered complex. When the formula (walks plus hits, divided by innings pitched) and basic principle (how many baserunners a pitcher allows per inning) are combined into the very acronym of the stat, and that is considered complex, there's an issue—at least, for people trying to use data to tell stories like Baumann and occasionally Fitt.

But what is the reason for this? Is the answer simply that college baseball coaches, players and fans do not care enough for meaningful changes to be made? Or are there external forces—such as a lack of resources—that prevent change from taking place? When considering Fitt's response, it appears to be both.

"I don't think the average college baseball fan is as much of a stats-oriented reader as you might find in pro ball," Fitt said. "The advanced stats revolution in my opinion I feel like it's put on by the fact that there's a lot more technology available. Not only Major League Baseball but also minor league baseball, with BAM, with all the stuff that you can now find through *minorleaguebaseball.com*. There's just a lot more resources there, there's a lot more data."

Lenneburg also acknowledged the lack of funding being a hurdle, but then alluded to a growing demand for more data in college baseball eventually influencing change.

"I mean obviously part of our issue is the lack of resources," Lenneburg said. "(But) I think beyond even for their own good, for the fans it's just sort of what people want now. It's why they do it on TV. It's just another added component of the game where you can quantify how somebody did… I think it's a combination of wanting the data to win and then wanting it to build fan affinity and get people in the door and get them excited."

Shifting the focus to the use of data in an actual game, strategy for example, let's make no mistake about it: There are many brilliant coaching minds in college baseball, regardless of whether or not they use data to make lineup or strategic decisions. According to Baumann, coaches may be making decisions that have a strong backbone in-depth statistical analysis, and yet, do not know they are doing so—a glowing indication that sabermetric thinking and traditional, gut-based thinking are not all too far separated.

"A lot of them are ways that we think of sabermetrically sound," Baumann said. "The thing with Cal State Fullerton is their pitchers never ever walk anybody… (Vanderbilt) strikes a lot of guys out; Florida State draws a ton of walks and they run incredibly deep counts. Vandy plays a lot of four or five hour games because their kids are seeing five or six pitches an at-bat. I

think a lot of that is just intuition. We know it has mathematical basis, but I don't know if any of the coaches are doing it for that reason. I think it's just something that they've sort of teased out by their own experience."

Another influential player in this is Jeff Sackmann—someone who saw a gap in the market of college baseball stats and founded a business as a result. Sackmann and his partner, Kent Bonham, had the idea of gathering play-by-play data for college baseball, and *collegesplits.com* was born. From his vantage point (one that's markedly different from that of Baumann and Fitt), the outlook of college baseball stat keeping and data usage is not as bleak as it may seem.

"Many college coaches do rely on us for advanced scouting reports, split stats and spray charts on their opponents," Sackmann said. "Not many coaches care much about advanced stats, but that's changing, and even those coaches who don't care at all still want to see spray charts and basic splits."

"Coaches are already using more and more data when it comes to working with their own players—radar guns keep getting cheaper, and sports science is steadily changing how players can train to maximize achievement. Analysts who work with performance data—that is, stats from the games themselves—tend to ignore that side of things (referring to college baseball writers like Baumann and Fitt), but it's huge," he said.

Along with an increasing amount of college programs seeking out advanced stat services like Sackmann's, college baseball is also benefitting, slowly but surely, from expanding technologies in accruing the data (which Sackmann aggregates) in the first place. It may not be

as grandiose as MLB's Statcast, but services such as Trackman[13] and PITCHf/x are starting to become the standard for NCAA data tracking.

In fact, Fitt was a key middle man in the installation process, as he connected those at Trackman with those who would ultimately house the technology in their stadiums.

"A couple of years ago, I helped (Trackman) get in touch with a lot of college coaches, and I think they started with maybe eight or ten or twelve programs," Fitt said. "It's still probably only the big-resource programs that can afford to do it... But their data is so cool. You can break down spin rate, off-the-bat velocity, all that kind of thing. I think it's pretty neat. I love what those guys do."

