ATHLETE SORENESS SELF-REPORTING FOR INCREASED SPORTS RECOVERY

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Abstract

Prior exploratory research into a division one, southeastern, public University's football team revealed that the athlete identity, warrior mentality, cognitive dissonance model, and health disclosure decision-making model were barriers to their players' self-reporting soreness information. Soreness data collection is used to help training staff understand what is going on with their team members physically and help players understand what they need to focus on recovery-wise to be at their best potential. Using the exploratory research as a guide, this study looked to change existing soreness data collection strategies and implement a new soreness communication plan to, hopefully, increase soreness self-reporting and player-led recovery initiatives. Using individual interviews and observational data, results were collected on a weekly basis from all 135 players on the roster throughout the course of the 2024 football season. Descriptive statistics were used to compare the results from the 2024 season to data collected in the 2021-2023 seasons. Results found that interpersonal communication between players and The Applied Science Lab staff led to an increase in soreness self-reporting by players and an increase in player-led recovery usage. Future research should consider creating a longitudinal study to verify the impacts of a communication plan on soreness, self-reporting, and recovery usage. The study materials could also be used to evaluate the impacts of the communication plans on other sports, examining the role training schedules and sex play in soreness, self-reporting, and recovery usage.

Athlete Soreness Self-Reporting For Increased Sports Recovery

Introduction

Athletes, team staff, and schools all want their athletes to be eligible to play and to be able to play at their peak performance level. However, athletes can only play at their peak if they are healthy in all aspects: physically, mentally, and emotionally. Nowadays, top-level athletes train multiple times a day, placing a tremendous amount of stress on their bodies. Without proper recovery from exercise, athletes will become chronically fatigued, which puts them at a predisposition for injury (Orunbayev, 2023). Low-intensity activities, such as stretching, massages, and contrasting temperatures (e.g., cold therapy to warm therapy), have been found to accelerate an athlete's recovery time. However, at the college level, recovery strategies are player-led and driven. Player-led indicates that it is on the athlete to set aside time in their schedule to participate in recovery activities to speed up their rehabilitation process rather than wait for a trainer or coach to push them (Wilson & Young, 2024; Orunbayev, 2023). . For example, an athlete with a sore calf muscle may choose to utilize the ice bath, followed by using compression sleeves. This player-led nature further perpetuates the growing issue of underreporting soreness, which often leads to injuries (Rees et al., 2022). As Rees et al (2022) forwards, athletes may under report due to a lack of information provided to them on injuries and injury prevention protocol.

The lack of self-reporting of injuries is not an uncommon problem in athletics. Athletes are known for pushing through soreness, minor fatigue, and injuries, noting that it is part of being an athlete (Jessiman-Perreault et al., 2016). Specifically, rather than letting their team officials know and taking the next steps in recovering their bodies, athletes would rather continue to push through it, even if it means risking further injury (Jessiman-Perreault et al., 2016).

Previous research has found that anywhere from 70-80% of athletes report being willing to play through pain/injuries, rather than acknowledging it and taking recovery steps to rehabilitate it (Jessiman-Perreault et al., 2016; Whatman et al., 2018). This statistic highlights the need for a more effective soreness screening process to help athletes feel more comfortable disclosing how they are feeling, to hopefully mitigate soreness from becoming worse or resulting in a detrimental injury.

To help clarify athlete load discussed in this manuscript, we organize it into two specific subsets: the *rehabilitation/recovery load* and the *training/play load*. The rehabilitation/recovery load consists of the players taking steps to allow their bodies to recover from the stress of exercise prior to their next sports-related activity. The training/play load refers to sports performance, with the hopes that players are playing at their peak performance level (McClean et al., 2024). Without the proper rehabilitation/recovery load, athletes cannot perform at their peak in that training/play load.

The interconnectivity of these loads suggests the need for a measurement tool to help bridge the gap between sports performance and sports recovery; the training room should not be a place athletes avoid unless injured. However, to establish an athlete's performance potential and injury risk can be difficult due to all of the responsibilities and burdens of being an athlete (Sansone et al., 2023). New and developing technology that exists today generates the need for research into how soreness communication and tracking methods influence athletes' self-reported soreness and recovery behaviors. This is why, Athlete Reported Outcomes (AROs), should be implemented as they allow sport team officials to go straight to the athlete and discuss their well-being in order to monitor how the athlete is performing and feeling. This leads to a more informed and well-rounded decision-making process for the athlete (Sansone et al., 2023).

AROs are measurements reported by the athlete that include a variety of aspects such as fatigue, stress, recovery performance, sleep quality, and soreness reporting (Sansone et al., 2023; Tavares et al., 2018; O'Brien et al., 2019). This means that athletes are asked by athletic trainers or similar positions (e.g., student athletic trainer) how the athlete is feeling and provide individual perspectives on their well-being. This type of ARO reporting is loosely linked with recovery (Sansone et al., 2023; Tavares et al., 2018) as athletes should be taking the necessary steps to improve their ARO measurements if necessary. For instance, prior research has supported that fatigue reporting is an important indicator of performance potential and injury risk if athletes choose to push through that fatigue (Draper et al., 2021; Sansone et al., 2023).

Relying on athletes to self-report data presents a unique set of barriers, with the athletes clouded by fears of losing their sports identity, being pulled from a game, and being seen as weak (Cranmer & LaBelle, 2018). Often, this fear is tied to athlete identity, which can lead to underreporting injuries and soreness (Jessiman-Perreault et al., 2016; Whatman et al., 2018). This phenomenon can make it difficult to ensure athletes' self-reporting of soreness.

