DESIGNING A SPORTS AND PERFORMANCE ANALYTICS CENTER

STUDENT ATHLETE DATA PRIVACY CONCERNS

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By
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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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Recently, students at the University of Virginia have become more involved in sports analytics in collaboration with multiple varsity athletic teams at U.Va. Not only have students been increasingly interested in the field of sports analytics, but multiple varsity sports teams have also benefitted and performed better as a result of the findings from the students. University of Virginia News Associate Whitelaw Reid (2018) pointed out the U.Va. football coaching staff used input and play-calling advice that was provided by data analytics models created by engineering students (p. 1). Additionally, previous engineering students' capstone projects have also created analytic frameworks for the varsity golf and field hockey programs. The U.Va. Athletics Department has expressed they want to make performance analytics more common and centralized across all varsity teams, as not all U.Va. teams currently apply data analytics to better their performance. Additionally, the University expressed interest in offering some sort of degree program incorporating sports analytics, which is something other schools already offer.

The technical project will look to design a performance analytics center at the University of Virginia. This project will include identifying the optimal levels and types of data collection undertaken by each varsity athletic team at U.Va. and recommending the details of a performance analytics program that promotes the collaboration of academia and athletics. Tightly coupled with the technical project, the Science, Technology, and Society (STS) research will address the ethical concerns associated with data privacy for student athletes and the shortcomings of current legislation which exists to protect athletes. The social construction of technology framework will be used to analyze the relationship amongst stakeholders involved in the context of data privacy for student athletes. Both the technical project and the STS research will be developed over the course of the 2019-2020 academic year and will be completed by the beginning of May, 2020. Shown below in Table 1 is a Gantt Chart which displays the schedule for the main tasks that will be completed throughout the year for the technical project.

Table 1: Gantt Chart for Capstone Project: Schedule of major tasks to be completed throughout the duration of the year (Ungerleider, 2019).

DESIGNING A SPORTS AND PERFORMANCE ANALYTICS CENTER

Under the guidance of Engineering Systems and Environment Professor William T. Scherer and in conjunction with Deputy Athletics Director Ted White, Systems Engineering students Aniket Chandra, Jacqueline Hoege, Rishab Iyer, Rachel Kreitzer, Maryanna Lansing, Jacob Leonard, Ben Metzger, Sarah Nelson, Carl Rhodes, Daniel Ungerleider, and Peter Worcester plan to recommend the details of a performance analytics center at the University of Virginia, hopefully culminating with a presentation to University President Jim Ryan.

Currently, the only sports analytics courses offered to undergraduates at U.Va. are STAT 1800: An Introduction to Sports Analytics, STAT 4800: Advanced Sports Analytics, and a few sports medicine courses in the Kinesiology department (Bloomfield, 2019). This technical project seeks to increase the student involvement in and collaboration with U.Va. athletics through the creation of a sports analytics center as well as a degree program that involves an emphasis on sports analytics. One of the main goals of the sports analytics center is to improve the data collection methods across all U.Va. varsity teams and to store all data in a secure, centralized location for team analysts, trainers, or involved students to access. Some of the varsity teams already follow exceptional processes to secure their data. Varsity basketball strength and conditioning coach and data analyst Mike Curtis (2019) explained that all of the data the basketball team collects is stored in the Ivy secure environment, which is Health Insurance Portability and Accountability Act (HIPAA) compliant. In an ideal scenario, all of the varsity teams should follow similar processes as the basketball team to ensure secure and compliant data storage. However, the majority of other teams currently collecting data do not follow such secure procedures for storing their data. Many teams store their data on personal computers, creating the realistic possibility of losing all existing data if anything happens to the personal computer or coaching staff member who owns the personal computer. This technical group will look into possible options for optimizing the security and centralization of all data collected by the varsity athletic teams.

