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Using Virtual Reality to Train Athletes

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Abstract

Training athletes is an ever-evolving part of sports that, with the growth of the use of technology in sports, has become increasingly complex. Organizations and teams are constantly looking for new ways to be at the forefront of training development. As the development of virtual reality has moved forward, so has the ability to adopt these new technologies to a wide variety of areas. There are multiple systems already in existence that use virtual reality to train athletes. This proposed study aims to shed light on this promising technology to help athletes learn more efficiently and effectively in a safe environment.

Keywords: virtual reality, sports, training, innovations in training, sports research, football

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Chapter 1: Introduction

Context and Background

Video games and college/professional sports: what do these things have in common? Both of these activities take a certain amount of skill to be successful at, both require attention to detail, and both have large fan bases. It is safe to say that, for most people, these two things touch our lives on a regular basis. “According to Nielsen, the average U.S. gamer age 13 or older spent 6.3 hours a week playing video games during 2013” (Aamoth, 2014, para. 1). Also, “the average young person racks up to 10,000 hours of gaming by the age of 21 – [a mere] 24 hours less than they spend in a classroom for all of middle and high school, if they have perfect attendance” (McGonigal, 2011, para. 1). If the average person already spends a large amount of time playing video games, why can it not be used for training? The development of increasingly immersive technologies to play games and consume sports only adds to the experience. Things like Virtual Reality (VR) headsets are transforming how fans can interact with sports, and even beginning to change how teams train their players (Dickson, 2016).

Purpose

The purpose of this paper is to propose a study to determine the validity of using VR as a training device for athletes. This study will also look at to what extent VR technology can affect those who utilize the various programs that have been and are being developed for this purpose. The goal of determining this is to provide extensive and proven research so that trainers, coaches, organizations, and individuals can make an informed decision as to whether they would like to pursue using VR as a device to enhance performance.

Significance of the Proposed Study

The significance of this study may be profound. If it is found that VR does indeed have a noticeable positive effect on player performance, this discovery could change the landscape of how athletes are able to train both in season, and during their respective off-seasons. This could also provide an avenue where athletes can train in a safe and cerebral environment, increasing their knowledge of the sport while remaining free from injury.

Training athletes has become increasingly more difficult due to restrictive rules such as the specific amount of time of on-field practice, where teams can and cannot travel, how often teams can travel, and limited practice times away from their home facilities (College Sports Scholarships, 2017). Athletic administrators and team coaches are fighting a constant battle of how best to train their athletes within these rules and stipulations and therefore may be seeking innovative ways to combat these restrictive guidelines (Kitsos & Sell, n.d.). To help protect players from injury and to provide extensive opportunities to learn, co-founder Derek Belch created the company STRIVR (Dickson, 2016).

"STRIVR uses VR to improve performance of athletes, brands, and organizations" (STRIVR Labs, Inc., 2017b, para. 1). Since its inception, "STRIVR's system has become part of the training program for 23 college and professional teams" (Dickson, 2016, para. 26). Another company that has vowed to create a training alternative for athletes is EON Sports, an offshoot of Californian company, EON Reality (Brandt, 2015). Ole Miss, a university in the Southeastern Conference, or better known as the SEC, is using a program created by EON Sports, (SIDEKIQ QB challenge) (Brandt,

2015). The program is fully immersive and helps to train the quarterbacks without actually having to get hit on the field. It is a straightforward way for the quarterbacks to learn the plays, stay healthy, and avoid fatigue (Brandt, 2015).

Biases and Assumptions

As with any major innovation and development of new technologies, there comes with it a degree of skepticism (Hursh, 2018). Those who are engrained in their ways of training "the old-fashioned way" may be less open to the idea that something new could be better. Therefore, it is important to fully explain the potential growth athletes may experience to allow them to remain open to new things. Biases from the researcher of the study lean toward being in favor of using virtual reality, but will in no way affect the study in any capacity that would skew the end results.

Limitations

There are bound to be some limitations to every study, and this particular research is no exception. One limitation of the proposed study is that it only focuses on a single sport (football), and only a single position in said sport (quarterback). Limiting the study to only two of these devices could appear limiting, and not encompassing the full array of options in existence. Other limitations include the ability to fully generalize the study's findings due to the number of participants available to use for the study and at what level of play they come from.

Organization of the Remainder of the Study

Chapter 2 of this paper will present the literature review associated with athlete training and virtual reality. Chapter 3 will present the proposed research study to

determine the validity of using VR as a training device. Finally, Chapter 4 will provide a discussion of the conclusions and practical implications.

Definition of Terms

Anatomic VisualizeR: a "virtual environment (VE) designed to support the teaching and learning of any subject that requires an understanding of three-dimensional (3-D) structures and complex spatial relationships" (Hoffman, Murray, Curlee, & Fritchle, 2001, para. 1)

EON Sports**:** EON Sports VR takes EON's Virtual Reality technology and leverages it in the Sporting World. By showing sports strategies, plays, and techniques in a virtual environment, EON Sports increases the amount of mental repetitions a player takes" (Reilly, 2017, para. 1). EON Sports VR contains four products designed for football training: SIDEKIQ 4-3 defensive challenge with Mike Ditka, SIDEKIQ 7 on 7 Challenge with Firstdown Playbook, SIDEKIQ NZONE Zone Read Challenge, and SIDEKIQ QB Challenge with Steve Clarkson (EON Sports VR, n.d.)