To increase soreness reporting at the author's institution, this study will build off of preliminary data collected and focus on improving the ARO reports by establishing a soreness communication plan. Specifically, a soreness communication plan will be tested to understand if the implementation of such a communication plan at the collegiate level will increase soreness self-reporting numbers, when compared to data previously collected in football seasons in 2019-2023, and increase player-led recovery usage, when compared to data previously collected in football seasons in 2019-2023. More specifically, this paper looks to highlight the possibility of assisting athletes in their process of injury and soreness reporting to provide them the opportunity to perform at their highest level throughout the season.

It is imperative to understand and examine communication strategies used to encourage such reporting in order to improve soreness reporting and decrease injuries throughout the football season. Therefore, this study will build off of previously collected data and design, disseminate, and measure the effectiveness of strategic messages to athletes through TeamWorks – an existing communication application used by many professionally managed sports teams – that is guided by athlete identity, cognitive dissonance theory, and the health disclosure decision-making model. These frameworks and theories are used together to fully understand the athlete self-evaluation process for self-disclosure on soreness and how to most likely increase self-reporting. The goal of this study is to use strategic messaging prior to collecting AROs and compare those results to athlete behaviors in order to get a fuller picture of athlete performance status. Successful message dissemination will lead to muscular soreness reduction and recovery time improvement through the use of recovery modalities. What follows will forward each framework as well as athlete reporting behaviors before forwarding the research questions and proposed methods.

Literature Review

College athletes navigating high levels of soreness or an injury have a myriad of decisions to make. Some of the major decisions revolve around the soreness or injury itself, whether or not to report, and if reported then when they can return to play. To fully grasp what it is athletes grapple with when sore or injured, it is important to understand what AROs are and how athlete identity, cognitive dissonance, and the health disclosure decision making model may influence their recovery process.

Athlete Reported Outcomes

Recovery is defined as the time it takes for the body to return back to its normal state post-exercise. If complete recovery is not achieved prior to the next exercise, an athlete will fatigue quicker and may place their body at an increased risk for injury (Gallagher, 2017). Athletes can take steps to quicken their recovery time through the use of recovery modalities like stretching, massages, cold and heat therapy, hyperbaric oxygen therapy, and general relaxation practices like meditation and sleep (Orunbayev, 2023). The connection between soreness and recovery may not be an automatic one made by athletes as they may not know what modalities to use or how they may benefit them in their recovery process (Barnett, 2006).

AROs consist of measurement tools reported by the athlete, such as fatigue, stress, recovery, performance, and sleep quality (Sansone et al., 2023). These measures provide a unique insight into how the athlete feels for a more well-rounded decision-making process for the athlete's well-being and performance (Gallagher, 2017). *Fatigue* can be classified as physical (whether that be muscular or just an overall feeling of tiredness), mental, or emotional (Draper et al., 2021; Sansone et al., 2023). One way an athlete's physical, muscular fatigue and recovery status can be evaluated is through soreness tracking. *Soreness* is defined as the musculoskeletal stress on the body after exercise as part of the psychophysiological adaptations to exercise, typically musculoskeletal growth and development (McClean et al., 2024; Draper et al., 2021). Soreness tracking looks to identify when an athlete is sore, establish its validity, and guide recovery, practice, and game plans to avoid major injuries (Draper et al., 2021; Sansone et al., 2023). Notably, increased soreness often leads to increased fatigue. In contrast, increased fatigue leads to injury, and primary injuries are known predictors for future secondary injuries, often due to compensation from the first injury (McClean et al., 2024). Therefore, tracking soreness allows sports health professionals to be more aware of the training load that their athletes' bodies are

under to be able to push tailored recovery and rehabilitation strategies, ultimately decreasing the risk of overuse injuries.

To date, AROs, including soreness tracking, present issues with validity and reliability, as athletes may not always report the most accurate information; additionally, the subjective nature of AROs results in a lack of standardization for self-reported scores (Gallagher, 2017), meaning that there is no standard for what a fatigue score of one is versus a ten. Currently, there is no accepted or standardized measurement tool for tracking soreness, so evaluating how changing soreness tracking and communication impacts athlete-led recovery usage is imperative.

More specifically, exercise science and analytics is still a relatively new and rapidly developing field, with data analysts providing sports team professionals with information about an athlete's physical, mental, and emotional well-being to aid performance and medical planning processes (Sansone et al., 2023). Sports team professionals, consisting of position coaches, strength and conditioning coaches, sports medicine professionals, data analysts, and recovery professionals, all work together to make decisions regarding recovery, treatment, and performance plans for every athlete on their roster. With over one hundred athletes on a collegiate football team roster, tracking every athlete and their perceived physical status can be cumbersome and lead to some players being overlooked. Healthcare research has documented that the number of professionals working with an individual positively correlates with the risk of interprofessional communication errors and poor outcomes (Foronda, 2016; Gleeson, 2023). As the number of professionals working with one person increases, miscommunication and, subsequently, poor outcomes also increase. Due to the large number of professionals working on a sports team with the athletes, interprofessional miscommunications can arise, indicating the need for a tool to connect the professionals. Performance tracking tools and AROs help make

that process more efficient, aiding in keeping athletes safe and at their peak performance potential.

More recently, performance tracking tools, like GPS tracking and isolated muscle strength assessments, have been used to evaluate the physical performance and health status of athletes (Tavares et al., 2018; O'Brien et al., 2019). Tracking performance-tracking data such as max speed, average speed, force, and player load over time provides valuable insight into the usual performance of an athlete so that coaches and sports medicine professionals can know when an athlete is off and may be at an increased risk for injury (O'Brien et al., 2019). Additionally, performance-tracking tools can measure neuromuscular force generated in common sport-specific muscle groups, like groin, hamstrings, shoulders, ankle, and neck. Tracking athletes, through these assessments, for weeks or even months at a time, establishes trends that can be used to set individual standards and injury risk criteria (Theodoropoulos, 2020).