When considering all these dynamic forces shaping the college baseball data landscape, it is easy to come away with a blurred picture. On the one hand, basic stat keeping continues to be a source of frustration for writers like Baumann and Fitt. If a stat as simple as plate appearances is not recorded, how will more in-depth stats (heaven forbid, righty-lefty splits) and data ever surface?

Sackmann acknowledged a degree of limitation with the evolution of college baseball stats, but also sensed adaptation and open mindedness starting to infiltrate programs.

"Because players are generally recruited when they're 18 or 19, and there's no trading or free-agent signing like in the pros, college baseball will never be like contemporary MLB, where every team has a staff of (data) analysts valuing players," Sackmann said. "But in the areas that

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[13] Another baseball tracking technology like PITCHf/x and Statcast. Trackman uses "3D Doppler radar and software for player development and evaluation," according to its website.

data can help—training, advanced scouting, etc.—plenty of coaches are doing a lot to take advantage of what's out there."

When asked to reflect on the accomplishments and shortcomings in the stat and data department of college baseball, Fitt offered an all-encompassing view.

"My final thought would be, we still got a long way to go in college baseball when it comes to data," Fitt said. "I do think college baseball lags way behind pro ball even now. (But) we're making progress. Trackman is getting more prevalent. That kind of technology—it helps. I'd like to see it continue."

Dangers of too much data

In *The Numbers Game*, Alan Schwarz details the numerous reasons why Bill James retired from his baseball work in 1988. Among them, Schwarz cites James's frustration over the "uncontrollable stathead monsters" he created because of his revolutionary way of looking at baseball. People were chewing up stats as if they were candy, and then throwing them around in trivial arguments in an uneducated manner. Meanwhile, when Gary Gillette spoke about the subject, he hypothesized that James was simply worn out with hitting rigorous deadlines, but did concede that he remembers when James said he knew it was time to retire because, "He realized he was writing too many letters that began with 'Dear Jackass.'"

Regardless of which reason played a more prominent role in the brief retirement of James, the situation can serve as a lesson. An overreliance on statistics and data can indeed by detrimental. A major goal of professional baseball, and all sports for that matter, is to grow people's interest in the game. If outsiders perceive it to be a game that lacks spontaneity and emotion and is too complex to understand, and instead perceive it to be one that has already

transfixed on multiplication tables and data sheets, they will be alienated and drawn to other sports. So, how much data is too much data, and what are the limits to its incorporation in baseball? How does baseball strike that oft-coveted balance to ensure all sides are happy?

Ken Rosenthal touched on the possibility of information overload in the digital age, ultimately concluding that catering to all sides is a battle not worth fighting.

"It depends on who you're talking to. Some people can't get enough and some don't want to hear it. If we were at an information overload, we'd be there by now I would think. For some people it certainly exists. I would say overall, the more information, the better. People are hungry for information, all kinds of information, and I don't know that that's a detriment."

Jeff Sullivan played devil's advocate. Even though his exact job description as a writer for *FanGraphs.com* is ingesting, interpreting and adding value to data, he revealed that even he can feel overwhelmed at times with the immense amount of data at his disposal.

"If you go to a player's player page on FanGraphs, there's so many numbers," Sullivan said. "Even I get overloaded just thinking about how much we actually offer. I use so little of it in my day to day. I think already it requires some amount of discipline to using the numbers. More than anything, you not only have to look at the numbers, but you have to know where they're coming from, what they mean, if they're actually backed up by player performance, if they're significant, if they reflect anything real."

John Thorn rounded up the competing thoughts on the topic and cautioned about our innate desire to categorize and measure the sometimes immeasurable.

"The temptation is to think that everything can be measured, that randomness and elective stats can be removed from the evaluation of a player," Thorn said. "I believe that modern baseball fans with a sabermetric inclination will get too hung up on comparative evaluations. Is (Miguel) Cabrera better than (Mike) Trout? That kind of thing. Ultimately, this was not what drove us in the *Hidden Game* (*of Baseball*). The questions that animated us for that book were: What is it that we're measuring? What is it we think we're measuring? What remains unmeasured?"