Gamer: "A person who plays video games or participates in role-playing games" (Oxford University Press, 2018a)

NCAA: National Collegiate Athletic Association

NFL: National Football League

Nielsen: "A global measurement and data analytics company that provides the most complete and trusted view available or consumers and markets worldwide" (The Nielsen Company, 2018, para. 1)

Orthopaedic surgeon: “Related to the branch of medicine dealing with the correction of deformities of bones or muscles” (Oxford University Press, 2018b)

Simulator: “A machine designed to provide a realistic imitation of the controls and operations of a vehicle, aircraft, or other complex system, used for training purposes” (Oxford University Press, 2018c)

STRIVR: a system that seeks “to improve performance of individuals, corporations, and sports teams” using virtual reality (STRIVR Labs, Inc., 2017a)

Video game: “a game played by electronically manipulating images produced by a computer program on a monitor or other display” (Oxford University Press, 2018)

Virtual reality (VR): “computer-generated simulation of a three-dimensional image or environment that can be interacted with in a seemingly real or physical way by a person using special electronic equipment, such as a helmet with a screen inside or gloves fitted with sensors” (Oxford University Press, 2018e)

Wonderlic Test: A commonly used intelligence test used to evaluate the ability of potential personnel for learning and problem-solving for a wide variety of jobs (Wonderlic Test Sample, 2018)

Chapter 2: Review of Literature

Athletic training has evolved through the ages. Today, athletes are bigger, stronger, and faster than ever thanks to technological developments and innovations in training efficiency (Loria, 2016). With the foundation of the National Athletic Trainers' Association (NATA) in 1950, came the beginning of a more formal curriculum for athletic training and trainers (Delforge & Behnke, 1999). Through NATA, athletic training models were formed and subsequently "the curriculum was designed to prepare the student not only as an athletic trainer but also as a high school teacher, primarily in the areas of health or physical education" (Delforge & Behnke, 1999, p. 54).

Olympians have a rigorous training schedule that allows them to compete at extremely high levels in events that can end in a split second, and these athletes are both professional athletes and amateur athletes (Golden, 2018). Many athletes focus on a very well-rounded training regimen. "Varying training can help improve skills like strength, endurance, agility and speed, regardless of what activity it's needed for" (Angle, 2018, para. 5). While combinations of weight training and a wide variety of cardio exercises help to maintain the entire body, sleep is imperative to high performance athletic training. Being able to recover from a long, tough day of training is extremely important, and as Douglas Ebner said, "Of all the recovery techniques, proper sleep is undoubtedly the most cost-effective strategy for athletes" (Angle, 2018, para. 11).

Professional athletes are always looking for new ways to enhance their training regimens to become better. Techniques to improve skill, recovery time, and mental ability are key to transforming from an amateur athlete to one of the best in the world. This is where traditional training meets with technology. Some athletes use a device

called the Halo Sport; a device that utilizes mild "electrical stimulation (such as transcranial direct current stimulation, or tDCS) to increase plasticity in the brain prior to an activity" (Halo Neuroscience, 2018, para. 11). This means that the electric impulses help prep the brain for training, affecting the parts of the brain that control motor movement. Through a process called neuropriming, Halo Sport aims as "accelerat[ing] gains from physical training" with neurostimulation (Halo Neuroscience, 2018, para. 1). Olympic athletes are using the technology such as athletes like "Bryan Fletcher, a childhood leukemia survivor who won the Nordic combined Olympic trials, [are] believer[s]. 'We were able to repeat movements with precision more often with Halo Sport'" (Calahan, 2018, para. 3). Halo Sport is just one of many devices athletes now use to improve their training schedules. Wearable devices like Fitbit, Samsung's Gear devices, and others from companies like Under Armor, Apple, and Garmin help athletes track their fitness in a variety of ways, from heart rate monitors to step counts (So, 2018).

Virtual Reality

Virtual reality is an avenue that is pushing the barriers of how people experience many things. From changing how a person can view something as simple as a large picture, to being fully immersed into a video game or environment, virtual reality has allowed people the ability to truly enhance life experiences and entertainment (Merritt, 2016). The Virtual Reality Society (2017) defined virtual reality in technical terms as "a term used to describe a three-dimensional, computer generated environment which can be explored and interacted with by a person" (para. 5). VR can date back all the way to the 1800s with things as simple panoramic paintings (Virtual Reality Society, 2017). Based on the concept of providing the feeling of being somewhere a person is not, "the earliest

attempt at virtual reality is surely the 360-degree murals (or panoramic paintings) from the nineteenth century" (Virtual Reality Society, 2015b, para. 1). The idea was to impress upon someone the feeling of being present at an event by filling his/her entire field of vision. What most have come to understand as VR now has its traces back to the 1980s, when the term itself (virtual reality) was officially coined by the founder of visual programming lab (VPL), Jaron Lanier (Virtual Reality Society, 2015b).