These measurement tools have established personalized standards that athletes should hit to not be at an increased risk for injury, so repeated neuromuscular tests can help track fatigue in athletes (Tavares et al., 2018). For instance, if an athlete consistently averages a certain force production but drops substantially one day, that raises a red flag to question the scenario causing that change: was the sport activity that day requiring max speed, was the athlete simply not as motivated that day, or was the athlete experiencing soreness and at an increased risk for injuries? Fatigue, physical, mental, or emotional, decreases performance and can put an athlete at an increased risk for injury (Theodoropoulos, 2020). Additionally, if an athlete drops below the standardized score one week for a neuromuscular force assessment, then sports team professionals can be informed to take steps to minimize the impacts of fatigue/soreness (Tavares et al., 2018). Performance tracking tools provide analytical data with a relatively high reliability

and validity score. The analytical tools also raise questions that can lead to a conversation with the athlete about AROs.

Given that most recovery strategies are player-led at the top levels of athletics, players need to be informed on the connection between soreness and recovery, as well as steps they can take to prevent and reduce their muscular soreness so that they know that reporting soreness is not a bad thing and that they do not have to power through everything. However, one barrier to improving this issue is how one's athletic identity influences athletes' disclosure decisions.

Athlete Identity and Warrior Mentality

For many collegiate athletes, their sport shapes who they are; their sport is their identity, leading to psychological distress when a threat of losing their sport arises (Cranmer & LaBelle, 2018). Simply put, for an athlete to be taken out of the game, practice, or worse, kicked off the team threatens their most salient identity, being an athlete. The fear of losing their sport and a fundamental part of who they are, even for a few days or weeks at a time, leads athletes to avoid reporting injuries to coaches and trainers (Whatman et al., 2018). The lack of self-reporting of injuries is not an uncommon problem in athletics. With "over 80% of players reported hiding an injury to continue playing," it is vital to understand why athletes continue to avoid self-reporting, putting themselves at risk for greater injuries at times (Whatman et al., 2018, p. 3).

Brewer (1993) and his colleagues introduced the idea of the athlete identity in the 1990s, examining the effects of social identity, exclusivity, and negative affectivity on the strength of athlete identity. The study was the first of its kind to include an athlete identity measurement scale (AIMS scale). The scale quantifies the effects of all the factors that can influence the athlete's identity. The strength of the identity depends on what factors are at play, as positive factors tend to lift the identity up, and negative ones tend to tear the identity down (Brewer et al.,

1993). For example, a positive social factor would be the use of positive affirmations from a coach, saying things like “Great job” or “I’m so proud of you.” Positive affirmations inflate the athlete’s identity because they cause the athlete to feel better as an athlete in the athlete role. On the other hand, something like not making the travel list or being named the back-up role on a depth chart deflates the athlete identity because it makes the athlete feel like they are less than their peers in a competitive environment. Since then, additional researchers have focused on the effects of the athlete identity on different aspects of sports, especially the psychological effects of injuries and sports retirement (Lally, 2007; Grove et al., 1997; Giannone et al., 2017).

Athlete identity is the degree to which a person labels themself as an athlete. A person with a high athlete identity is known to interpret information and make decisions from an athletic perspective, view their sport and performance as being of high importance, and perceive their own athletic performance highly (Burns et al., 2012). Athletes spend their childhoods developing their skills, gaining confidence in what they do, and interacting with other athletes, reinforcing, oftentimes, that their sport is their life. Part of athletics if facing adversity, injury or otherwise, and building personal resilience skills as a result (Fletcher & Sarkar, 2021). The extent to which their sport and athletic performance are their identity dictates how they deal with said adversity. Viewing oneself in only the athlete role can lead to detrimental psychological and emotional responses when a threat to that athlete’s identity arises because they are not prepared to view themself or function as anything but the high-level athlete they were used to being (Lally, 2007).

Athlete identity research began within psychology literature, with researchers looking into how sport orientation affects the identity of adolescent athletes (Daniels et al., 2005; Martin et al., 1995). Since then, psychology research into athlete identity has grown, focusing on the post-sport transition and the effects of athlete identity on athlete motivation and emotions;

post-sport transition psychology research focuses on how one's athlete identity can influence their ability to transition out of their sport and into their next phase of life (Cosh et al., 2013; Lavallee et al., 1997). Most recently, athlete identity has been evaluated by its psychological effects on achievement perception, sportsmanship/sport participation levels, and aggression (Lamont-Mills & Christensen, 2006; Yukhymenko-Lescroart, 2018). Outside of psychology literature, athlete identity has not been evaluated extensively. On the more sports medicine side of things, athlete identity has been researched in how its effects on the way an athlete handles an injury (Renton et al., 2021). However, athlete identity has not been used as a guidance for preventative sports medicine care like with its influence on soreness reporting and sports recovery.

Closely related to athlete identity is the idea of warrior mentality present in sports. The warrior mentality is the idea that pain is part of sports and it requires the athlete to "toughen up" up and keep pushing through the pain; this mentality of playing through the pain at all costs complicates soreness reporting, recovery initiatives, and injury mitigation (Salmon et al., 2022). Injury heroism is an ideology that promotes injury as an inevitable aspect of sports and a symbol of courage and strength (Tricker, 2000; Zanin, 2018). A previous study into injury disclosure documents a division one football player as saying, "Yeah, they say it's part of the game. You're gonna get bumps and bruises, but you gotta push through it, that's what they say" (Zanin, 2018, p. 268). The injury heroism ideology normalizes soreness and injuries, creating the mindset that athletes must push through to prove their strength.