At a very recent point in the past, fielding skill was the most glaring answer as to what remains unmeasured and what the limits of statistics from a calculation standpoint were. With so many different factors at play, such as park intricacies, force at which the ball was hit and amount of shift being employed to name a few, fielding statistics remained mired in the shortcomings of fielding percentage—lagging far behind the advancements made in measuring pitching and hitting skill. Even still, Sullivan spoke about a "false precision" many people get when looking at metrics like WAR, defensive runs saved and **ultimate zone rating**, since they are all calculated to the decimal point. He cautioned that these statistics still represent a range of outcomes.

"They're mostly in the right neighborhood of where these players' true talents would actually be," he said. "Anyone would admit that there are shortcomings, and the way I think of it is, the numbers kind of give you a good sense between what the range would be between the best and the worst values. There's still a lot of room for scouting interpretation…"

His last sentence triggers instant images of the previously mentioned Statcast—the godsend technology to defensive statistics that marries numbers to scouting observations. It is for that reason that defensive skill is no longer unmeasurable.

Does this mean we have reached a point in which every act in the game of baseball is calculable? Statisticians are indeed closer than ever before to be able to claim this, but alas, one previously mentioned topic remains inseparable: What is innate skill? What is attributable to chance alone? Granted, strides have been made with statistics like fielding independent pitching and batting average on balls in play to try to strip the luck aspect out of the skill aspect. But the fact that there still is no set-in-stone answer shows a limit to how far stats can go—a torturous reality for people like Sullivan.

"I remember it was really exciting to learn about this stuff at first," he said. "Like batting average of balls in play and I was like, 'Oh look, all this stuff is wrong! Look at all this element of luck.' It was a lot of fun to write about that and tell people about that. And then now, I've been doing this for 14 years, it's f***ing paralyzing."

"There's no good answer to this," he continued. "(Luck is) difficult to write about because you know it's there and you don't want to just keep writing the same thing, but it's also still not publicly accepted to enough of a level where you want to not keep saying the same thing… I prefer to believe there's more skill just because I think that makes it a more interesting game, but I don't know. Most people don't know. It's all kind of a guessing game."

While Sullivan's 14 years appear an impressive feat considering how difficult it is to navigate and articulate ideas like this to an audience, Pete Palmer has been studying it his entire life. He took a more reserved approach, perhaps finally settled on the idea that the two cannot be split.

"That doesn't take away from the enjoyment of it; it's just something you have to realize," he said. "I've been a baseball fan all my life and it doesn't take away from the enjoyment of it; it's just something that's there."

To round up the discussion on the limits of statistics in baseball, it is important to consider that it is the players, human beings, who still have to perform. Trying to tap into the current sentiment of MLB players regarding their consumption of numbers, the SABR Analytics Conference and the interview with Jeff Sullivan were solid references. The consensus was that players cared little about human-tailored, and thus flawed, statistics, yet increasingly were finding value in the raw data (which is presented to them in an easy-to-understand format by the team's analytics department).

"With the majority of players, there's not a whole lot to gain necessarily from looking at the advanced numbers," Sullivan said. "If you're a hitter and you figure, okay, 'I'm going up to the plate and I want to work on my wRC+. What on earth does that mean?' You want to hit the ball hard, and you want to take your walks… Where it seems to be really useful for players, for a pitcher you can look at your movement; you can look at which of your pitches you're throwing for strikes, which one's you're locating, which one's you're throwing bad; you can look at hitter tendencies; you can look at where hitters tend to hit the ball."

Sullivan then referenced data from two years ago that suggested Los Angeles Angels centerfielder Mike Trout was having trouble hitting fastballs up in the strike zone. Pitchers were aware of it and began to pound that portion as much as possible. When Trout was turned on to the data, he corrected the mechanical flaw that was causing the hitch and has since hit those

pitches at the level of all other locations[14]. Sullivan sees immense value to this interplay, particularly for younger and less established hitters than Trout, who may be getting discouraged by potentially misleading and limiting overall numbers.

"I don't think that there's a great benefit to looking at the overall numbers, but there's benefits for preparation," he said. "It would also be useful to be reminded, if you're a young hitter and you've gone 2-for-your-last-30, but you've had a bunch of line drives caught, it's important for someone to tell you, 'Actually, you've been doing a good job. It's just that your batting average isn't good.' There's a psychological component to it as well where players need to understand when they've been successful even if the numbers may not convey success."

