

The Takeover of AI in Sports

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

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Introduction

Imagine a football game where coaches are replaced with artificial intelligent computers. Nobody to shout out plays and nobody to decide formations, simply an algorithm spitting out the next decision to the quarter back based upon millions of data points. The coach's role in sports would become one of reading, replacing the traditional art of complex decision-making in high pressure situations. As spectators, we seek a game where the best players or teams should win, but that small percent of unpredictability is what brings an element of passion and astonishing excitement (Chamorro-Premuzic, 2015). Individual performance remains within each player's control, but coaching decisions have recently indicated a shift toward reliance on algorithms that prioritize outcomes according to probability and prior success rates.

Computers have come to occupy a crucial role in all aspects of sports today. From the use of cameras to track and analyze every play, to wearable wristbands for monitoring player performance in practice, sports analytics has become an integral part of the sports world (Ricky, 2019). Will there be a point in time when we can completely replace human skills with algorithmic automation in coaching and recruiting? The implications of this question and the utility of automation is most apparent when considering high pressure moments, when a decision must be made within a fraction of a second. Sport as a social phenomenon is integral to all levels of modern society, impacting national relations, business life, social status, fashion forms, ethical values, and lifestyle choices (Essays UK, 2018). Not only do sport competitions develop society as a whole, but also personal traits including dedication, perseverance, courage, initiative, and self-control—all of which contribute to an individual's functioning in everyday life, separate from the athletic arena (Essays UK, 2018). If artificial intelligence were to replace human

judgement as the primary form of decision making, sport's intrinsic benefits for players and society could be lost.

Artificial intelligence (AI) has solidified prominence in other industries in addition to sports, most notably the healthcare and finance spheres. In the health industry, machine learning techniques have begun the transition from human interaction to computerized information transmission. From patient data to robotic surgeons, artificial intelligence is gradually taking over many aspects of healthcare, with some proponents arguing for more AI involvement. Barzilay, a leading computer scientist at MIT, teamed up with radiologists to develop machine-learning algorithms that take advantage of computers' superior visual analysis to spot subtle patterns in mammograms that the human eye might miss. Their resulting algorithm, published in May 2019 in *Radiology*, was significantly more accurate at predicting cancer—or the absence of cancer—than practices generally used in clinics (Langlotz, 2019). Although scientific studies have often proven these technologies to be more statistically sound, critics remain skeptical about letting machines undertake human jobs—particularly doctors' jobs. Trusting a computer with a human life can be daunting, but shouldn't probability of success trump gut feeling?

In the finance industry, stock market trading has become dominated by algorithms, so much so that most traders have virtually no input in their trading decisions anymore. The trading world has essentially become void of human deliberation or involvement, run solely by “fool-proof” algorithms based on mathematical equations. Will sports follow the trajectory of the Fintech industry completely dictated by AI, or will the need for human professionals remain a factor, like in medicine? The goal of this paper will be to tackle this question by looking at the social construction of AI in multiple industries (SCOT framework) coupled to the desire for

analytics in sports. My analysis will look to understand and compare the process through which social groups and industries introduce the idea of AI and its use.

Literature Review

AI in Medicine

It is forecasted that medical AI will become a \$10 billion dollar market and pervade 90% of hospitals, replacing as much as 80% of what doctors currently do. In order for this to occur, the health care system will have to overcome patients' distrust of AI (Longoni, 2019). When the performance of IBM Watson (Watson is a question-answering computer system capable of answering questions posed in natural language developed in IBM) was compared to human experts for 1,000 cancer diagnoses, Watson found treatment options that doctors missed in 30% of the cases. In another case, UK researchers compared the accuracy of triage diagnoses made by doctors to those made by AI; doctors were found to be correct 77.5% of the time whereas AI demonstrated an accuracy rate of 90.2% (Longoni, 2019).

A study at New York University found that patients are resistant to medical AI because it does not take into account one's idiosyncratic characteristics and circumstances (Longoni, 2019). In a study at Boston University, 700 Americans were asked to choose between having a doctor diagnose a medical condition with varying level of success, or having AI diagnostics with no human interaction which have a considerably higher success rate. Despite knowing that AI had a higher success rate, people were still more inclined to choose the human doctors that provide emotional comfort. Patients often report feeling as though they are simply a statistic in a computer when AI machines are used, rather than having personalized individual care. Consumers are more resistant to utilizing healthcare delivered by AI providers than healthcare delivered by comparable human providers due to concern that the unique facets of their case will be neglected (Longoni, 2019). Chiara Longoni, Andrea Bonezzi, and Carey Morewedge,

document eight different studies that were performed to examine why patients were often less willing to pay for AI medical care. Across all eight studies, uniqueness neglect was the primary psychological driver of resistance to medical AI (Longoni, 2019). Patients felt a lack of personalization when it came to medical AI, fueling considerable distrust in the automated process—a sentiment that is especially amplified in higher acuity situations.