Current research into the warrior mentality exists primarily in the sector of social media communication research. Social media research into the warrior mentality has focused on how people, like broadcasters and fans, communicate about sport on social media, and how that

communication has furthered the warrior mentality expectation and mental health concerns in athletes (Beasley & Johnson-Pack, 2024; Jenkins, 2013). Additional warrior mentality research exists in the portrayal of injuries in the media; the portrayal of injuries in sport as heroic has been a focus of research for decades (Berg, 2002; Hutchinson & Kleiber, 2000; Zanin, 2018). There is a research gap into how the warrior mentality affects athlete disclosure to sport support staff, offering a unique opportunity for future research.

An understanding of warrior mentality and athlete identity is crucial to alleviating the cognitive dissonance that hinders soreness and injury disclosure. While athlete identity research is somewhat prevalent, there is very limited research on the cognitive dissonance theory in sports and the role it plays in the injury-reporting process (Markus & Kunda, 1986; Rougeau et al., 2025). The cognitive dissonance produced between athlete identity, an injury, and the threat of losing their sport represents one possible reason athletes do not self-report so many injuries.

Cognitive Dissonance Theory

Cognitive dissonance theory was first introduced by Festinger (1957) and built from previous consistency theories. Miller et al. (2015) elaborates on Festinger's original theory, stating that "cognitive dissonance theory posits that individuals seek to maintain consistency among multiple cognitions (e.g., thoughts, behaviors, attitudes, values, or beliefs). Inconsistent cognitions produce unpleasant states that motivate individuals to change…" (Miller et al., 2015, p. 1). Inconsistent cognitions generate an uncomfortable dissonance, that individuals take action to balance out, as all human beings desire mental consistency and balance.

One of the biggest and most easily understandable examples of cognitive dissonance within the general population is smoking **(**McMaster & Lee, 1991**)**. An individual may currently smoke if they believe that they will continue to be okay. However, if they believe that smoking

will have adverse effects on their health, producing a dissonance between their actions and their beliefs, then the individual will usually take steps to stop smoking (behavior change). For athletes, those cognitions tend to revolve around their sport and sports performance. They value their sport and playing time, they believe that their sport is who they are, and they do whatever is required of them to stay on that field. Per the cognitive dissonance model, an injury serves as the action; the belief that reporting the injury will get them pulled is the belief, creating dissonance in athletes that causes them to not report injuries.

This dissonance is compounded at the collegiate level as athletes have a role as students, athletes, and now as influencers with the new name, image, and likeness (NIL) initiatives. The athlete role and now influencer role, rely on themselves to perform their sport and post on social media to gain a following. Simply put, the athlete playing their sport is what makes them an influencer, monetizing the value of their sport and that part of their identity (Su et al., 2022). Therefore, without their sport, many athletes would not be influencers or earn income from social media or advertising. It is now, more than ever, a cognitive decision to report a soreness or injury as athletes now risk more than just playing their sport, but possibly NIL deals as well (Harris et al., 2021). As such, when adversity presents itself, the prospect of losing the sport they love and now their NIL career, becomes too much for many athletes, leading to cognitive dissonance and distraught feelings.

In the 1980s, the ideas of traditional vs. alternative dissonance causes arose (Miller et al., 2007). Traditional dissonance involves forced compliance or persuading someone to do something that they would not normally do. Alternative dissonance includes hypocrisy studies, focusing on dissonance that arises when someone does not take their own advice on a certain behavior (Miller et al., 2007). For athletes, traditional dissonance may come into play if

check-ins or physical exams with sports medicine staff are required. If an athlete begins to associate sports medicine with restrictions from play, the dissonance between reporting injuries and their sports identity grows. Hypocrisy may come into play if an athlete tells his or her teammate to be proactive with injuries and verbalizes discomfort with sports medicine to catch it early but then does not follow their own advice. Knowing what could be causing cognitive dissonance in athletes, hindering them from reporting injuries, can help lead researchers to find varying ways to combat the dissonance for increased self-injury reporting.

Health Disclosure Decision-Making Model

The health disclosure decision-making model (DD-MM) states that there are three assessments individuals make when deciding to either disclose a health outcome or conceal it: an information assessment, a receiver assessment, and a disclosure efficacy assessment (Greene et al., 2012). The DD-MM can be used to help sports team professionals understand why their athletes make the decisions they make when it comes to AROs.

Research in the early 2000s argued that the specific information in question has no impact on whether or not an individual chooses to disclose it or not (Kelly, 2002; Petronio, 2002). However, DD-MM counters this stance, stating that what is being disclosed plays a huge role in whether or not an individual chooses to disclose (Greene et al., 2012). When choosing between disclosure and concealment, an individual evaluates the information according to five different but interrelated factors: stigma, prognosis, symptoms, preparation, and relevance (Greene et al., 2012). If an individual views the information as having roots in stigma, then their likelihood of disclosing that information decreases (Cranmer & Labelle, 2018).

For athletes, stigma may come into play with soreness reporting if they are worried about being viewed as weak or less than if they report soreness rather than “toughing it out” or

“pushing through the injury” (Zanin, 2018, p. 268). A common phrase in athletics is “no pain, no gain,” and this philosophy creates the stigma of warrior mentality in sports. The athlete’s perception of this stigma may play a role in ARO reporting (Zanin, 2018, p. 268). Additionally, he stigma and presence of warrior mentality pushed in sports can impact how athletes perceive their symptoms and prognosis (Zanin, 2020).

