# Rising Interventions in Sports Science – AI to Optimize Data for Athletes

Andrew Choy

Hunter College High School

## ABSTRACT

Data scientists and AI researchers have been propelled to examine how their technological tools can optimize the performance of athletes in an ever-so-dynamic world of continuous inflow and changes within the market. This article will specifically go in depth of the multi-components of kinesiology, cognitive science, and marketing interventions that are currently incorporated to effectively optimize athletic performance.

## Introduction

As sports fans continue to increase, data science is the change-maker that controls the ebb of the changes within new physiological, sensor-related and kinesiological changes in devices, tools and platforms that could help athletes secure optimal performance. The goal of this article will be to examine the multiple components to data science and its interventions in kinesiology, both on and off fields in investigating new electrical trackers, 3D and AI tools that can reduce injuries and risks, neural mechanisms and frameworks within cognitive science that help to demonstrate the positive impact of sports in athletes in conjunction with their brain functionalities, alongside new marketing interventions that can help bolster the development and growth of sports teams.

## Data Science & Its Applications in Sports Science

Data science has become a more prevalent tool for sports teams and athletic trainers in recent years as it is used to optimize athletic performance and improve team tactics. Tracking athletic performance has become easier with wearables like GPS trackers and accelerometers that allow analysts to track players' locomotive motions, physical recovery, and even mental welfare (Candelier, 2022). These tools give insight to an athlete's intensity and maximum potential in their workouts which assists their trainers in tailoring exercises or recovery time specifically to the body's fitness level which is useful in preventing overtraining or pushing them even 1 extra rep. In addition to these devices, 3D modeling and other simulations have been used to improve training and prevent injuries by identifying fatigued areas of the body (Morrell, 2022). For example, 3D body scanning has offered additional information to wearables by providing computational and neural-micro skeletal modeling that is missed in the heap of one dimensional numbers obtained from GPS trackers' data (Alderson & Johnson, 2016, p. 2). 3D visualization bridges raw data collected from on-field athletics with computer modeling to provide real-time lab-based kinematic data (Alderson & Johnson, 2016, p. 3). Another use of data science in sports analytics is for gathering data of the opposition's players and studying their movements in order to create tactics to counter their strengths. Tactics have become integrated in these analytics because in some cases teams might not have as an athletic lineup as their opponents but by analyzing the opposition's total distance run in previous games or their in game tendencies, teams can find a way to adapt their own playstyle and make up for their lack of athleticism. For instance, in professional soccer, studies have shown increased running distances against teams that utilize a 4-2-3-1 formation with more depth and width on the field as opposed to a 4-4-2 formation that is flatter with the 4 midfielders (Memmert & Rein, 2016). This shows how athletic capacity to run these

greater distances throughout the full 90 minute matches can be utilized or exploited because teams might be able to change around formations and ball movement tactics like using increased possession or a counter-attacking style of play to best suit their team players' physical capabilities monitored by statistical data captured from emerging technologies.

## Artificial Intelligence – How Is Emerging AI Used in Sports Science?

Thus, how can AI and new technological tools be utilized to increase performance in team sports? Within the sports industry, it has been noticeable how modern approaches in adapting AI have helped facilitate optimal athletic performance with lower risks of injuries. In a study that analyzed 11 AI techniques and methods being adapted in a pool of 6456 participants with 76% of them being identified as professional athletes, it was uncovered that the use of AI techniques in its applications led to lower rates of knee injuries in multidirectional sports like handball and volleyball (Malfait et al, 2016). Furthermore, it was identified that AI techniques and methods also helped to reduce risks of concussion in an accurate manner in a study that examined American football players, composed of collegiate, professional and retired professional athletes (Bock, 2016). Today, with its myriad applications, AI is being adapted in the professional sports world, where in December 2019, Amazon and the NFL joined forces with the Cloud Unit artificial intelligence to develop a wide range of applications in medical and health solutions (Hall Jr., 2021). Furthermore, data-based prediction analysis using AI tools has been proactively utilized by the National Football League, where the NFL has been limiting the number of practice players can pursue – subsequently, limiting injuries on-court by 26% in the first two weeks of the new season.

## Neural Efficiency and Mechanisms Used in Kinesiology

Amidst the new innovation within the space of kinesiology, recent researchers and scholars have been pointing towards a "neural efficiency" hypothesis that highlights how athletes show different activation in different areas of the brain related to visuospatial tasks. For instance, in a study that examined 14 table tennis athletes and 14 non-athletes performing visual-spatial tasks, it was uncovered through the use of fMRI brain-imaging data that athletes exhibited less brain activation than non-athletes in the bilateral middle frontal gyrus, left middle temporal gyrus, and left cerebellum crus. These results point to the idea that athletes can construct "neural efficiency" in allowing them to facilitate task-specific projects (Guo et al, 2017).