Curtis Langlotz from Stanford University, explained that the current skepticism means that AI programs will most likely assist professionals in the near future, rather than replace them altogether. Nonetheless, he admits that some algorithms have already been approved to make medical decisions without requiring human oversight (Langlotz, 2019). He says that this could be a plausible way to close the socioeconomic gaps in medicine, by using standard machines to run day to day medical care. Yet, the human desire for personalized care and emotional stability provided by human doctors persists. Culturally, we as humans are tuned to benefit from one-on-one care characteristic of the intimate doctor-patient relationship. Since medical care is such an important aspect of our lives, and any probability of failure is a matter of life or death, patients are unwilling to blindly surrender their trust to AI machines, no matter how “perfect” they might be. AI is certainly advancing the medical industry by assisting physicians and by allowing data to be stored and analyzed for research, however, it is difficult to imagine AI wholly taking over critical decisions in modern society due to the unique and tailored care that patients seek from healthcare professionals.

Analytics In Finance

One of the earliest industries to incorporate AI and automated technology into their practice was stock market trading. Most professional traders today do not even individually place their daily trades, they let an algorithm do it for them. Today's notion of 'algorithmic trading' refers to a set of rules or guidelines created based upon thousands of historical data points, and a trade is executed only once those guidelines are met. Even the creation of these algorithms has become progressively automated through the use of machine learning algorithms, which are algorithms that teach themselves how to find maximum utility, or in the case of trading, how to optimize trades to make the most money. According to Marcos Lopez de Prado, the former head of machine learning at AQR Capital Management (one of the world's top hedge funds), algorithms in electronic markets have already automated the jobs once dominated by thousands of traders (Kelly, 2019).

Lopez de Prado spoke about the challenges of algorithmic trading: "Financial machine learning creates a number of challenges for the 6.14 million people employed in the finance and insurance industry, many of whom will lose their jobs—not necessarily because they are replaced by machines, but because they are not trained to work alongside algorithms" (Kelly, 2019). The job of a trader has completely changed in today's world. In prior times, a trader's job consisted of yelling and shouting, working to get the best price for trades, in hopes of beating the so-called "efficient market." Nowadays, it is deemed that about 70% - 80% of the trading world is commanded by data scientists who sit behind a computer, trying to develop algorithms that can one up each other, and gain the slight competitive edge needed to secure a profit. The role of a human trader today is one that solely watches over the algorithm, and implements tweaks when needed, particularly when large macro events are likely to occur. This is exemplified by the

anticipated effects of Brexit, an event that traders know may drastically impact the market, but that mathematical trading algorithms cannot predict as conclusively.

One of the most successful businessman in Charlottesville, Virginia is a man named Jaffray Woodruff. Jaffrey attended the University of Virginia and after a few years working in finance decided to open his own Hedge Fund called Quantitative Investment Management, or QIM for short. After spending a summer interning at Felton Group LLC (Jaffray's family office), I was able to understand what Jaffrey does as a highly successful quantitative hedge fund manager. After visiting the trading floor, it was alarming that there were only a few trading stations when such a large amount of money was involved. During my visit to the trading floor I had the opportunity to ask both Jaffray and some of his colleagues a few questions. When asked why AI is occupying a greater space in trading, a QIM trader explained that humans are not capable of analyzing masses of data so fast. The advantage of algorithmic trading is that the computer can analyze billions of data points at the same time, finding more opportunities to execute profitable trades. Although the computer makes almost all the trades based on a set of rules set by the developer, human interaction still plays a vital role. When irregular and obscure economic events occur (such as Brexit), Jaffray and his coworkers manually alter the algorithm in accordance. They also go back once every few months and revise the algorithm, correcting the mistakes it has made in the past and attempting to fine tune it to generate an even higher probability of success. Quantitative traders like Jaffray are becoming much more common, and have shown that this method of trading can be extremely lucrative.

Traders have traditionally been full of fear, panic, euphoria, and greed, but have now started to resemble emotionless computers. At its core, algorithmic trading attempts to predict the future markets based on historic outlines, taking human emotion and gut feeling out of the

equation. The fact of the matter is that machines are capable of running through millions of data points in milliseconds, able to find more consistent and reliable patterns than humans. Historical data might not always be perfect in predicting the future of the market, but by finding repeatable patterns and signals, making money becomes much more probable. It is vital to understand that in today's age, no matter how good they are, computer algorithms still cannot act solely on their own because of the world's irregularity. Even when computers are profoundly involved, just as in Jaffray's case, there still must be some level of human involvement in order to adapt to the ever changing variabilities of the economy.