What's on the horizon? How does the Schumpeterian moment continue?

Greek philosopher Heraclitus once said, "The only thing constant in life is change," and that certainly holds true for stats and data in baseball. As has been illustrated throughout the work, baseball and numbers have been paired throughout history. As the nature of one changes, so does the other. The 2015 season offered a perfect example of the Schumpeterian moment continuing, as Statcast's data destroyed old perceptions of truth and gave way to more advanced ideas of defensive alignments, fielding range and batted ball velocity, to name a few. With these unprecedented strides in very recent memory, it seems a bit greedy to ponder what could possibly be next.

Ben Baumer was accordingly cautious with his outlook, ever-so-slightly tampering expectations for more significant developments to come in the near future.

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[14] *FanGraphs.com* and Sullivan published the study that found Trout had indeed fixed his problem in the 2015 offseason.

"Well, I think anytime there's a new field, there's low-hanging fruit to be picked," he said. "I think at this point, a lot of that low-hanging fruit has been picked. Things like, the whole importance of on-base percentage over batting average, like yes, that came to light in *Moneyball* in 2003 but that was an idea that had been discussed in the 50s. Once play-by-play data started coming through and people were able to do things like sophisticated base running models and win probability added and things like that, people did them. But now we have all those things and the question is, what is the next step?"

Though Baumer's point may be viewed as reactionary in message, his tone was optimistic. The fact that he concluded with asking "What's next?" implies there will always be development and change. But before actually answering, "What is next?", it is necessary to stress what is driving the change.

"Because of things like Statcast and other similar developments, because the Major Leagues are taking this seriously and making it part of their effort, it's apparent there's a whole lot more you can learn about baseball by taking more data. Data is driving. If there's more data, there's more chances to learn from that data," Dick Cramer said.

Delving into the changes many expect to be implemented in the near future thanks to new data available, Sullivan said he expects to see starting pitchers throwing fewer innings every year. This can be attributed to data that suggests pitchers become increasingly susceptible to hard contact when they face hitters for a third or fourth time in a given game. Sullivan also envisions much more personalized defensive alignments for every hitter in nearly every different ball-strike count.

For Baumer, at the top of his wish list are robot umpires—a controversial subject given the fact that it replaces a human factor of the game. The crux of his argument centers on data that confirms a catcher's ability to frame pitches and steal strikes as a legitimate talent. He argued that this value is only tied up in the fact that robot umpires do not exist yet.

"The impetus of the robot umpires is just fairness," he said. "Let's just remove ambiguity and let the strikes be called as they're defined in the rule book… We already use (machines) to judge the efficacy of umpires. It's implied that it's better than the umpires are now anyway… No offense to the umpires. It's not their fault. It's not that they're bad at their jobs; it's just we have a machine that's able to do this particular task better than a human being can."

Additionally, Sullivan predicts some changes in the way baseball is covered by journalists and television networks. In the broadcasting realm, he foresees the dissemination of more scouting numbers. Graphics will increasingly display a pitcher's pitch types and pitch speeds and a hitter's exit velocity, swing strike zone and hot and cold maps. For the written analysis portion of baseball coverage, Sullivan singled out his colleague at *FanGraphs.com* Eno Sarris, as someone who represents the future of baseball media coverage. Sarris's content routinely features statistical analysis breakdowns combined with direct quotes from players, who give context to where those numbers come from.

"That is not only the best way to use the analysis that we have, but it's also the most interesting way for readers as well," Sullivan said. "They're not just reading an article that's by some dude that's a baseball analyst but you're also seeing input from a baseball player that legitimizes the analysis as well."

In addition to strategic changes (shifts and starting pitcher usage) and coverage changes, technological advancements are a key aspect when predicting how baseball and its data will continue to change. The SABR Analytics Conference featured a technology panel of three speakers in Kevin Forbes, Michael Bentley and Jason Sherwin, each of whom detailed their product and demonstrated how it could continue to add to the ongoing data driven changes baseball is experiencing. The message was resounding: Statcast will hardly be the last technological breakthrough that Major League Baseball experiences.

