Baseball Technology and its Impact on the Player Development Process

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Matthew Pezolt

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

Advisor

Professor Kent Wayland, Department of Engineering and Society

Research and Question Significance

Baseball is in the midst of a quantum leap surrounding data collection and analysis to identify and develop talented players. Over the last 20 years, baseball has gone from an archaic industry that drew on the knowledge of conventional baseball wisdom (subjective talent and appearance evaluations) to an industry with robust Research and Development, with each organization exploring data to try to find a competitive advantage over the others.

This data surge is not strictly confined to the realms of professional baseball. College programs throughout the country deploy data analytics on a smaller scale to try to stay one step ahead of other teams in their conferences and throughout the country. Many schools have even begun to value data collection in the recruiting process. Beginning with 8th-grade students, schools are looking to find the next great college baseball player, and are using now readily available baseball technology to help find that player. This has created a trickle-down effect in the baseball industry that has proven to be very controversial and potentially problematic for young players.

Now that baseball data has taken off the way it has over the last twenty years, those in the amateur baseball industry have filtered into two "competing" camps. One side has embraced baseball technology and what it has to offer as a means of developing metrically advanced baseball players through specialized training. The other side believes in the complete development of athletes through encouraging performance in multiple sports, under the belief that as the athlete matures, they will grow into being a high-caliber baseball prospect naturally. This variation in development philosophies has created a pool of mixed messages for developing athletes, directly impacting their athletic maturation process as baseball players. With the college recruiting process beginning at such a young age, there is a desire to get ahead of the curve in

terms of athlete development. As players and parents explore specialized training in hopes of landing college scholarships or MLB Draft selection at the end of high school, the demand for readily available baseball technology has changed. Continued R&D in the baseball technology sector has also created new training ideals centered around the promise of creating more developed and advanced baseball players, potentially at the risk of greater injury risk for the athletes. I want to perform an analysis of competing viewpoints in the player development industry, specifically focused on training methods in youth/amateur baseball players to provide a better understanding of the various player development messages present in amateur baseball today.

Background and Context of the Problem

In this paper, I will be making various mentions of baseball technology, metrics, training programs, and body movements/injuries. I will be focusing on training risks and rewards regarding amateur pitchers. While overuse injuries can be experienced by all baseball players, regardless of position, the severity of these injuries can be much greater with pitchers (torn UCLs, labrums, rotator cuffs, pinched nerves, etc.). Also, the threshold for what are considered advanced metrics in pitchers is more concretely defined.

Pitchers can have their throwing velocity, pitch movement/spin (also known as the Movement Profile), and release point tracked by now-popular baseball technology such as Trackman and Rapsodo. Other examples of baseball metric tracking technologies include swing path trackers such as “Diamond Kinetics” and “Blast Motion”, force plate technology, and a product called “HitTrax” which allows a player to see what a ball hit in a batting cage would look like on an open field. For the context of this paper, when referencing these metric tracking technologies I will mostly be referring to Trackman and Rapsodo, as these two systems are the

most applicable to major league data collection and most affordable/available technologies respectively. Both are used heavily in lower-level professional (minor league) baseball and at the collegiate level.

These technologies have become increasingly popular over the last decade, beginning with Major League clubs, the technology has found its way into almost every collegiate program in the country in one way or another. Now, many high school and 3rd party player development facilities have brought these technologies to bolster their 'player development' practices, and certain metric tracking systems are now available to the general public at shockingly affordable costs for what the technology can do for a player's development. Taking a broader look at the two competing player development methods, we find that those embracing the specialization method are more willing to adapt these technologies and metrics into their everyday training practices. Those who are more firm believers in a traditional 'multi-sport' model are less intrigued by the possibilities the technology offers in the player development cycle.

Relevant Literature

I will explore the existence of a mutual shaping between the technology that is used in player development and the amateur baseball training industry. I hope to reach an understanding of how the technology has led to a more ambitious pursuit of metric advancement in younger age players, and how the pursuit of advanced opportunities, including but not necessarily limited to college scholarships and professional contracts, has driven a more rapid development process for baseball technologies.

The notion of using advanced training tactics as a means of "creating" superior athletes for educational and monetary gain is not a concept unique to baseball. Every sport has a sect of individuals that go to extremes to achieve "greatness". Some of the most famous examples of

this come from golf. Jeff Benedict and Armen Keteyian's (2018) biography *Tiger Woods* recounts potentially the most famous example of a child being raised for greatness in sport, leading to Tiger Woods becoming arguably the best golfer of all time. The Netflix series *The Short Game* (Greenbaum, 2013), depicts a collection of parents who are adopting similar parenting and development styles with their 10-13-year-old children, pushing them to become great golfers. The same type of pressure can be seen in amateur baseball (and almost all other sports) today, with parents pushing their children to become elite players at a young age in hopes of securing college or professional opportunities later in their development cycle.