Analytics In Sports Today

The market for sports analytics is expected to reach almost \$4 billion by 2022, as it helps a variety of sports organizations in a range of areas (Ricky, 2019). Data analytics has become the new hot topic, as industries realize that algorithms can oftentimes make more accurate decisions than people. Data can help make better predictions, but it will not make people more predictable than they already are. Professionals and coaches have access to the same quality and quantity of data, but significant differences between their performances in today's games remain because athletes must still complete the desired actions (Chamorro-Premuzic, 2015). It is no question that algorithms can improve systems today by using probabilities and prior data to create the highest possible chance of success. Analytics is becoming a key determinant in all aspects of sports management, spanning injury rehabilitation, strategy decisions, performance training, recruitment, and even team marketing.

Darren O'Shaughnessy uses the example of center bounces in Australian Rules Football. This is where the referee bounces the ball into the air, usually unfairly to one side, for two 'faceoff' players to go after possession. Teams employ full-time coaches for this expertise and establish detailed strategies for center bounces, but data analytics indicate that outcome could be guessed by a coin toss. Understanding that the ball toss is almost impossible to prepare for could save time and money to invest in resources elsewhere (Macaulay, 2017). Historically, football coaches both at the professional and college level have hesitated going for fourth down with only a few yards to go. The anxiety and fear of turning the ball over lingers over coaches, causing them to take the 'safe' option by punting. When looking at the statistics, going for fourth down has had a 62.7% success rate in the last three years. The raw data tells us that fourth and short attempts are not a high-risk gamble, and in fact, have very low risk-to-reward ratio, meaning that the reward is much higher than the possible turnover (Tanier, 2013). Just as in game-time decision making, data and AI are used in almost the same fashion for recruitment. By using data to understand the strengths and weaknesses of the team and players, it is much easier to understand recruitment needs. Strategy decisions are being implemented more and more in sports today, but unlike some other industries, the computer is not the sole decider.

Advances in training technology have resulted in portable devices (such as accelerometers and similar activity monitors, GPS, heart-rate monitors, power-output meters, and related mobile phone apps) being used habitually to gather data by a wide spectrum of users, from recreational exercisers to elite athletes. In the past, coaches had to provide their athletes with workouts that lacked systems of monitoring and evaluation of weaknesses beyond what they could visually witness at practice. With this newer technology, performance can be evaluated directly in the field, rather than be inferred from laboratory trials and simulations

(Passfield, 2017). Data can now be tracked through the entire day, allowing athletes to gain a competitive edge by optimizing lifestyle and nutritional habits. This data can easily be transferred onto analytics platforms where teams and individual players can see how they performed on a day to day basis, and then tailor their training accordingly. Similar data technology can aid in recruitment, since recruits can now easily be analyzed with these devices, making it much more feasible to understand the strengths and weaknesses of players.

Just as measures of sport aptitude have been used in the sports setting to increase win probability, there is increasing recognition that understanding injury occurrence and identifying factors that prevent injury can provide a team with an advantage over their opponent, with the implementation of AI-driven injury prevention methods (Wasserman, 2018). Common practices for athletic trainers attempting to use data include injury risk prevention and incident rate occurrence. Compared to other parts of the game, it seems injury rehabilitation is far behind others when it comes to using data analytics AI. Trainers have started analyzing how frequent injuries occur and find specific trends related to rehabilitation traits and times. By understanding which injuries are more prevalent to specific types of players and sports, these areas can be more heavily targeted as a concern. Although AI does exist within athletic injury rehabilitation, its use is much less frequent and signals an area for continued development.

AI has become deeply entrenched in many industries today. What we must understand is why AI has completely transformed some industries with success, while others have been resistant to the changes brought by AI. Is there something unique about some industries that makes them susceptible to the AI takeover? In my further discussion, I will be exploring why AI is being used more in various industries in order to try and foresee where AI in sports is headed.

Discussion

We must start to ponder upon why a money-making industry like stock market trading has become almost entirely automated, while medicine, one of the most important industries in the world has not. There is a very large cultural difference between medicine and stock market trading. The idea of stock market trading is simply to make a profit off of finding patterns or trends that are consistent and reliable. The fact of the matter is that computers are better than humans at this task. By being able to analyze millions of data points in almost no time at all, the number of angles and ways to find trends is insurmountably greater than what a human could do. There is no reason not to use AI when trading stocks, as it creates a way to analyze much more data much faster, with no emotional attraction or biased opinions.