The 1980s and 1990s had its fair share of attempts at popularizing VR, but sadly nothing lasted for any true length of time (Taylor, 2017). One such example of a failed attempt at virtual reality in the 1980s was the VPL Dataglove. It was a relatively simple concept; wear a glove to "control video games and other computer applications with [your] hands" (Taylor, 2017, para. 3). Sadly, the computers at the time were not nearly powerful enough to handle the required output from them. The company that created the glove filed for bankruptcy a mere three years later (Taylor, 2017). Another VR attempt in the late 1980s was Nintendo's Power Glove. Similar in concept to VPL's Dataglove, the idea was to provide users the ability to use their hand to control a game. Unfortunately, the glove barely worked and eventually failed altogether (Taylor, 2017). The early 1990s saw the first public access for VR thanks to Virtuality Group's arcade machines, but these were still not affordable pieces of technology (Virtual Reality Society, 2015). Video giants SEGA and Nintendo both attempted to create their respective VR devices, but failed for a variety of reasons, including extremely high price points (SEGA Ath that time, VR was for sale at $200 (about $322 in 2015 money) and Nintendo's Virtual Boy sold for $180 (Virtual Reality Society, 2015, para. 16).

Virtual reality today comes in many forms. As shown in 2017 by massive companies like Google, Sony, and Samsung leading the pack to bring VR into the mainstream, VR is here to stay (Hills-Duty, 2018). Affordability has always been an obstacle for VR, but these companies have helped make its accessibility to the general public a (virtual) reality with lower production costs and more available content (Rodriguez, 2018). Sony Playstation introduced Playstation VR, Samsung has Samsung Gear VR, and Google has the Daydream View (Greenwald, 2018). There are also devices designed for computers, such as the HTC Vive/SteamVR headset and the Oculus Rift. These are the more expensive headsets, but come with controllers, multiple cameras, and higher definition screens built into the device. There are even a few VR headsets that do not require either a smartphone or computer, but like the others, still have their limitations (Rodriguez, 2018).

Standalone headsets (those that do not require additional hardware) are often quite affordable and offer the ability to experience VR without wires or extra technology. However, most come with a single controller which "limits the range of interactions compared to what's possible with two controllers" (Claburn, 2018, para. 8). Additionally, standalone headsets are simply not as powerful as their fully connected counterparts due to the limitations of the hardware and making them affordable. Finally, standalone VR is limited by its simplicity in that it only functions for VR (Claburn, 2018). This can significantly restrict the ability to use the device for anything other than VR, whereas other headsets that require a phone allow the user to remove the phone and use it for any number of tasks outside of VR. Overall, virtual reality has made incredible strides over the last decade, and, as technologies become cheaper, so will the devices.

The experiences people have with these devices will also continue to improve. ”It seems like only a matter of time before movies like Ready Player One (“an adaptation of Ernest Cline’s near-future sci-fi adventure novel about an avid gamer (Tye Sheridan) who spends most of his time in the Oasis, a virtual reality universe/multi-user game”) will become a reality (Chen, 2018, para. 1).

Using virtual reality as a training device can provide an alternative way for athletes to practice. Sports are not the only field to consider the idea of using a new format to train new prospects. A study involving the use of VR to train orthopedic surgeons was performed and showed that through the usage of a VR simulator, surgeons performed better than those without the extra training (Akhtar, K., Sugand, K., Sperrin, M., Cobb, J., Standfield, N., & Gupte, C., 2015). The training allowed “trainees to practice technical tasks without putting patients at risk,” as well as “addressing restrictions on working hours” (Akhtar et al, 2015, p. 1). Reznek (2002) discussed additional ways in which other forms of training were being used in the medical field. It was mentioned that human error contributes to a large portion of unintentional incidents during procedures. There have been many attempts at alternatives to “practicing diagnostic, therapeutic, and procedural skills, but those “have shown even greater flaws” than practicing on live patients (Reznek, 2002, p. 1). According to Reznek (2002), the University of Michigan has designed “an immersive training environment…. [involving a combination of] VR and computer-enhanced mannequin simulation” (p. 7).

The use of VR in the medical field has already begun to show that it is a viable, and a much safer way to train surgeons and medical professionals (Akhtar et al, 2015). By reducing the amount of risk involved in surgical procedures with the elimination of

human subjects, practicing has become a much safer and less daunting task. Using VR as a training tool for athletes is not new either. Aside from the two larger companies (STRIVR and EON Sports), there are other alternatives to VR training. Schroeder (2017) introduced the idea of using VR, not only to train athletes, but also as a recruiting tool. With prospective athletes able to "[virtually tour] facilities to virtual point-of-view experiences such as a day in the life of a football player on gameday", VR is changing the way athletes can experience a college campus (Schroeder, 2017, p. 1). Other early adopters of VR training and experiences include companies such as NextVR, Intel, YouVisit, and Jaunt (Schroeder, 2017).