Perceived symptoms have to due to with how the indivdual views their personal symptoms, being part of the problem or not; perceived prognosis has to due with the individual's perceived outcome of the health behavior or disease and what will be done if they do disclose it (Greene et al., 2012). For athletes, perceieved symptoms can be connected to the stigma in the sense that if athlete’s view pain as being part of the sport (going back to warrior mentality), then they may be less likely to disclose (Wallace et al., 2022; Chrisman et al., 2013; Sanderson et al., 2017; Wallace et al., 2022; Zanin et al., 2020). Additonally, prognosis is tied to the athlete's identity. A major deterrent for sports injury reporting is the fear of getting benched and losing that part of their identity (Cranmer & Labelle, 2018; Chrisman et al., 2013; Sanderson et al., 2017; Wallace et al., 2022; Zanin et al., 2020). Symptoms have to do with visible or invisible, and whether or not the individual even realizes that they are having symptoms that are worth reporting (Greene et al., 2012). Preparation involves whether or not an individual has time to prepare and wrap their mind around the health outcome, so whether the disease or injury is anticipated or unexpected. Individuals who have time to understand their symptoms and what they mean have a greater likelihood of disclosure (Cranmer & Labelle, 2018; Turner et al, 2021; Zanin et al., 2020). For athletes, educating them on what soreness tracking is used for and what will happen if they say they are sore, explicitly explaining that reporting soreness does not mean you will get benched, could be a mitigating factor to a lack of reliability in soreness tracking.

Relevance of disclosure indicates that individuals are more likely to disclose if they perceive the disclosure as having impacts on others, namely as protecting others (Greene et al., 2012). However, the relevance factor differs significantly with athletes. For athletes, they tend to view relevance as whether or not the disclosure will affect their team. If an athlete views the disclosure as hindering the team or as a barrier to the team doing well, they are less likely to disclose (Cranmer & Labelle, 2018; Chrisman et al., 2013; Zanin et al., 2020).

The receiver assessment of the DD-MM takes into consideration two factors: the impacts of the relationship between the individual and the receiver and the anticipated response of the receiver (Cranmer & Labelle, 2018). Previous research regarding young adults and various health-related outcomes has found that building a rapport and establishing trust will increase disclosure (Hershkowitz, 2011; Simone et al., 2022). In the athletic setting, the anticipated receiver for soreness data would ultimately be their coaches and sports medicine teams. Previous research documents the importance of positive coach-athlete relationships and a caring sports environment (Jackson, 2009; Millroy, 2019). However, little research has been done on the relationships between sports medicine professionals and athletes and how these relationships impact disclosure. Based on coach-athlete relationship studies (e.g., Jackson, 2009; Jowett & Cockerill, 2003; Mageau & Vallerand, 2003; Millroy, 2019), it is reasonable to believe that establishing trust and understanding between the athletes and the sports medicine professionals could help the athletes feel more comfortable disclosing soreness. How the athlete anticipates the response of the coaches and sports medicine professionals is the next step in the receiver assessment process (Cranmer & Labelle, 2018).

Disclosure efficacy assessment is an internal assessment by the individual to decide if they feel like they have the confidence and the skills required to disclose the health-related

outcome (Greene et al., 2012). Previous research has indicated that high self-efficacy is linked to greater disclosure in athletes (Krochus et al., 2014). Giving athletes the confidence they need to report soreness and injuries is the first step in increasing disclosure. In athletics, athletes need to feel comfortable, confident, and able to report soreness or injuries. Understanding the social barriers and subconscious disclosure reasoning processes of athletes can provide coaches and sports medicine professionals with invaluable information on how to better approach AROs for more reliable results.

Soreness

Sports training is intended to push the body until adaptations take place. Following a strenuous workout or game, an athlete experiences systemic adaptations throughout each of the body systems: neuromuscular, endocrine, and metabolic (Draper et al., 2021). Following an intense workout, microtears occur in the muscle fibers as part of the adaptation process (which allows you to get stronger). The body views these tears as damage, responding with local inflammation, which an individual feels as pain and through decreased range of motion. That pain is known as delayed onset muscle soreness (DOMS). DOMS tends to peak one to three days after the workout and will slowly get better in the days following. DOMS can decrease sports performance by decreasing the range of motion, force, torque, and shock absorption. It can increase injury risk through decreased shock absorption and movement compensations made by athletes to avoid pain (Cheung, 2003). Systematic adaptations are required for an athlete to see improvement. However, an athlete can be pushed too far, physically, mentally, or emotionally, causing detrimental outcomes instead of adaptation; it is the staff's job to find the optimal training load for improvement, balancing training with recovery, to avoid overworking their

athletes (Theodoropoulos, 2020). Athletes can be monitored through their acute fatigue response to ensure recovery time is balanced with the training load (Saw et al., 2016).

Fatigue and soreness can be tracked objectively using biomarkers like VO2 max and creatine kinase levels. VO2 max testing requires the athlete to run or bike to exhaustion while a spirometer measures oxygen consumption. Creatine kinase levels are tested through a blood draw. High levels indicate muscle breakdown, a sign that recovery is still occurring, and injury risk may be elevated. Neither of these objective measures are efficient measures for testing fatigue in a sports pre-practice or pregame setting, which is when staff would need the information. Additionally, biomarkers fail to look at an athlete holistically and do not provide insight into why an athlete is off their game (Saw et al., 2016); without knowing the why, it can be hard for sports team professionals to make the best decisions for their athletes. AROs include the athlete's perspective, which, when paired with objective data, can provide a more holistic look at the athlete and insight into why they may not be performing at their best (Gallagher, 2017).