With regard to the current state of data analytics at U.Va., Varsity women's soccer Head Coach Steve Swanson and Director of Operations Eilidh Thomson (2019) revealed the women's soccer team is the perfect example of incorporating advanced performance analytics methods. The women's soccer team uses information collected from multiple types of sensors to optimize their training regimen, and they have their players self-report their sleep, readiness, and injury status. It is widely known that players self-reporting personal data is not always completely accurate, but Coach Swanson is confident his players are honestly reporting this information as a result of the trustworthy culture he has built within the women's soccer team (2019). Despite multiple teams being advanced in data collection, other teams lack the equipment necessary for data collection and thus do not have advanced performance analytics methods. Assistant men's tennis coaches Scott Brown and Brian Rasmussen (2019) explained the tennis team does not wear any sensors during practice or matches and thus does not have much data on their athletes to perform analytics on. Despite the current lack of data analytics within the tennis team, the assistant coaches were very optimistic about the idea of adding wearable technologies to upgrade their data collection methods and they would love the opportunity to carry out more advanced performance analytics (2019). The types of equipment currently being used by many teams are wearable technologies including Polar sensors, which measure athletes' heart rate and other biometric data, and Catapult sensors, which measure speed, acceleration, distance, GPS coordinates, and other metrics (Sharia, 2015). These technologies are worn by athletes during training sessions and games. Teams then use the data collected from these wearable technologies to improve their training regimens as well as their game plans. As former professional tennis player and current performance analytics lecturer at Northwestern University Lorena Martin (2016) stated concerning team performance, "performance on the field depends on training and conditioning" (p. 10).

Since many teams have their athletes wear sensors to collect data during training sessions and games, it is useful to look at how the wearable technologies actually collect data and relay the information back to the users. Figure 1, shown at the top of Page 5, displays how the biofeedback system of a sensor operates. The user's movements are captured by the sensor, which is the wearable technology worn by the user or athlete; these signals are then sent to the processing device, which could be a laptop, tablet, watch, etc. The processing device analyzes the signals and then sends the results to the actuator. The actuator provides the user with feedback obtained from the system. For this specific case, the actuator not only provides the athlete with the feedback but also the trainers, analysts, and other users of the data. These additional users then carry out analyses on the data collected by the wearable technologies to improve team performance and training regimens.

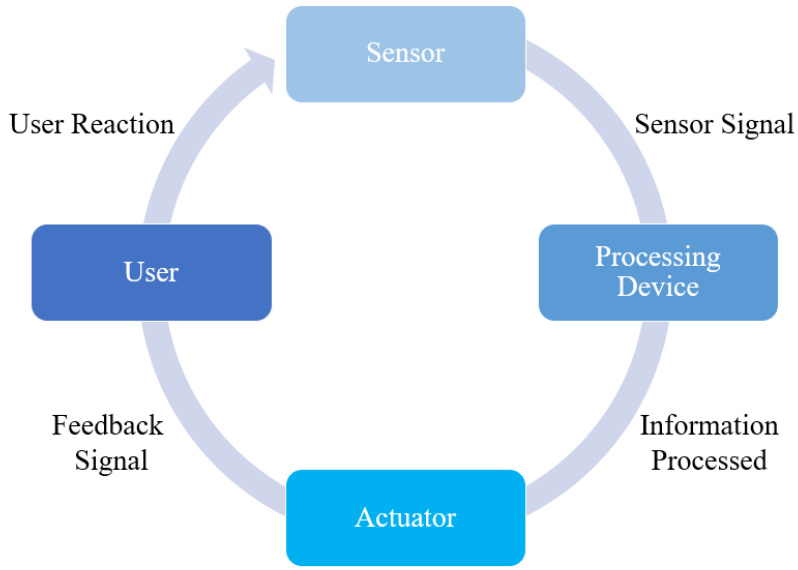

Figure 1: Biofeedback System and Loop Operation: The process of data collection using wearable technologies (Adapted by Daniel Ungerleider from A. Kos et al. 2019).

Another use of the wearables is for injury prevention and recovery. Sports medicine researchers Erin Wasserman, Mackenzie Herzog, Christy Collins, Sarah Morris, and Stephen Marshall (2018) assert that "measuring sports injury" has been an increasingly important aspect of sports analytics (p. 400). According to Wasserman et al. (2018), "Common analytical measures used in sports injury research include injury rate, injury risk and odds, incidence rate ratio, and risk difference and can be calculated based on the study design and research question" (p. 388).