## Brain Plasticity – How Do Athletes' Brains Differ Using Emerging Technology?

Furthermore, another study looked into varying components in brain functionality due to differing exposure to long-term training, differing in intensity. First of all, athletes were separated into two categories – 'aerobic', alluding to long-term athletes, and 'anaerobic', alluding to non-professional athletes who were exposed to a high-level intensity of athletic training. Findings showed that 'aerobic groups' displayed a higher activation in the gray matter volume of the cerebellum and temporal lobe, while the 'anaerobic group' demonstrated higher gray matter volume in the basal ganglia, and a higher activation in the cerebellum posterior lobe. Thus, these findings highlight that athletes' brain structures differ greatly in their functionalities and structures – bolstering the principles of 'brain plasticity' where the brain can constantly rewire itself from its exposure to varying stimuli. Another research has pointed to the other neural mechanisms in the field of sports science, where through utilizing the meta-analysis of brain functionalities, new EEG measures can be used to optimize and predict performance outcomes (Fang et al, 2022). For instance, athletes show higher advantages in neural functioning while conducting simple tasks including motor and cognitive tasks. Specifically, they have displayed increased cortical asymmetry, greater cognitive flexibility, and precise timing of cortical

activation. These findings have helped bolster new EEG-based research, which can be utilized as interventions for researchers and kinesiologists to apply effective training methods that could help improve sports performances (Zhang et al, 2022).

## Marketing and social media to Increase Revenue for Sports Teams

Within another scope of sports marketing, data science has extended past the coaching office into the front office of sports teams as it has not only been used for athletic benefit but also for increasing marketing and fan engagement analytics. With the improvement to digital ticketing and biometric stadium entry systems, sports teams have begun to gather specific information about each attendee that might shed light into the demographics of fans which can in turn allow the teams to personalize the fan experience even on top of the match being played (Giorgio, 2019). The stadium has also become a point of interest for sports teams because it has been recognized as a technological and commercial platform in its design to give the fans the best possible experience at a game (Giorgio, 2019). Understanding fan trends from what merchandise people purchase to past attendance data can allow sports teams to tailor advertisements and promote upcoming games to supporters for repeat ticket holders in order to drive up sales. Furthermore, the use of data analytics can target groups who do not frequently attend matches to expose them to the sports industry and bring in many first-time fans, or not target them at all and save financial resources on advertising to those who will not even consider attending.

Today, social media has been utilized in the marketing world – in the modern era, as fans' approaches to communicate with channels and athletes continue to evolve based on current market trends. For instance, the big league associated with higher traction and consumer fan base in America including National Basketball Association, Major League Baseball, National Football League and the National Hockey League generate roughly $23 billion in revenue. In adjusting revenues for profit in the sports industries, various sports brands have ensured various sources of profit — ranging from ticket sales, sports video games, licensed products, sports-related advertising, and social media to facilitate generous sources of income.

## How Do Sponsorships Contribute to The Sports Industry?

As marketing evolves to the new demographics of consumers, sponsorships tied to sports groups, new events and matches can also be a powerful form of marketing in implementing effective campaigns that achieve their objectives – which in return, boost the traction of athletes. It has been demonstrated that sponsorships can have varying applications in viewership demographics – for instance, the highest-grossing sport of the modern era is soccer, which has thrusted many businesses to take advantage of establishing partnerships and sponsorships that are mutually-beneficial in reaching a wider audience and a high ROI. It is estimated that out of roughly 1.3 billion Facebook users, over 500 million consumers are soccer fans. The sport has been gaining high traction from US Twitter fans, and fans have a higher likelihood of working with an associated brand from an integrated sponsorship that can add "high-value" value to fans in increasing entertainment, accessibility to brand products, and higher engagement ratio.

## What Are the Potential Disadvantages of AI's Applications in Sports Science?

Despite the prevalence of artificial intelligence being adapted towards competitive sports, potential drawbacks have been identified surrounding new technology applications that are potentially irreversible. For instance, despite how traditional security tools have prevented attackers from hacking and entering computer networks, the introduction of AI has also required more advanced technology applications. Researchers and scholars have been questioning whether

the continuous adaptations of artificial intelligence can cause e-sports to lose the meaning of itself, whereby AI may replace prominent industry professionals to complete their tasks, such as coaches and referees (Pu, 2021).

In spite of this fear surrounding the replacement of major competitive sports professionals, artificial intelligence has still been argued to provide reasonable data and techniques to facilitate the smoothness of the game, where referee reports, intricate rulings, and penalties become accounted for.

## Conclusion

With the vast ranges of studies being implemented today – examining everything from 3D visualization tactics, trackers and accelerometers, emerging Artificial Intelligence tools to track and measure athletic performance, to new marketing trends and sponsorship opportunities, researchers and scholars today are confident that the sports industry presents a high-growth potential. Through its varying interventions, effectiveness and applications to consumers, kinesiologists and data scientists today are able to derive commonalities in patterns that can help athletes better optimize their training, intensity, and performance.