The Wonderlic Test

Being able to properly measure an athlete's mental abilities is important to understanding how skilled he/she may be on the field. This is where the NFL has taken steps in aiding teams with this analysis; the NFL utilizes the Wonderlic Test. The Wonderlic test is comprised of 50 questions and,

> …is given to college football players looking to enter the NFL at their Scouting Combine. Every NFL team uses the information learned from the Wonderlic test and training drills at the Scouting Combine to determine when they would feel comfortable drafting each player in the upcoming draft. (NFL Wonderlic Test Scores, n.d.b, para. 2)

There have been multiple studies conducted on the Wonderlic test "to figure out how [the] scores correlated to the performance of several groups of NFL players" (NFL Wonderlic Test Scores, n.d.a, para. 2). While one study concluded "that there is no correlation between test scores and performance" (NFL Wonderlic Test Scores, n.d.a,

para. 3), another study found that “a collection of statistics from 61 NFL quarterbacks showed that more passing yards did correlate with higher average Wonderlic scores” (NFL Wonderlic Test Scores, n.d.a, para. 5). It is worth noting that the first “study assume that salary and draft order were predictors of success, and that the Wonderlic score meant nothing” (NFL Wonderlic Test Scores, n.d.a, para. 4), while the second “looked at statistical performance rather than salary” (NFL Wonderlic Test Scores, n.d.a, para. 5).

Conclusion

Chapter 2 focused on the relevant literature surrounding the topic of virtual reality and how it has been used. Key topics included a brief history on VR: its first inceptions, successes and failures, and how the technology has developed over time; the use of VR in the medical field and how it has transformed how future surgeons prepare and train; a brief history on athletic training and how it has evolved over time; and finally an overview of the Wonderlic Test, a device employed by the NFL to assess its future prospects. Chapter 3 presents a research study proposal to further investigate how VR can be used to train athletes.

Chapter 3: Research Study Proposal

Research Question

Training athletes using virtual reality is not the only application for such technology. Companies and programs like Anatomic VisualizeR by Basic Science, "3D Human Atlas" from Japan, and others are helping students by using VR to provide unbelievable ways to view and access the human body (Reznek, 2002). Advances in this technology not only help to teach future practitioners and medical personnel, they help to avoid injury to those who volunteer to be practiced on.

As VR technology continues to evolve, the practicality of using virtual reality as a training device will become easier and more effective (Beqiri, 2018). It will provide numerous opportunities for athletes to get better and decrease the number of injuries that occur during training sessions. Since the technology is still in its relative infancy, only minimal research has been conducted to prove its effectiveness. Most of the work currently done in this field has been by EON Sports and STRIVR, companies that already employ this technology (Dickson, 2016). It is important to expand the knowledge so that more facilities and institutions are aware of virtual reality's benefits as a training device. The purpose of this study is to show how the use of virtual reality in training athletes can positively affect their performance.

Hypothesis

The stigma that has long existed about video games is beginning to disappear (Sinclair, 2017). As technology evolves, the interaction between players and audiences also evolves. Alongside these technological advances are advances in how athletes train. Unfortunately, there still seems to be a lack of support and evidence suggesting that using

VR to aid in certain training exercise can improve upon already effective practices (Walton, Keegan, Martin, & Hallock, 2018). While the topic is broad and can be applied to a large variety of sports, football is one of the many in which VR is already being implemented (ST Staff, 2017). Since there are already a host of teams choosing to participate in this, it is important to gather more data to support using VR. The following are hypotheses as to the effectiveness of using VR as an extra training device:

H_1: Use of VR as an extra training device will improve a player's ability to perform on the field of play, as compared to those that do not.

H_2: Those exposed to the VR training will have an increased player IQ, making them more successful and able to read and adapt to changing situations.

H_3: The difference in performance of players using the STRIVR VR training system will be better than those who use the EON Sports VR training system.

Instrumentation

This study proposal uses a series of field tests for instrumentation. First, to get a good grasp on the base performance of the subjects prior to the study, both a field test consisting of a variety of quarterback skills and test questionnaire will be given. The set of field tests will be comprised of drills used at the NFL Scouting Combine: pocket movement, 3-5-5-7 step drops and throws, and 7-step roll out, right and left (NFL, n.d.). Second, a questionnaire will be given to each study participant. The testing questionnaire was created using existing football understanding and leadership questions from Career Guru99 (2017) (see Appendix B). It is comprised of the more mental aspects of quarterbacking and contains the following elements of understanding of defensive coverages, playbook knowledge, leadership qualities (Raza, 2016), and how the players

perceive their own skills in the aforementioned areas (Grassi, 2014). The third instrument that will be used in this study, is the NFL's Wonderlic Test, an example of which comes from JobTestPrep (2017) (see Appendix A). As previously mentioned, the Wonderlic Test as employed by the NFL, is used to test the mental capacities of players entering the NFL draft (Johnson, 2018).