This project will include interviewing varsity coaches, trainers, and athletes to gather more information on current levels of performance analytics, including how athletes and coaches feel toward data privacy issues. Additionally, the group plans to interview several other stakeholders and conduct research on the current state of performance analytics at competitive schools across the country. As the project progresses, the group plans to collaborate with multiple varsity teams at U.Va. to create analytics models and provide value to the teams. The group will also carry out analyses on the financial aspects of adding a physical analytics facility as well as what equipment and resources would be necessary. This technical capstone group intends to write a conference paper to reveal the findings and recommendations and hopefully present a proposal to University President Jim Ryan at the end of the year.

STUDENT ATHLETE DATA PRIVACY CONCERNS

As the use of wearables continues to increase, the amounts of data collected on all of the student athletes also continues to increase. A large concern of student athletes with regard to data collection is their privacy and the ethical issues associated with it. Many athletes are concerned that higher levels of personal data collection could reveal attributes that negatively affect the way some athletes are viewed. The STS project will attempt to address the ethical concerns associated with data privacy for student athletes and the shortcomings of current legislation. According to Wake Forest School of Law graduate Gilbert Smolenski (2019), college teams that track player health and sleep data could punish athletes for not getting enough sleep or for having poor nutrition (p. 296). Additionally, athletes do not have much protection over the data that is collected. Jason Arnold, attorney and researcher on bioethics and emerging technologies at NYU, and Robert Sade, researcher at the South Carolina Clinical and Translational Research Institute (2016), admitted “federal regulations do not address the use of biometric technologies in [college] sports” (p. 70).

To further illustrate this situation, Figure 2, shown on Page 7, exemplifies the Technology and Social Relationships framework of the social construction of technology. As seen, trainers and analysts are at the center of the framework because they are the end users of the data collected by the wearable technologies; they are the users who actually perform the analyses on the data. Engineers design the wearable technologies worn by the athletes, and thus they determine the design of the sensors worn by the athletes as well as the extent of the data available to be collected by the wearables, showing that they have power in this relationship. The coaches' involvement revolves around improving team performance and optimizing training methods to prevent injuries and promote readiness to create competitive advantages. Coaches do this by making decisions based on the recommendations provided by the data analysis. The coaches do have power, but most of their findings are already made apparent by the trainers and analysts. The recruiters' main goal is to collect as much information as possible on the athletes when making decisions on which athletes they want to bring to the next level. Therefore, the more data the better for the recruiters. The athletes do not have nearly any power in this framework as they do not have control over what data is collected and how that data is used for or against them.

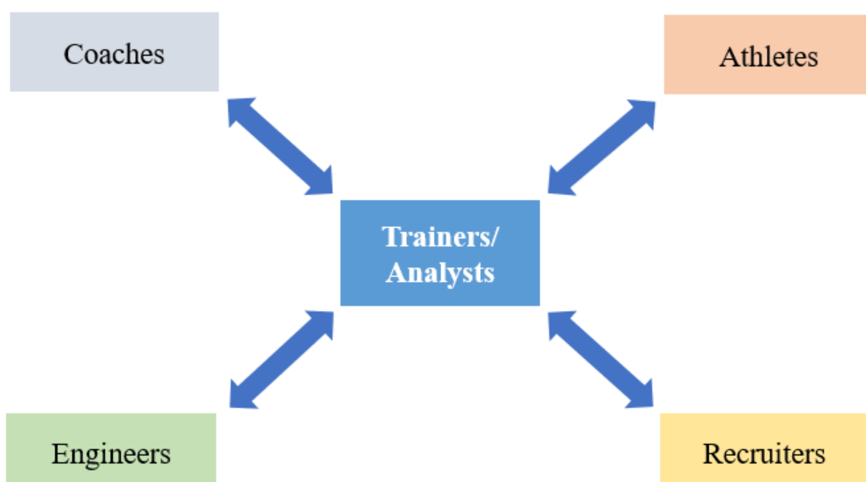

Figure 2: Technology and Social Relationships Diagram: Athletes do not have much power over what data is collected and how it is used (Ungerleider, 2019).