## Limitations

Upon establishing the findings, a few limitations of this research publication are prevalent. Potential limitations to this research might be seen demographically. For instance, the articles referenced only utilized data from America whereas accessibility to AI and advanced technologies to predict performance might be limited in lesser developed economic nations. Furthermore, notable findings from this publication are limited to athletic groups that are composed of soccer and American football players; thus, ongoing research moving forward can take this into consideration, by diversifying the applications of AI on various types of sports. Another limitation is the lack of differentiation between age groups and how age might affect data results in usage and overall advantages in using data science to optimize performance. By only looking at professional sports teams, one might miss out on the rising applications of data science in sports science to improve overall performance and health for younger athletes so in the future their bodies are primed to better fit the intensity of a professional setting. Thus, future research designs that analyze the efficacy of AI and Machine Learning on athletes may incorporate diversification into their ongoing research to ensure that extraneous factors are taken into consideration.

## References

Alderson, J., & Johnson, W. (n.d.). *The personalised 'digital athlete': An evolving vision for the capture, modelling and simulation, of on-field athletic performance*. ISBS - Conference Proceedings Archive. Retrieved March 13, 2023, from https://ojs.ub.uni-konstanz.de/cpa/article/view/7099

Bock, J. R. (2016, December 29). *Empirical prediction of turnovers in NFL Football*. MDPI. Retrieved March 13, 2023, from https://doi.org/10.3390/sports5010001

Candelier, E. (2022, August 10). *Natalie Kupperman uses data science to improve sport and athlete performance*. School of Data Science. Retrieved March 2, 2023, from https://datascience.virginia.edu/news/natalie-kupperman-uses-data-science-improve-sport-and-athlete-performance

Fang, Q. (2022, April 6). *Impact of sport training on adaptations in neural functioning and behavioral performance: A scoping review with meta-analysis on EEG Research*. Journal of Exercise Science & Fitness. Retrieved February 15, 2023, from https://doi.org/10.1016/j.jesf.2022.04.001

Giorgio, P. (2019, July 4). *How data can help drive sports sponsorship and Fan Engagement*. Deloitte United States. Retrieved February 16, 2023, from https://www2.deloitte.com/us/en/pages/consumer-business/articles/fan-engagement-analytics-improve-fan-experiences.html

Giorgio, P. (2019, July 4). *Integrating venue technology into sports business to enhance fan experience*. Deloitte United States. Retrieved February 16, 2023, from https://www2.deloitte.com/us/en/pages/consumer-business/articles/integrating-venue-technology-sports-business.html

Guo, Z., Li, A., & Yu, L. (2017, April 7). *"neural efficiency" of athletes' brain during visuo-spatial task: An fmri study on table tennis players*. Frontiers. Retrieved February 20, 2023, from https://doi.org/10.3389/fnbeh.2017.00072

Hall Jr., O. P. (2021, March 11). *Editorial: How ai can help reduce sports injuries - a peer-reviewed academic articles: GBR*. Graziadio Business Review | Graziadio School of Business and Management | Pepperdine University. Retrieved March 2, 2023, from https://gbr.pepperdine.edu/2021/03/editorial-how-ai-can-help-reduce-sports-injuries/

Malfait, B., Dingenen, B., Smeets, A., Staes, F., Pataky, T., Robinson, M. A., Vanrenterghem, J., & Verschueren, S. (2016). *Knee and hip joint kinematics predict quadriceps and hamstrings neuromuscular activation patterns in drop jump landings*. PLOS ONE. Retrieved February 20, 2023, from https://doi.org/10.1371/journal.pone.0153737

Morrell, T. (2022, July 22). *How technology is changing athletic training*. Styku. Retrieved February 20, 2023, from https://www.styku.com/blog/how-technology-is-changing-athletic-training#:~:text=3D%20body%20scanning%20is%20a,training%20programs%20and%20prevent%20injuries

Pu, Qiyu. The Effects of Artificial Intelligence on Competitive Sports. *Clark University School of Professional Studies, Master's Papers Collection (June 2021)*, 22-24. https://commons.clarku.edu/cgi/viewcontent.cgi?article=1091&context=sps_masters_papers

Rein, R., & Memmert, D. (2016, August 24). *Big Data and tactical analysis in Elite Soccer: Future challenges and opportunities for sports science - springerplus*. SpringerOpen. Retrieved March 2, 2023, from https://doi.org/10.1186/s40064-016-3108-2

Zhang, K. (2022, February 22). *Exercise intensity and brain plasticity: What's the difference of brain structural and functional plasticity characteristics between elite aerobic and anaerobic athletes?* Frontiers in human neuroscience. Retrieved March 13, 2023, from https://doi.org/10.3389/fnhum.2022.757522