Participants

A nonprobability purposive sample of quarterbacks from NCAA football programs will be used for the study. A stratified sample of quarterbacks representing 35% of currently listed on NCAA football rosters will be utilized for this study. There are roughly 256 NCAA Division I quarterbacks, assuming each of the 128 programs carries only a single back-up (Lillibridge, 2017). Of the over 300 Division II schools, roughly 148 have a football team, and following the same logic, there would by approximately 296 DII quarterbacks (Athnet, 2018a). Division III is comprised of 442 schools, with 237 hosting a football team. As such, DI, DII, and DIII would be comprised of roughly 474 total quarterbacks (Athnet, 2018b) Participants for this study will be student athletes of traditional college age, ranging from 18 to 23 years old.

The study participants will be divided into three separate groups: a control group (only standard training, without the use of VR), a group using EON Sports system of VR training, and a group using STRIVR's system of VR training. Each treatment group will contain an equal representation of NCAA level quarterbacks from each of the three divisions (with a total of nine groups). The purpose of this division is to determine how effective each system is at training the quarterbacks from each division of NCAA collegiate play.

Pilot Test

A pilot test comprising of a small representation of the desired overall number of participants will be conducted to understand the viability of the study. Quarterbacks will be introduced to the VR environment to gauge its effectiveness prior to full testing. Participants will be exposed to a single exercise within the VR system and a single physical exercise, followed by both a mental and physical test.

Communication Strategy

The invitation to participate in the study will be sent out via email. Coaches of NCAA teams will be contacted to determine players that might be interested. An initial email will be sent out, with three reminder emails sent one week, two weeks, and four weeks later to reach those who have not responded. Along with the purpose of the study, coaches will be able to have their athletes receive training that will potentially improve their players.

Ethical Considerations

There should be no negative ethical implications in this study. The athletes that participate in the research will be kept anonymous. The study and research will also comply with all rules and regulations set by the Institutional Review Board, as well as NCAA rules and regulations for student participation in research studies. Participants will read and sign a consent form before any testing is performed. This is meant to inform the participants of what they will be undergoing, as well as protecting both parties from liability in the unlikely event of trauma. A sample of the consent form can be found in Appendix C.

Data Collection

The testing questionnaire for this study was created by the researcher (see Appendix B) and the Wonderlic test was created by E.F. Wonderlic. These two instruments, along with the field tests, will be facilitated by the lead researcher. The researcher will gather and assemble data from both tests for analysis. The EON Sports VR training system will feature the SIDEKIQ QB Challenge. This program is designed to put the quarterback into "over 100 interactive tutorial and training situations" and features "voice-over and real-time feedback from Steve Clarkson coaching you on your ability to identify, analyze and break down defenses" (EON Sports VR, 2017, para. 2). The STRIVR VR training system "captures live plays and content from teams' practices and then via its software, feeds 3D video images to training players through an Oculus Rift headset" (Lelinwalla, 2015, para. 4). Each session in the different training systems will last for one hour.

Data Analysis

The data collected from the questionnaire for this study will be analyzed using a factorial multivariate analysis of variance (MANOVA) and the Wonderlic test will uses a simple scoring guide (the higher the score, the better). Both of these methods involve quantitative data analysis.

The independent variables in this part of the analysis are the three groups of athletes: 1) quarterbacks that only receive normal training, 2) quarterbacks receiving normal training and time using the STRIVR system, and 3) quarterbacks receiving normal training and time using the EON Sports system. The dependent variables will consist of the understanding of defensive coverages, playbook knowledge, leadership qualities, and how the players perceive their own skills. For the field testing, simple

calculations with numbers will be used to analyze the results. For example, in the throwing routes exercises of field testing, simple calculation of number of accurate and caught passes will be used to determine success or failure. It can be assumed that a quarterback throwing nine accurate and caught passes is more successful than another who only throws eight of the exact same passes to the same receiver (Gagnon, 2013).

Limitations of the Methodology

As is possible with any research, there are some limitations of the methodology and research conducted. First, there will be demographical limitations as this research focuses on quarterbacks from NCAA-level players. Since the total number of NCAA-level quarterbacks is unknown, it is possible that further research with more subjects may need to be conducted for better generalizability. There may also be limitations pertaining to the wide range of talent available in NCAA-level quarterbacks, and the overall perceived success or failure of adding training within a virtual reality environment. As with any questionnaire, there will be limitations (Rowley, 2014). Even though emails will be sent to coaches with information about the study, there is no guarantee that they will read it or pass along the information to their players.

Conclusion

As technology evolves and the ability to train athletes changes, it is important to adapt athlete trainings to these new conditions. To educate coaches and sport organizations on how training using VR will benefit their players and help to avoid injury, more research needs to be conducted. With limited sources in existence at the current moment, it is imperative that new research is done to provide real results and valid opinions.

Using the proposed research study as a guide, there is hope that more knowledge will be gained by conducting a study to determine the viability of VR as a useful training system for athletes at the college level. These results may in turn, provide possible viability at all ages for the use of VR in athletic training. By providing successful results, teams, coaches, and organizations can make an informed decision as to use or not use virtual reality as a new tool to make their players better. This is further discussed in Chapter 4.