LACK OF REGULATION IN COLLEGIATE ATHLETICS

With regard to the lack of regulation and protection for student athletes, Gicel Tomimbang, Santa Clara University School of Law graduate and data privacy expert (2018), explains "wearable devices fall outside federal regulatory frameworks" and "wearable device companies have limited [liability] exposure under HIPAA" (p. 3). Wearable technology companies have little motivation to focus on protecting athletes' data privacy because there are little to no consequences these companies are responsible for. Jason Arnold and Robert Sade (2016) compared collegiate athletes to professional athletes by explaining professional athletes are employees and therefore have to follow certain processes defined in their contracts while collegiate athletes do not have any protection from federal and state employment regulations (p. 70). Despite the current lack of regulation, there is promising hope that the situation will improve in the near future. The California Consumer Privacy Act (CCPA), which will go into effect on January 1, 2020, will give consumers more power over their data. Under this law, "consumers have the right to know what personal information a company has collected, where the data came from, how it will be used, and with whom it's shared" and "consumers can request businesses to remove the personal information that the business has on them" (Stoltz, 2019). The law is a California law, but it extends far outside California borders. The STS project will look into how this law will affect student athletes nationwide.

Furthermore, Tucker Partridge (2019) states that he expects states nationwide to follow California's lead on the CCPA and that this type of legislation has "been coming for a long time" (p. 1). The author expresses that giving consumers more power over data privacy is part of a "worldwide change in belief regarding data privacy" (p. 1). Additionally, the author argues that even though there is a political divide in this country, bills improving the data privacy situation for consumers are passing easily. Figure 3 below depicts an example of Pacey's Triangle, which is a framework for displaying the relevant cultural, organizational, and technical stakeholders. This diagram examines the stakeholders involved within the context of improving the legislation and regulation surrounding data privacy for student athletes. Athlete privacy, coaches, and trainers are included in the cultural component of the framework as they have been affected by the lack of regulation for far too long and will be strongly affected by changes that are made. The organizational component includes universities, wearable technology companies, and legislators. The legislators are the stakeholders that can cause the most change as they decide which bills will be passed and what they include. The technical component includes the actual data collected as well as the wearable technologies used to collect it. How these technologies can be used will be determined by the legislation that is passed.

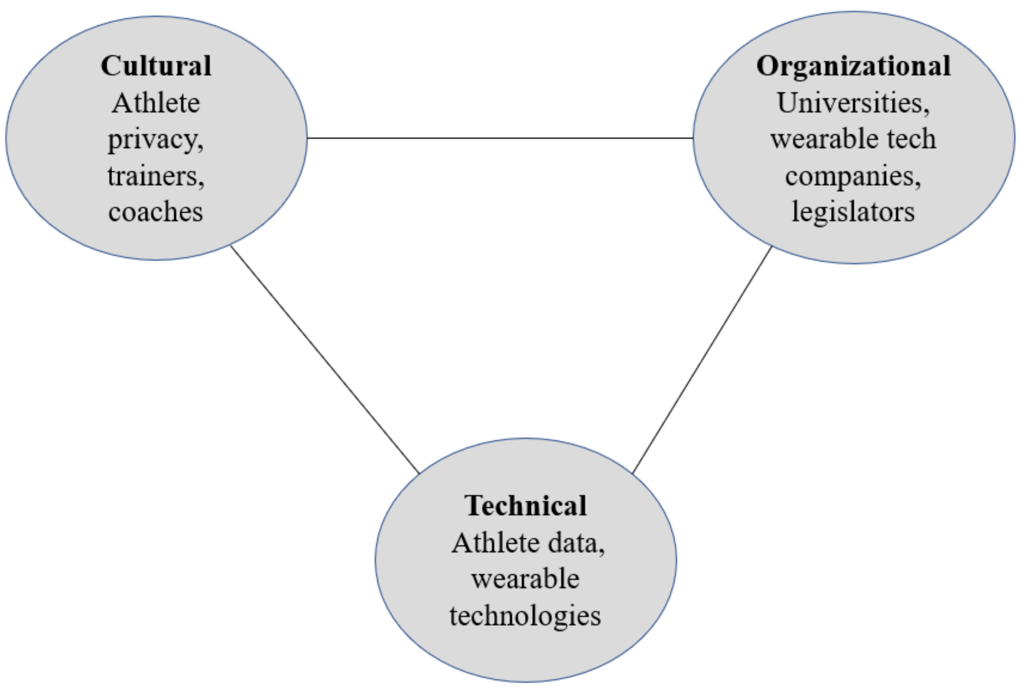

Figure 3: Cultural, Organizational, and Technical Triangle: A diagram using the Pacey's Triangle framework which includes the relevant cultural, organizational, and technical stakeholders (Adapted by Daniel Ungerleider from A. Pacey, 2019).