Methods

Over the last few months, I have gathered scientific articles surrounding the more heavily debated differences between the two conflicting groups. I have also gathered articles that provide a broader perspective of the source of contention between the two conflicting sets of beliefs. My goal was to find sources that are addressing one particular component of the debate in a greater amount of detail so that I can then use that information to effectively lay out each side's beliefs on that specific topic.

Large portions of the foundational context for the different arguments were gathered through years of conversations with industry professionals involved in varying levels of baseball, (i.e. youth/high school, college, professional). My work experience has exposed me to a variety of perspectives and beliefs on the matter through a series of organic conversations (not collected through interviews). I have been working alongside players, coaches, scouts, player development personnel, and trainers closely over the last five years, giving me a firsthand experience of the

resources and technologies various levels of baseball have at their disposal and how those resources are deployed daily.

Results

Through years' worth of conversations with industry professionals, I have come to the general conclusion that there is no "one-size-fits-all" method to approach player development. Everyone in the baseball industry has their own philosophy surrounding what athletes should/should not do, what data is/is not important, and what technologies are/are not helpful. While this seems like an uninspiring conclusion, I believe that it makes the debate surrounding common training methods used today more interesting. Everybody that is involved in player development can point to college/professional players that hold similar baseball philosophies as justification for their training methods, on both sides of the debate. For example, Lorenzo Cain – a two-time MLB All-Star and World Series Champion – did not begin even playing baseball until his sophomore year of high school. On the other hand, Bryce Harper – a two-time league MVP and 2012 National League Rookie of the Year – graduated high school 2 years early to begin playing college baseball and eventually his professional career.

While I have drawn the conclusion that there is no true best way to develop amateur baseball players, there are some interesting trends in amateur baseball, and more generally, amateur sports as a whole. It is generally accepted that high volumes of practice allow someone to better execute a given task, and the same trend applies to athletes and sports. It is not overly shocking then, to see that single sport specialization is trending upwards amongst amateur athletes. Participation in organized sports has increased from 9% to 12%, with the rate of specialization increasing as the players get older as well (Jayanthi et al, 2013). However, this

does not come without risks, as Jayanthi explains, the focus on one sport combined with an intense training regiment (16+ hours of intense training a week) opens up the athlete to a 1.5x higher risk of injury. Conversely, multiple studies demonstrated specifically in this paper with Rugg's study on NBA players, have shown that participation in multiple sports reduces an athlete's injury rate over the course of a career (Rugg et al, 2018).

Specifying the above down further to a conversation about baseball, popular baseball (specifically pitching) training programs today such as "Driveline" emphasize high-intensity throwing as a method to increase metrics and performance (Morgan, 2022). However, these types of training programs are commonly believed to put pitchers at a higher risk of overuse injuries, as they push athletes to throw both frequently and at an intensity that overloads the stress and torque placed on the arm, leading to greater risk of overuse injuries (Parks & Ray, 2009). Leading-edge technology has begun to focus on tracking the biomechanics of a pitcher's delivery, allowing for earlier identification of pitching motions that put the athlete at a higher risk of injury (Mizels et al, 2022). However, this technology is only available to professional teams as well as top-of-the-line college programs and training facilities. So, while pitchers have access to the technology needed to increase their metrical performance, the technology used to identify potential risks in their pitching mechanics is not as readily available.

Discussion

The results above appear to paint the picture that specialization in sports only leads to increases in injuries, which would be an overall detriment to the development of an athlete. Especially in baseball, where an arm injury can derail a pitcher's entire career. Why then do we continue to see specialization rates rise? The answer turns out to be rather simple. Kids are

chasing the dream of playing college/professional baseball, and industry trends are telling them that they need to be ELITE baseball players at younger and younger ages to make that happen.

Current MLB drafting practices show teams have a desire to influx their player development systems with young talent (Sims, 2014). At the collegiate level, it is not uncommon to see rising Freshmen committing to play at some of the nation's top programs before they even have the chance to play high school baseball. Organizations such as Perfect Game have created an entire business model off of "evaluating" and producing rankings for players of all ages. While most industry professionals view this practice as ridiculous and over the top, one would not be out of line to determine that the issues with this system are self-inflicted by the industry itself.

Going back to the examples of parental pressure being applied to young golfers in the "Relevant Literature" section of the paper, this is where we see the baseball equivalent of the same behavior. Parents (and players) are willing to overlook the risks associated with specialization in baseball in order to pursue college and professional opportunities. Committing to major colleges and the idea of potentially being drafted before that are viewed as major status symbols in today's baseball culture, leading to players (and in some cases their parents) choosing to specialize in baseball early. On the other side of the argument, those that do not specialize risk losing out on the opportunity to commit to play at some of the top colleges or being drafted while waiting for more natural baseball maturation. It is important to note that while specialization may be increasingly more popular as a way to pursue high-level baseball opportunities, the number of kids that achieve these elite-level opportunities remains incredibly small.