Chapter 4: Conclusions and Practical Applications

As discussed throughout the course of this paper, the potential use of VR as an athletic training device shows great potential. Unfortunately, research still needs to be conducted in order to provide empirical evidence to support its use. Previous research suggested that using VR as a training device increases performance and the user's ability to be successful (Akhtar et al, 2015; Reznek, 2002; Hoffman, Murray, Curlee, & Fritchle, 2001). Virtual reality can provide a safe space for athletes to increase their sport knowledge without the chance for injury during traditional practices. Sadly, athletes experience injury on a regular basis, even during controlled practices (NCAA, n.d.).

Within the past few years, numerous athletes have incurred season-ending injuries, sometimes without any contact at all. For example, "late last month, Dallas Cowboys linebacker Sean Lee suffered a torn left ACL during an OTA [(organized team activities)] drill. Though he could conceivably return in 2014, the injury almost certainly ends his season" (Siebert, 2014, para. 6). Torn ACL injuries have seemed to rise over the past few years, with a large number of them occurring during training camps and preseason games (ProFootballDoc, 2017). According to ProFootballDoc (2017), "Of the 32 teams, 19 have had at least one player suffer an ACL injury since the start of training camp" (para. 7). This indicates there is a need for an alternative training device that helps to minimize some of the more physical aspects of training. While reducing the overall amount of physical training does not guarantee a decrease in potential injuries, there is certainly a statistical likelihood of this helping to do so. As such, the purpose of this study and paper helps to show that using VR will indeed be a viable and valuable training device for athletes looking for alternatives in their training regimen.

Expected Findings

It is expected that athletes who are in both the STRIVR and Eon Sports groups will exhibit an increased ability to perform, benefiting from the additional mental stimulation triggered from the different VR headsets. Another benefit expected from the groups utilizing the VR headsets is improved mental abilities when it comes to reading plays and the ability to adapt to changing situations. As discussed in Chapter 2, orthopedic surgeons who used a VR system in additional to traditional training demonstrated better performance than their counterparts who did not use VR training (Akhtar et al, 2015). Similar results are expected in the athletic training setting.

It is also expected that those participants using the STRIVR system will show better performance than those using the Eon Sports system. The STRIVR system uses previously captured video to help players literally see what is happening on the field (Lelinwalla, 2015). Players who use this system are expected to perform better than their colleagues using the Eon Sports system because previous research shows that it more beneficial to use skills you already know to improve than learning new things (Pisano, Bohmer, & Edmondson, 2000).

Practical Implications

There are certainly many potential outcomes from this study, but if each of the hypotheses are supported, the implications could be very influential. Coaches, trainers, and athletes will be able to make more educated decisions as to whether or not they will want to use VR as an additional training tool. Showing that VR is an effective way to train could have profound impacts on how athletes train. It could help significantly reduce the number of injuries that occur during training sessions, especially non-contact

injuries. In the NFL specifically, quarterbacks are often the focus of rule changes; changes that aim to protect the players from injury (Bruner, 2018).

If the hypothesis of increased player IQ is supported, that could also have a profound impact on how athletes choose to spend their training sessions. Instead of constantly pouring over the playbook, watching video, and taking tests, quarterbacks could simply put on the VR headset, immerse themselves in the field of play, and improve. Having such an immersive technology available could be truly valuable, and would help to reduce injury for important players such as the quarterback. Adjustments would certainly have to be made as virtual training is very different from traditional training, and as such, trainers themselves would also have to learn to adapt and learn how to implement these systems into their schedules. Coaches could also work with the trainers to design detailed programs or videos aimed at working on specific plays and mental repetitions.

Limitations

One limitation of the proposed study is that it only focuses on a single sport (football), and only a single position in said sport (quarterback). In addition to such a narrowed focus on the sport and position within the sport, the actual devices used in the study may limit the overall possibilities of this technology. As discussed in Chapter 2, there are wide variety of VR devices aimed at sport training. Limiting the study to only two of these devices could appear limiting, and not encompassing the full array of options in existence. Also, due to the nature of virtual reality and its fully immersive experience, varying levels of nausea are common (Pappas, 2016). Nausea can certainly

hinder the amount of truly effective training an athlete may obtain, so it is important to monitor this and inform the participants ahead of time.

Second, acquiring the number of desired participants could prove to be quite difficult. Many programs throughout the country appear to be somewhat secretive and protective of their players. In this event, coaches may not be willing to subject their star players to a study of this nature. While the desired study would likely take place during the offseason, some programs may still normally use this time for their own training, making players availability limited or non-existent. It is important to emphasize the potential impact of the study, as well as potential improvement the players may experience during the study, as it may translate to increased success at the home school.

Finally, funding for the study has the potential to be difficult to acquire as it experimental in nature and the volume of desired participants is high. There may need to be adjustments to player compensation, purchase of devices, and location of study dependent on availability of funds.