A product specialist at Kinduct technologies, Forbes described his technology as a software platform that identifies human performance data by focusing on the human body. Through the use of GPS and accelerometer vests, Kinduct is able to perform fitness testing and player tracking with the main goal of injury prevention and injury recovery.

"One of the main things we want to do is try to find ways to present data to (1) Hopefully identify indicators for injury (2) Once an injury happens, be able to get that athlete back on the field in a quick amount of time," Forbes said. "The second point that is actually very exciting for me, is looking at some of the information coming off of Statcast. Looking at that and being able to look at overall load exertion on an athlete on a game-by-game basis… That's where all of a sudden, you're not just looking at, 'What's the player doing on the field?' You're also looking at… what did that actually do to his body?"

Bentley's Blast Motion is also seeking to become the next trendy technology incorporated into Major League Baseball. He describes themselves as a motion-capture company that is able to measure every degree of movement and any orientation changes that are happening in the baseball bat by actually placing the sensor (which is the size of a quarter and weighs less than seven grams) on the bat itself. Given that one of the big topics of conversation at the SABR

Analytics Conference was how the timing loads of hitters have changed—today they are presumed to be bigger than in earlier times because there is more of a focus on hitting home runs—Bentley said his technology is well-suited to give statistical evidence of a change.

"The inertial sensor is actually the most accurate sensor for measuring any kind of rotation change or load or force," he said. "We can measure that load really, really accurate. At the capture rate we're now moving, we can move up to 1000 frames per second, so you really can see how those players are creating those loads. And are those loads different from what they used to be years ago?"

Bentley concluded his conversation by describing the current technological landscape in professional baseball as "the old Model A" and where it will be in the coming years as a "Ferrari." To wrap up the discussion on emerging technologies in baseball, Jason Sherwin provided a description of deCervo that exemplified Bentley's thought.

With a Ph.D. in aerospace engineering and a Bachelor's degree in physics, Sherwin's work at deCervo has focused on operationalizing his academic research on how the human brain makes quick decisions. Questions like "When did the player decide to swing at a pitch?" and "When did the player think it was a strike or a ball?" are central to his quest of measuring previously unmeasurable mental aspects of baseball.

"When I look at something like when the player is deciding on a pitch, that's something that is not observable any other way besides actually tapping into the nervous system," Sherwin said. "We're looking at what happens that leads up to that decision. How that decision was formed. How that metric that you capture from a distance, whether it's with a motion tracking

system or it's entered in manually, you're trying to get back to why the player made that decision."

Sherwin related that deCervo is close to getting coaches and players using this kind of information on a regular basis, but continuing to make the data relevant in baseball language is critical.

"The one thing we've taken a lot of care in is to make sure that the data means something in baseball terms when they're deciding on it being a strike or not," he said. "Not saying like, 'This is when there is 300 amplitude on the occipital part of the sensors.' It doesn't mean anything to a baseball player. I think there's going to be more of that and integrating this information together to figure out what it is about the physiological makeup of the player that day and boiling it all down to a number that the player or the coach can actually respond to.

A tactic he plans on using to ensure that the information is presented in a relatable way is to abolish written scouting reports and instead create game versions that are fed to the iPhones of the players and coaches. Ultimately, his data will be used to showcase how players compare to others from a mental standpoint. Insights that his measurements can glean demonstrate how the incessant Schumpeterian moment of stats and data in baseball will continue into the foreseeable future.

"I really see that in the next five years, we're going to look at accurate cognitive measurement as being the 'We couldn't believe we lived without it for the last 100 years,'" Sherwin concluded.

Thus, in the quest to detail how baseball stats and data have evolved, what are the lasting takeaways? Above all else, we must recognize that a love for numbers and statistics in baseball is not anything new. The relationship that baseball has with numbers and numbers have with baseball is mutually beneficial. Both are well suited for the other and both prosper thanks to the other's existence. By viewing at stats from a historical perspective—even if the accuracy was sometimes shoddy—demonstrates that attaching numbers to baseball is indeed tradition.