Baseball-specific training programs have both increased in popularity and availability. A simple Google search can yield an entire crop of training programs with baseball-specific

training goals in mind, such as a standard and regimented baseball-specific training method generally focused on rotational mobility and general power (Klein et al, 2021). There are also a series of paid programs that a player can access and follow completely on their own such as Driveline. The technology that tracks metric performance such as Rapsodo is also available to anyone at the relatively inexpensive cost of $3,000 when considering the benefits the system can have on a player's development. For more professional oversight in the training process, many baseball-specific training facilities have full-time staff devoted to player training and development, with varying levels of technological implementation in the process. The technology is readily available in multiple ways for anyone that wants access to it. The impacts of its use may vary from individual to individual.

The single greatest argument for my conclusion that there is no universal answer to player development may come from an analysis of how baseball data is used by different individual players and trainers. Improper teaching of baseball metrics from trainers on both sides of the argument and improper interpretation of baseball metrics by players can lead to significant hindering of the athlete's development. To understand this point there needs to be a small side discussion about the nature and psychology of baseball.

Baseball at its core is a game of failure, and playing baseball is oftentimes a more psychological than physical test. Successes can be short-lived and followed by extended periods of failure (known as "slumps"). Baseball's lower physical demands allow the seasons to consist of more games over an extended period of time. This can magnify the effects of failure for a player in a slump. The impacts that failure can have on amateur athletes include anxiety, psychological stress, as well as an increased risk of burnout (Gustafsson et al, 2016). Both of the

competing player development methods can have their own effects on the ability to process and rebound from prolonged slumps.

Beginning with the metric-based development approach, data can become a crutch for slumping players in both a positive and negative way. Players stemming from this training method can become paralyzed by their data. For example, pitchers train to develop certain movement profiles on their various pitches, meaning that they train to throw a pitch that moves a certain way. As long as their pitch data shows that they're getting the desired movement, they may struggle to understand a lack of pitch effectiveness in game situations, showing signs that data-centered training has negatively impacted their ability to process failure. Situations like this can lead to more significant psychological effects than this level of failure would normally entail.

On the other end of the spectrum, players that are from more traditional "data-free" training methods may become hyper-attached to their in-game performance. These players may be able to play to a certain level based on their natural talent alone, but eventually, baseball finds its level, and the first period of extended struggle may leave a player searching for performance answers with no understanding of where to start. The issue here is that since players don't understand why their performance is declining, they may make adjustments that are temporary fixes, but will hurt the athlete's development in the long term. For example, a pitcher who is struggling to throw strikes for the first time may subconsciously decide to throw slower in an attempt to regain control, and this may work for the time being. However, once the player reaches higher levels of baseball this solution will probably no longer be viable, and they will have to revert to throwing harder which may bring back the control issue. This can also exasperate the feelings of failure in the athlete.

A combination of the two methodologies may serve as the best remedy for failure in amateur baseball. Allowing athletes to develop a complete toolset through multiple sports may allow them to coast on their raw athletic ability for a longer period of time, specifically in baseball. This can allow players to reach a state of mental maturity capable of processing metrics and data constructively and more effectively correlating that data to in-game performance, especially during slumps. This is the more positive use of data as a crutch in player performance analysis discussed earlier. By the time these players are ready to use data-centered and baseball-specific training methods, they will also be farther along in their physical development, helping to mitigate some of the heavy injury risks associated with baseball specialization (especially for pitchers). The reason this approach would not be "one-size-fits-all" is that every player will reach this point of development at different times in their development cycle.

Conclusion

The world of baseball analytics is ever-evolving, and technology to improve performance continues to become commonly available at an unbelievable rate, but debate over whether this technology should be embraced in amateur player development continues. Technology continues to improve, and the reward for being an elite player at a younger age continues to grow as colleges begin the recruiting process earlier and earlier. However, the risks associated with complete technological, and data-driven training also continue to grow.

While there is no one-size-fits-all approach to player development, having a deeper understanding of the risks and rewards of various player development methods can allow young players (and their parents/trainers) to be more aware of the differences between specialization and holistic training. A more honest evaluation of a player’s ability to withstand the physical stress of specialized training, as well as their mental capacity to handle the psychological toll of

baseball's volume of failure, can be used to guide athletes, trainers, and parents to more informed decisions on what player development path to take. This can ultimately lead to less burnout, creating an amateur baseball culture that keeps kids loving to play the game longer, leading to an overall larger talent pool for colleges and professional teams to choose from, creating an overall better environment for the entirety of the game.

A more balanced and honest player evaluation can also allow data and technology to create a more positive impact on a player's development in the long term. Allowing for the proper level of physical and mental maturation before specializing in baseball can lead to a more complete understanding of both metric analysis as well as the correlation between training metrics and game performance.

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