Future Research

To truly showcase virtual reality's potential, more research should be conducted, and studies published. Further research surrounding additional position players within football is suggested, as this may be beneficial to positions other than the quarterback. For example, a defensive back may benefit from studying and training in a similar manner. The defensive back position is "unquestionably the fastest and quickest [position] of the defensive unit, responsible for preventing long pass plays that take place further downfield from the linebackers" (Lewis, 2018, para. 1). They have to be able to adjust to changing offensive schemes and account for a number of possibilities.

Outside of American Football, international sports such as soccer could possibly benefit greatly from research aimed at the sport. Defensive players would be able to better prepare for high-performance strikers, strikers could better prepare for defensive tendencies, and even goal keepers could learn to predict how a striker may approach scoring a goal. Similar to American football, soccer players would be able to add mental training to their regimen without fear or risk of injury.

In addition to the use of VR devices, further studies should adjust the mental testing aspect of the proposed study to account for differences in sport. For example, it would likely be less important to focus on specific plays in sports like tennis or golf, but instead focus on how the player can adjust their technique depending on the opponent or course. These adjustments, while physical in nature, also have a heavy focus on mentally preparing for the moment. It would be important to integrate these parts of the game into the study to understand how athletes are affected.

Conclusion

With the framework provided, questionnaire produced, and background information showcased, there is a strong basis for implementing this proposed study. The ever-changing dynamic of athletes and trainers, how athletes train, and player safety hves increased the search for safer practices. While there is no guarantee that this research will definitively support that VR is an all-encompassing master training device, there is a strong case for its use as another beneficial tool for athletes in training. It is the hope that this research proposal will provide a solid template for those looking to conduct research on athletic training.

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Appendices

Appendix A

Wonderlic Test Example

The following is an example of what the Wonderlic Test may look like, and not an exact replica of the test itself (JobTestPrep, 2017).

<table>
<tr><th>Dimension</th><th>Factor and item</th></tr>
<tr><td>General Knowlodge/Following Instructions</td><td>The sixth month of the year is
A. August
B. September
C. January
D. June</td></tr>
<tr><td>Antonyms</td><td>SCRUPULOUS is the opposite of
A. Rigorous
B. Punctual
C. Negligent
D. Meticulous</td></tr>
<tr><td>Vocabulary/Acronyms</td><td>Does DIY mean “do it yourself?”
A. Yes
B. No</td></tr>
<tr><td>Word Comparison</td><td>ANTECEDE vs. PRECEDE
The meanings of these words are
A. Similar
B. Contradictory
C. Neither similar nor contradictory</td></tr>
<tr><td>Checking and Speed</td><td>How many of the five pairs listed below are exact duplicates?

<table><tr><td>Truman. H.W.</td><td>Trumen, H.W.</td></tr><tr><td>Salif, O.L.</td><td>Salif, O.J.</td></tr><tr><td>Grinberg, A.L.</td><td>Grinberg, A.L.</td></tr><tr><td>Havanos, B.G.</td><td>Havanos, B.G.</td></tr><tr><td>Lichtenstein, D.W.</td><td>Lichtunstein, D.W.</td></tr></table>A. 1
B. 2
C. 3
D. 4
E. 5</td></tr>
<tr><td>Disarranged Sentences</td><td>Arrange the following words so that they make a complete sentence. Is the rearranged sentence true or false?

not Winter seasons summer are and</td></tr>
</table>

	A. True B. False
Dimension	**Factor and item**
Deductive Reasoning	Black-haired people are kind. I am kind. I have black hair. A. Yes B. No C. Uncertain
Math Word Problems	Question 1: Five cookies cost $0.30. How much will 30 cookies cost? A. $1.50 B. $1.80 C. $2.80 D. $5.00 E. $30.00 F. None of the above Question 2: A train travels 100 feet every two seconds. How far will it travel in 36 seconds? A. 1670 ft B. 1836 ft C. 200 ft D. 286 ft E. 1480 ft F. None of the bove Question 3: Ariel, Alex, and Dana form a business agreement in which Ariel receives 20% of profits, Alex receives 70% of profits, and Dana receives the remaining 10%. The total profits for the month of June were $6,600. How much more would Dana receive if the profits were divided equally? A. $1,540 B. $1,820 C. $1,900 D. $2,180 E. $2,200 F. None of the above
Number Series	What is the next number in the series? 24 28 32 36 40 44 __ A. 40 B. 48 C. 24 D. 88 E. 42 F. None of the above

Appendix B

Testing Questionnaire

The following are a series of questions designed to understand how the subject view their own performance as it relates to defensive coverages, playbook knowledge, leadership qualities, and how the players perceive their own individual skills. This not a comprehensive list of criteria, and there are likely to be more questions needed to further evaluate the player's abilities and personal thoughts.