With this established, it allows us to appreciate the magnitude of change that baseball has experienced in the past half century. The advent of technology, most notably personal computers, paired with innovators like Pete Palmer, Dick Cramer, Bill James and many more instigated a time period many refer to as the "Sabermetric Revolution." Texts like *Moneyball* and *The Hidden Game of Baseball* allowed ideas like the value of getting on base and not being frivolous with making outs to be implemented and immortalized with stats like on-base percentage and OPS. In-house analytics personnel like Ben Baumer also did their part in ensuring that data was supporting every baseball decision being made. More recently, the concentration has been on advancing and polishing that data in the first place. Statcast has only been implemented for one year but already has those within the baseball community giddy about the likely convergence between scouts and stats. No longer is personal intuition the sole driver of opinions of players, but rather the data is now available to quantify previously-unquantifiable acts like a pitcher's spin rate and batted ball velocity.

Many within the baseball community, including Jeff Sullivan and John Thorn, reiterated that the scouts-versus-stats debate is one of the past. This may indeed be the case, but bits of contention still exist between the advanced analytics community and the traditional guard. Philosophical differences like the value of stealing bases, intentionally walking hitters to get to

weaker hitters and relief pitcher usage still run rampant and may never be agreed upon. These examples, as well as players shying away from data for fear of an overload, demonstrate the limits of how much we attach numbers to baseball.

But the progression of technology and data has never seemed to care about baseball's old-school nature or its desire to remain uninfluenced by societal forces. As Blast Motion, Kinduct technologies, deCervo and MLB Advanced Media showcase, baseball data and baseball itself will continue to evolve. There will be those who mourn the loss of baseball's simple ways. There will be others who will be enthralled by any desired piece of information being available. Both arguments are valid, but evolution is on the side of those who embrace the change. Shakespeare's quote in *Hamlet*, "Nothing is either good or bad but thinking makes it so" is applicable. Data, statistics and technology are not inherently positive or negative. They are simply tools. It is not impossible to use them in ways that hurt baseball. However, we must also consider the immense upside that they possess—giving fans, scouts and coaches alike concrete data to back up arguments and opinions, and simply allowing people to understand the game at a more complex level. What is guaranteed is that change will take place. The evolution of baseball stats and data will not be a story with an expiration date. The incessant and perpetual destruction of old and creation of new—the basic principle of any Schumpeterian moment—will continue into the future. In order to understand this future, it is important to consult the man tasked with knowing everything about baseball's past one last time.

"My vision of the future of baseball has always been rosy," John Thorn said. "It seems to me that it's a game you can't kill. There have been institutional decisions, there have been scandals, there have been episodes of game fixing, there have been performance enhancing drugs, but it's such a great game, you can't kill it. Whether the future tilts towards more statistical

analysis, more fantasy play, more web-based review of the game, it doesn't matter to me. My

vision is not backwards or forwards. History can be interesting in and of itself, but it's most

interesting when it casts a particular light or perspective on the present moment."

Glossary of Terms

BABIP: Calculated as (H - HR) / (AB – K – HR + SF). According to *FanGraphs.com*, it is a "statistic which measures how often non-home run batted balls fall for hits." The goal of BABIP is to document how fortunate a hitter or pitcher has been, if the individual's mark is significantly different from the league average.

Data: A simple term but an important distinction needs to be made from it and "stats," as the two are not interchangeable. Data refers to the raw totals from which stats are then derived. Data could be as simple as counting the number of home runs a player has hit, or as complex as needing radar cameras to calculate a player's exit velocity.

Defensive Runs Saved: Also known as "DRS," this is a fielding metric "calculated by *The Fielding Bible*, an organization run by John Dewan, that rates individual players as above or below average on defense," according to *FanGraphs.com*. Like many sabermetric statistics, it is measured in terms of runs.

Exit velocity: Defined by the *MLB.com* Statcast glossary as "the speed of a baseball after it is hit by a batter."