The frameworks of cognitive dissonance theory and the health decision-making model, as well as understanding athlete identity and soreness, provide the background understanding of barriers to using AROs. Implementing a new soreness questionnaire that takes steps to mitigate the barriers, explained through cognitive dissonance theory and the health decision-making model, is expected to create a more effective tracking system, leading to more informed sports team professionals and, subsequently, fewer injuries. As such, three research questions are proposed to help build a project that increases soreness reporting in a football team through improved communication:

RQ1: Does soreness self-reporting increase with an open-ended, non-specific interview

question?

RQ2: Does player-led recovery usage increase with the addition of weekly updates on overall team status and educational materials?

RQ3: Does the number of players who report and utilize recovery modalities each week increase with the addition of weekly updates on overall team soreness status and educational materials?

Methods

Exploratory research was conducted during the summer of 2024 with the university football team of interest to uncover the barriers to soreness self-reporting with the current soreness tracking system. Open-ended, semi-structured interviews were conducted with 51 total football players to collect the base-level information the football players hold, surrounding soreness reporting and recovery in an effort to reveal their barriers to self-reporting and recovery usage. The sample population included representation from all position groups (quarterbacks (QBs), running backs (RBs), wide receivers (WRs), tight ends (TEs), offensive line (OL), defensive line (DL), defensive backs (DBs), and special teams (STs)) and from all academic years (first through sixth years). Some of the questions proposed to the players were as follows: "What does soreness mean to you," "How does soreness and pain differ for you," "Why do you think we collect information on your soreness," "Tell me about a time in which you may have not told us when something was bothering you," and "How do you determine what to report?" Athletes were anonymized by given random numbers, as a way of preserving their anonymity and confidentiality during the reporting and analyzing of their resposnes.

For the question, "What does soreness mean to you," the research team received a few different answers where in general the team associated soreness with a general feeling of

discomfort, indicative of overuse. Athlete 12 reported: “It’s when you overuse your body and a certain muscle tightens up and gets to hurting,” and athlete 42 reported: “To me, soreness is anytime a muscle is tense and it's where it's essentially stopping me from performing at my best,” when they were asked what soreness was. While the results were consistent, and mostly accurate, the answers prompted a follow-up question that yielded findings that had greater impacts on the needs of the study.

Going along with that first question was the follow up question of, “How does soreness and pain differ for you.” Athlete 23 reported: “Umm I would say soreness is different from pain cause soreness is more of a day-to-day thing. Whereas pain can be from an injury and more of a long-term thing,” athlete 38 reported: “Pain is usually from some sort of injury or contact. Soreness is usually just from like normal movement. It’s not like something out of the ordinary,” and athlete 30 reported: “Soreness is manageable, and you can manage it. But you can’t control pain because it’s always going to be there until something is healed. But you can prevent soreness almost immediately most times,” when asked what they saw the difference to between pain and soreness to be. About 90% of the athletes agreed that soreness is just a normal part of day-to-day sport activity and that it is less severe than pain. The idea that soreness is something that can be pushed through, without discussion, furthers the stigma and warrior mentality mentioned previously. Improper understanding of symptoms and prognosis indicates the need to evaluate the soreness disclosure process with the health disclosure decision making model.

For the question, “Why do you think we collect information on your soreness,” athlete answers varied tremendously compared to the previous questions. 50% of the athletes viewed soreness collection as a tool for tracking load and performance potential. Athlete 22 can be quoted as saying, “Probably to see the demand on people’s bodies throughout and to see like how

hard the workouts are over the years and compare that data." While performance is a focus of the Applied Science Lab, the focus of interest for soreness collection is actually helping the athletes recover and track the effectiveness of the recovery strategies. 45% of the athletes identified that there is a connection between soreness and recovery, however, they often (25% of the time) linked it to injury prevention and mitigation which is not the exact purpose of recovery. Athlete 33 can be quoted as saying, "I think you measure our soreness cause too much of it could probably lead to injuries." The purpose of the Applied Science Lab's recovery initiative is to instead help athletes be at their peak performance potential. Athletes' discrepancy in understanding the connection between soreness reporting and the recovery usage pushed by the Applied Science Lab, indicating a need for greater communication on soreness and recovery strategies that can be used for soreness alleviation/mitigation.

For the question, "Tell me about a time in which you may have not told us when something was bothering you," 15% of the athletes reported that a major barrier to disclosure for them is the fear of getting pulled from a practice or game. Athlete 44 can be quoted as saying, "Yeah last season in practice or something I think I may have tweaked my hamstring or something and I think it was like a big week, a big game, I just didn't want to get pulled out of practice so I just pushed through out there so I wouldn't have to sit out and I'd be able to play." This finding furthers the ideas of athlete identity and warrior mentality as warriors to soreness disclosure. Cognitive dissonance may also come into play with the athlete's deciding between what is bad enough to disclose versus what is not.

For the question, "How do you determine what to report," 60% of the athletes reported that they have an internal threshold that the discomfort has to reach for them to disclose. In other words, the discomfort has to be bad enough that they think they won't be able to work through

that discomfort on their own without team staff noticing for them to disclose the soreness. Athlete 29 can be quoted as saying, “I think if it’s really bad. Cause like some stuff can just hurt just from working so you just keep working through it and it’ll get better over time.” This finding represents warrior mentality, and the mindset of pushing through until they can’t.