Dimension	**Factor and item**
Leadership qualities	I view myself as an honest leader? • Strongly agree • Agree • Neither agree or disagree • Disagree • Strongly disagree I view myself as a credible leader? • Strongly agree • Agree • Neither agree or disagree • Disagree • Strongly disagree Being committed is a <u>good</u> quality of a leader? • Strongly agree • Agree • Neither agree or disagree • Disagree • Strongly disagree What would be your greatest strength? What would be your greatest weakness? How could a leader fail? Tell me about a time when this happened to you. What kind of leader do you believe yourself to be? • Team leader (working for the team as a whole) • Coaching leader (teaching and supervising others) • Laissez-faire leader (minimal intervention, players do as they choose and see fit)

	• Visionary leader (learning from your teammates to become a better leader) • Autocratic leader (centered around yourself, having all authority and responsibility)
Dimension	**Factor and item**
	How do you motivate your team? How would you lead the team through a change?
Playbook knowledge	How would you rate your understanding of the playbook? • Very knowledgeable • Mostly knowledgeable • Somewhat knowledgeable • Not very well • Very poorly I would be able to run a play at random with efficiency. • Strongly agree • Agree • Neither agree or disagree • Disagree • Strongly disagree I have taken sufficient time to know and learn the playbook before practice. • Strongly agree • Agree • Neither agree or disagree • Disagree • Strongly disagree I have a strong, positive feeling about calling plays in the field of action. • Strongly agree • Agree • Neither agree or disagree • Disagree • Strongly disagree
Coverages	I am able to successfully read a defense during play. • Strongly agree • Agree • Neither agree or disagree • Disagree • Strongly disagree I feel like I can adjust a play after recognizing a defensive shift. • Strongly agree • Agree • Neither agree or disagree

	• Disagree • Strongly disagree Calling an audible is imperative to being a successful quarterback. • Strongly agree • Agree • Neither agree or disagree • Disagree • Strongly disagree Playing against zone coverage is more difficult than man-to-man coverage. • Strongly agree • Agree • Neither agree or disagree • Disagree • Strongly disagree

Appendix C

Participant Consent Form

Using Virtual Reality as a Training Device

INFORMATION SHEET FOR

PARTICIPANTS

Thank you for showing an interest in this project. Please read this information sheet carefully before deciding whether or not to participate. If you decide to participate, we thank you. If you decide not to take part, there will be no disadvantage to you of any kind and we thank you for considering our request.

What is the Aim of the Project?

The goal of the study is to show the viability of using virtual reality as an additional training device in sports. It will be used to provide extensive and proven research so that trainers, coaches, organizations, and individuals can make an informed decision as to whether they would like to pursue using VR as a device to enhance performance.

What Type of Participants are Needed?

This study seeks NCAA level quarterbacks from all divisions, ranging in age from 18-23 years old. Due to the high volume of NCAA quarterbacks, the study seeks to test roughly 474 total athletes to provide thorough and extensive proof of VR's viability.

What will Participants be Asked to Do?

Should you agree to take part in this project, you will be asked to .....

Perform a variety of mental and physical tests to determine your abilities before, during, and after the study has been completed. Examples of such testing include various drills and techniques to improve performance, mental testing including the Wonderlic Test and Leadership questionnaire.

In addition to traditional drills, some participants will be asked to use one of the selected VR devices as part of the training process. These devices utilize a combination of prerecorded videos and digital exercises.

Please be aware that you may decide not to take part in the project without any disadvantage to yourself of any kind.

Can Participants Change their Mind and Withdraw from the Project?

You may withdraw from participation in the project at any time and without any disadvantage to yourself of any kind.

What Data or Information will be Collected and What Use will be Made of it?

Data collected from participants include generic contact information such as name, email, and phone number. In addition to this, participants will answer questions related to

leadership, their knowledge of various plays before, during, and after the study, and a simple mental test. This data will be collected and analyzed, and destroyed at the conclusion of the study.

Results of this project may be published but any data included will in no way be linked to any specific participant.

You are most welcome to request a copy of the results of the project should you wish.

The data collected will be securely stored in such a way that only those mentioned above will be able to gain access to it. At the end of the project any personal information will be destroyed immediately except that, as required by the University's research policy, any raw data on which the results of the project depend will be retained in secure storage for five years, after which it will be destroyed.

What if Participants have any Questions?

If you have any questions about our project, either now or in the future, please feel free to contact either:-

[*Name of Student Researcher*] or [*Name of Supervisor*]

Department of [.....] Department of [.....]

University Telephone Number:- [.....] University Telephone Number:- [.....]

This project has been reviewed and approved by the Ethics Committee

of the [NAME OF YOUR INSTITUTION]

Using Virtual Reality as a Training Device

CONSENT FORM FOR

PARTICIPANTS

I have read the Information Sheet concerning this project and understand what it is about. All my questions have been answered to my satisfaction. I understand that I am free to request further information at any stage.

I know that:-

1. my participation in the project is entirely voluntary;

2. I am free to withdraw from the project at any time without any disadvantage;

3. the data [*video-tapes / audio-tapes*] will be destroyed at the conclusion of the project but any raw data on which the results of the project depend will be retained in secure storage for five years, after which it will be destroyed;

4. I understand I may experience some discomfort during the study, including, but not limited to nausea, soreness, exhaustion, and mental fatigue;

5. the results of the project may be published but my anonymity will be preserved.

I agree to take part in this project.

....

(Signature of participant) (Date)

This project has been reviewed and approved by the Ethics Committee

of the [NAME OF YOUR INSTITUTION]