FIP: Calculated as (13 x HR + 3 x (BB + HBP) – 2 x K) / (IP) + FIP constant. Defined by *FanGraphs.com*, as a "statistic that estimates a pitcher's run prevention independent of the performance of their defense."

HR/FB: The ratio of how many home runs are allowed in relation to how many fly balls a pitcher induces. Like BABIP, it is designed to measure how fortunate or unfortunate a pitcher has been if his rate is vastly different from the league average.

Linear weights: The idea that each individual baseball event can be assigned a unique run value based on the probability that it leads to a team scoring a run.

OBP: Calculated as (H + BB + HBP) / (AB + BB + HBP + SF), it measures how many times a batter reaches base successfully.

OPS: Invented by Pete Palmer and Dick Cramer. Calculated as on-base percentage plus slugging percentage, it is perhaps the most accepted stat that has surfaced from the sabermetric community. Though it relies on two separately flawed statistics, combining the two mirrors actual run scoring production close to as well as linear weights does, making it a great indicator of true skill.

Park Factors: A comparison of the rate of stats at home versus the rate of stats on the road. Its goal is to identify which parks aid hitters and which one's aid pitchers.

Pythagorean Winning Percentage: Invented by Bill James, it is calculated as Winning % = [(Runs Scored) ^ 2] / [(Runs Scored) ^ 2 + (Runs Allowed) ^ 2]. The stat is "based on the idea that runs scored compared to runs allowed is a better indicator of a team's future performance than a team's actual winning percentage," according to *Baseball-Reference.com*.

Range Factor: Invented by Bill James, Range Factor is a defensive statistic that places the emphasis on total number of outs rather than the percentage of cleanly executed chances (which is what fielding percentage does). It is calculated by dividing putouts and assists by the number of innings played at the given position. Like many of James's stats, more advanced metrics have since superseded it, but its core tenets have remained.

Runs Created: Invented by Bill James, Runs Created seeks to quantify a hitter's run contributions to his team. It has been phased out in favor of more predictive and accurate stats

like weighted runs created plus, but its core message has stood the test of time: players who get on base and hit for extra bases are most valuable to an offense.

Sabermetrics: Defined by Bill James in 1980 as "the search for objective knowledge about baseball."

SIERA: Like FIP, SIERA (Skill-Interactive ERA) is an ERA predictor that attempts to tell us what a pitcher's ERA should be, stripping luck out of the equation. *FanGraphs.com* claims the three largest contributions of SIERA are that it tells us that strikeout pitchers are even more valuable than once thought, walks are shortcomings but do not devastate pitchers that do not allow many baserunners in the first place, and the outcome of balls in play remain tough to predict.

SLG: Known as slugging percentage and calculated as (1B + (2 x 2B) + (3 x 3B) + (4 x HR)) / (AB). Despite the inaccurate weights it applies to offensive events (a triple is not three times as valuable as a single and so on), it is a popular measure to judge power hitters.

Stats: Like data, a simple term, but it is important to distinguish. Stats are human-generated numbers intended to gauge performance. Batting average and ERA are perhaps the two most widely regarded ones, while wRC+ and WAR are more complex and not yet universally used.

Ultimate Zone Rating: An example of one of the biggest strides recently made in the way of fielding statistics, UZR "puts a run value to defense, attempting to quantify how many runs a player saved or gave up through their fielding skill," according to *FanGraphs.com*. UZR incorporates outfield arm runs, double-play runs, range runs and errors runs into its complex calculation.

WAR: Calculated as (Batting Runs + Base Running Runs + Fielding Runs + Positional Adjustment + League Adjustment +Replacement Runs) / (Runs Per Win) for position players. Defined by *FanGraphs.com* as "an attempt by the sabermetric baseball community to summarize a player's total contributions to their team in one statistic."

wOBA: Defined by *FanGraphs.com* as a "rate statistic which attempts to credit a hitter for the value of each outcome rather than treating all hits or times on base equally." A very similar metric to linear weights, but with more updated run values to reflect the current run scoring environment.

wRC+: Also known as weighted runs created plus. It is very similar to linear weights but is more accurate in its run values. It is identical to wOBA, but goes a step further by incorporating park factors and the league average.