Medicine oftentimes has much bigger implications than stock market trading. Medical care can often be the difference between life and death, and the subject matters are all unique human beings. Different to the stock market, whereby only one market is the subject to analyze, medicine looks at examples of thousands of different humans who are all slightly different. As shown before, studies have shown that people are less willing to trust machines than doctors even if the success rate of machines is proven to be higher. Since humans are all created uniquely, the culture of medicine has become one of nurture and care. Humans do not believe that machines will understand everything about their body that might affect the results, but since they can communicate with doctors, they believe that there is a more personalized care. The fact that decisions can have such large implications causes fear and caution, causing patients to need empathy in their decisions, an emotion that machines are not able to give.

One important point to consider is that no computer or human can be perfect in decision making, which is one of the main issues in trusting AI machines (Wharton, N.D.). Oftentimes humans believe that if an AI machine makes a wrong decision or an error, then it is untrustworthy. In reality, AI machines can improve and correct themselves much more rapidly than the human brain. We often look for the perfection predictor method through machines, and if we cannot find then we consider it a lost cause. When analyzing this theory, it makes complete sense in the realm of medicine. As a patient in need of urgent care, if not certain that a treatment can work and could in fact make things worse, then the emotion of fear takes over your brain no matter how high the probabilities of success.

Sports are an interesting industry to consider when talking about the role of AI. Sports have the same uniqueness as medicine in the sense that each player is different and what could work for one person might not be the same for all. But, at the same time, for a player to be successful they must theoretically win just 1% more than their opponent, so there is room for error. When we break sports up by all the different types of coaches, we can see from the literature review that AI plays a very different role in all of them. What we can tell from our studies is coaches are starting to invest more and more into analytics following a similar path to finance, taking opinion and gut feeling out of the equation. Coaches are now analyzing player performance and using cameras to come up with specific plays tailored towards a team's strengths and weaknesses. At this point in time, coaches still have a role to understand their team's specific player strength's. The role of a coach today is to answer the "how" question. If a computer tells a coach that they should go for it on fourth down, how will the coach go about doing that. One of the baffling things about football in recent years is that even though teams are

spending millions of dollars for data analytics experts, coaches are still behaving in perplexing irrational ways against what the computer says. In the last two years, NFL teams have gone for fourth downs over 13% more than in past years, showing that coaches are finally starting to trust the computer over their own gut more and more (Beaton, 2019). As more data is being established, and more team specific data, computers will slowly take over complex decisions as well as more black and white questions.

As I am a player on the University of Virginia squash team, it was very interesting talking to my coach about his view on analytics as Squash is a very small sport at UVA. When discussing AI and squash with him, he told me that he wants to try and implement it as much as possible in the sport. He argued that computers are just a more efficient and accurate way to track and analyze the game, basically being a much more powerful human eye. He says the role of a coach will soon become very similar to that of a trader, someone who looks over and maintains stability in their team. The job of a coach will be to take what is shown from AI and show how players can use it to improve their game, in a way more of an interpreter than a decision maker. A coach will still be imperative to a team's success in training the team/player how to implement certain techniques that can help them improve weaknesses shown from the analytics. Just as in finance, it is no doubt that machines give a higher chance of success than human's in sports decision making.

When it comes to sports rehabilitation, this becomes a lot more similar to medicine, but why is it this way? Just as with general medical care, we see this need for personalized care when it comes to athletes. Athletes do not want a computer telling them that there is an 85% chance they have pulled their groin, but they want a doctor to inspect them in detail and give recommendations. This need for personal care is something that is indoctrinated into our world,

it is an emotional response that gives us hope and trust, especially with such big decisions, like whether a player can return to the sport or not.

Conclusion

It is no doubt that sports analytics has improved decision making for sports teams, but still coaches and dynasties are hesitant to completely rely on these machines. Ambiguous decisions that are not so black and white, are where data analytics might change the game, but it will rely on the coach's trust against their own gut decisions. It has become apparent that coaches are relying on data analytics to make decisions based on historical probabilities, and with more money being spent on AI, the more decisions will be made by computers. Based on my research, I do believe that AI will dominate strategic decisions just like in finance, as it will install reliability in the coaching staff. Even though teams are unique, using predictable AI algorithms gives coaches a way to use what has worked in the past to their advantage.

With AI taking over more coaching decisions in sports the impact of sports in society could be greatly affected. Future research would need to take place in order to analyze if the benefit of sports related competition is lost with the dominance of AI decisions. Sports have such a critical component in today's world, from the development of teamwork in the youth to the relationship of countries around the world competing in the Olympics. The rise of AI in sports could have an abundant affect on society today, limiting the competition and collaboration that sports bring to civilization. From the analysis, we can see that AI is becoming a lot like finance in its use of AI, we must now try to understand the potentially harmful effects to society that could come from an impending AI takeover.

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