As the project progresses, the framework shown above will be used to analyze how the landscape could change as a result of updated legislation. Additional research on current legislation relating to data privacy for collegiate athletes will provide valuable insight on the potential improvements which need be made. The STS project is tightly coupled with the technical project, as the technical project involves designing a sports analytics center specific to U.Va. The STS research will be presented by a scholarly article displaying the findings discovered throughout the duration of the year-long project.

WORKS CITED

Arnold, J., Sade, R. (2017). Wearable technologies in collegiate sports: The ethics of collecting biometric data from student-athletes. *American Journal of Bioethics, 17*(1), 67-70.

Bloomfield, L. (2019). U.Va. class schedules: unofficial Lou's list: Obtained from U.Va. SIS. Charlottesville, VA. Retrieved from https://rabi.phys.virginia.edu/mySIS

Brown, S., Rasmussen, B. (2019, October 3). Personal interview [Interviewed by Sarah Nelson and Daniel Ungerleider]. University of Virginia. Charlottesville, VA.

Curtis, M. (2019, October 11). Personal Interview [Interviewed by Sarah Nelson and Daniel Ungerleider]. University of Virginia. Charlottesville, VA.

Kos, A., Milutinovic, V., Umek, A. (2019). Challenges in wireless communication for connected sensors and wearable devices used in sport biofeedback applications. *Future Generation Computer Systems, 92,* 582-592.

Martin, L. (2016). Sports performance, measurement and analytics: The science of assessing performance, predicting future outcomes, interpreting statistical models, and evaluating the market value of athletes. Old Tappan, NJ: Pearson Education, Inc.

Partridge, T. (2019, October 8). Data privacy: How the current NCAA debate reflects the state of big data [Blog post]. Retrieved from https://www.zlti.com/blog/

Reid, W. (2018, May 24). 'Hooball: The Cavalier football program is employing unique data models created by engineering students, some of whom are contemplating careers in the burgeoning field of sports analytics. *UVAToday.* Retrieved from https://news.virginia.edu/content/

Sharia, M. (2015, July 13). 5 amazing pieces of wearable tech being implemented in professional sports [Blog post]. Retrieved from https://www.wearables.com/blogs/news/

Smolenski, G. (2019). When the collection of biometric and performance data goes too far. *Wake Forest Law Review, 54*(1), 279-301.

Stoltz, B. (2019, September 7). A new California privacy law could affect every U.S. business – Will you be ready? *Forbes.* Retrieved from https://www.forbes.com/sites/allbusiness/

Swanson, S., Thomson, E. (2019, September 7). Personal interview [Interviewed by Sarah Nelson and Daniel Ungerleider]. University of Virginia. Charlottesville, VA.

Tomimbang, G. (2018, January 22). Wearables: Where do they fall within the regulatory landscape? *IAPP: The Privacy Advisory.* Retrieved from https://iapp.org/news/a/wearables-where-do-they-fall-within-the-regulatory-landscape/

Ungerleider, D. (2019). Gantt chart for capstone project. [Table 1]. *Prospectus* (Unpublished undergraduate thesis). School of Engineering and Applied Science, University of Virginia. Charlottesville, VA.

Ungerleider, D. (2019). *Biofeedback system and loop operation.* [Figure 1]. *Prospectus* (Unpublished undergraduate thesis). School of Engineering and Applied Science, University of Virginia. Charlottesville, VA.

Ungerleider, D. (2019). *Technology and social relationships diagram.* [Figure 2]. *Prospectus* (Unpublished undergraduate thesis). School of Engineering and Applied Science, University of Virginia. Charlottesville, VA.

Ungerleider, D. (2019). *Cultural, organizational, and technical triangle*. [Figure 3]. *Prospectus* (Unpublished undergraduate thesis). School of Engineering and Applied Science, University of Virginia. Charlottesville, VA.

Wasserman, E., Herzog, M., Collins, C., Norris, S., Marshall, S. (2018). Fundamentals of sports analytics. *Sports Medicine Statistics, Clinics in Sports Medicine, 37*(3), 387-400.