Following the interview analyses, three major themes were identified: athlete identity, warrior mentality, and a knowledge gap on the topic of soreness (i.e., what it is, why team support staff care about it, and how soreness is connected to player-led recovery). Health disclosure decision making model and cognitive dissonance theory were identified as possible theories and models of interest to make sense of these themes and disclosure barriers. These themes prompted a literature review of previous research on athlete identity and warrior mentality, cognitive dissonance, health disclosure decision-making model and soreness tracking in an effort to design a health communication plan that could work to close the knowledge gap found amongst this university team’s players and increase self-reporting and recovery usage.

Study Design

The project will track soreness reporting and recovery usages in the 2024 Fall football season as a means to measure the implementation of a soreness communication plan. Weekly updates and resource flyers will be pushed out via the football team’s communication platform - TeamWorks application. This study will use athlete identity, cognitive dissonance theory, and the health disclosure decision-making model as a theoretical framework to potentially mitigate self-reporting barriers, identified during the exploratory research, and guide the communication strategies implemented in TeamWorks to the public university’s football team.

Participants and Procedures

Based on the exploratory research conducted prior to this study, we have identified that athletes may need to be asked a broad question with non-specific wording during their weekly check-ins in order to work around the various meanings of the word soreness that different athletes hold. The specific use of the word soreness may have led to underreporting due to the varied definitions of soreness on a player basis. These previous findings have helped influence and change the Monday morning check-in question from "*What is sore today*" to "*What is bothering you today?*" The phrase "bothering" was chosen over the phrase soreness in an effort to gain more inclusion and work around the aforementioned inconsistencies in the definitions of soreness held by the participants. In light of these findings, the current study will implement this change in communication from the applied science team and collect data each Monday morning during the 2024 football season.

With the information collected from the athletes, we will use their insight to create educational flyers to inform the athletes on what to do for each specific body part to most effectively recover. Emails containing an update on the overall reported percentage for the team, the top five most sore body parts, and how those soreness reporting numbers compare to the same week in season to previous seasons will be sent out Monday nights, and soreness alleviation options for those top five areas will be included as attachments to the email; subsequent recovery data will be collected throughout the week and analyzed to compare reporting and recovery usage behaviors of athletes from the 2019-2024 football seasons. To do so, throughout the week, the research team will collect data every time a player completes a recovery modality, keeping track of the total number of recovery usages and the specific modalities the athlete chooses to use.

Within each recovery space, posters with soreness information on each of the areas (such as lower back or general recovery) will be posted in high-trafficked areas as a resource to those who choose to engage in recovery modalities. Additionally, interpersonal communication between athletes and staff surrounding the topic of soreness was encouraged. As such, this study is multi-faceted in that it looks at how communication and education on soreness can lead to changes in athletes' soreness reporting and subsequent recovery usage, as well as their ability to draw the connection between reporting and recovery strategies.

This study will use data from a public, southerneastern university football program. This team consists of 135 male athletes aged 18 to 24 years old, representing all major ethnicities, and come from all over the United States of America. Participants at this university have access to an applied science lab with a wide range of recovery modalities that are available on a voluntary, player-led basis.

Measures and Instruments

Each player will be asked to answer the question "What is bothering you today?" and self-report soreness information to a research team member. The prior exploratory research highlighted the impacts of athlete identity/warrior mentality, health DD-MM, and cognitive dissonance theory on the athlete's decision-making process with regard to self-reporting, leading the research team to add and alter disclaimer/reminder messaging and soreness information prior to the questions being asked. Soreness information and disclaimers include a definition of soreness, why we were asking about it, and a reminder that there will be no consequences for self-reporting. The soreness responses were coded as the following general responses: "neck, upper back, shoulder (right/left/both), traps/middle back, lower back, bicep (right/left/both), tricep (right/left/both), forearm (right/left/both), lateral hip (right/left/both), groin

(right/left/both), hamstring (right/left/both), quadricep (right/left/both), calf (right/left/both), foot (right/left/both), ankle (right/left/both), achille (right/left/both), knee (right/left/both), hand (right/left/both), and wrist (right/left/both)."

Participants at this university will have access to an applied science lab with a wide range of recovery modalities that are available on a voluntary, player-led basis. Throughout the week, the research team will collect observational data every time a player completes a recovery modality, keeping track of the total number of recovery usages and what modalities the athlete was choosing to use. Soreness reminder messaging included reminders on recovery strategies to best reduce that specific sore body part.

Following the conclusion of data collection on Mondays, digital messaging will be pushed out to all athletes via the TeamWorks application, noting where they stood that week with regard to soreness, information on how they could alleviate that soreness, and general reminders geared towards reducing the cognitive dissonance and stigma associated with reporting soreness (guided by the athlete identity/warrior mentality, cognitive dissonance theory, and health DD-MM literature). Messaging will be individualized to target the individual athlete's specific soreness based on what they reported that morning. If an athlete did not report any soreness that morning, they would be provided materials on general recovery strategies, as well as the general reminders all other athletes received. Interaction with these materials will be tracked through the 'read' feature in TeamWorks messaging systems. An example of health promotion materials to be pushed out via TeamWorks post-data collection can be found in appendices six and seven; they include an example of a soreness checklist and an example of soreness reduction/recovery resources.

Data Collection Procedures

Participants will be asked to speak with a research team member and self-report their soreness for the duration of their 2024 football season, for a total of about 1 minute of work on their part each Monday morning. Football players play on Fridays or Saturdays, and Sundays are their rest days; Monday mornings were chosen as the evaluation day because it was the day after their recovery day, and sports team officials want to see what soreness lingered after the recovery day as that would be the soreness to watch for for injury prevention (Gallagher et al., 2017). Following data collection on Mondays (on Tuesday mornings), athletes will receive educational materials in their inbox in the TeamWorks application. They will be asked to read through all of these materials. Still, the next steps (which recovery strategy to utilize or not utilize) are left up to the individual athlete and will be recorded to measure the effectiveness of the interview methods and digital communication strategies. As athletes come into the applied science lab and work on their recovery, a research team member will document the athlete's name and the recovery modality they chose to use. This process will be followed every day of the football season.

Results

The first research question sought to understand if soreness self-reporting would increase with an open-ended, non-specific interview question provided by a staff member of the Applied Science Lab at the beginning of the week. This study's results demonstrate that the average player reported soreness throughout the 2024 football season was 57% of the team reported soreness. This average appears to be a 9.94% increase in reporting when compared to the 2021-2023 football seasons, which saw a cumulative average of 52% of the team reporting soreness. Figure 1 shows how soreness self-reporting was more consistent in 2024, avoiding any high highs and low lows as a result of the broadened question.

For the second research question, the research team examined if player-led recovery usage increased with the addition of weekly updates on overall team status and educational materials. Over the course of the 2024 football season, the team completed 22,103 recovery usages with the various recovery modalities, which was a 22% increase from the 2023 football season. Additionally, the team reached record-breaking usage numbers for seven specific modalities, which were as follows: 8,691 theragun administered massages (37% increase from the previous record), 3789 theralight uses (37% increase from the previous record), 2,891 massage chair uses (5% increase from the previous record), 1,468 assisted stretches (13% Increase), 940 cryotherapy uses (3% increase from the previous record), 666 dry sensory deprivation float uses (7% increase from the previous record), and hyperbaric oxygen therapy 341 uses (11% increase from the previous record).

The last research question looked at whether the number of players who reported and utilized recovery modalities each week increased with the addition of weekly updates on overall team soreness status and educational materials. Throughout the 2024 football season, the research team could determine the percentage of the team that opened and read the digital messaging each week. On average, 31% of the team read these weekly messages, with the high being 42% during week nine of the season and the low being 12% during week twelve of the season, which can be seen in figure three. Since the digital communication plan was a new addition to the way the team handled soreness collection and discussion, the read average could not be compared to any years prior. Additionally, the team tracked the number of players who reported soreness each week but chose not to participate in any recovery modalities to help alleviate that reported soreness and compared that to the number of athletes in the 2021-2023 seasons (can be seen in figure two). In 2021, athletes reported feeling sore but did nothing about

it 436 times over the course of the 17-week season, which is an average of around 25 athletes per week missing out on recovery while sore. However, by 2023, that number had declined to 389, around 23 athletes per week, and it declined even further in 2024, with the total number being 293, an average of 17 athletes per week over the course of the 17-week season. The data in Figure two indicates the effectiveness of the study materials in helping athletes bridge the gap between reporting soreness and recovery, keeping athletes healthier in the long run.

Discussion

This study evaluated the impact of interview question formatting and email communication on soreness self-reporting and player-led recovery usage. The research team used data from exploratory interviews with 51 of the 135 football players at the public University of interest to guide the changes being tested. The interviews highlighted the impacts of athlete identity, warrior mentality, cognitive dissonance theory, and the health DD-MM on the athlete's decision-making process when choosing to disclose soreness or not. Based on these findings, the research team implemented open-ended questions regarding soreness, added in discloses to remind athletes that reporting soreness would have no impact on game/practice eligibility, and implemented a digital communication plan through the TeamWorks application to remind players of the soreness they reported and offer recovery strategies tailored to what they were reporting.

One goal of this study was to see if changing the interview question format to be more open-ended in nature would increase soreness self-reporting (RQ1); soreness reporting did look to increase by 9.94% in the 2024 season compared to the 2021-2023 seasons. However, that cumulative average appears to be brought down by an uncharacteristically low reporting season in 2022 (43%), bringing down the cumulative average of that time period. 2022 was determined to be uncharacteristically low through a deeper analysis of the 2018-2020 seasons, which found

the reporting average to be 56%, which matched the 56% reporting average seen in 2021 and 2023. Comparing the 2024 average (57%) to the cumulative average of the 2018-2021 and 2023 seasons (56%), it can be concluded that changing the format of the question and the addition of the email communication methods may not have actually increased soreness reporting, but they may have contributed to more consistent reporting trends. The consistent nature of reporting throughout the whole season displays the team's ability to recover after a particularly physically demanding week, indicating effectiveness in the study materials and messages. Figure one demonstrates each season's soreness self-reporting percentage trends. Not only did 2024 see more consistent reporting, but during the 2024 season, players went into the last game of the season at almost the same soreness level that they started the season with, indicating effective recovery throughout the course of the season. In years prior, the team did not reduce soreness back to its original level (except the 2023 season) by the end of the season, making going into postseason games that much more challenging. In 2024, the reporting was at its lowest (52%) at the start of the season, remained consistent, and then ended close to its starting point (54%). In 2022, the reporting started at 34% at the start of the season, had some variability throughout the season, and then ended at 57%. In 2021, the reporting started at 47% at the start of the season, had some variability throughout the season, and then ended at 60%. The one exception to the trend was in 2023; the reporting started at 47% at the start of the season, had some variability throughout the season, and then ended below its starting point at 41%. 2023 was a season in which the team did not qualify for their conference championship game and only qualified for a non-playoff bowl game. With this schedule, the team was able to have an extra week of recovery time that the team in 2024 did not have, which could have been why this season saw soreness drop below its starting point. Soreness reporting being brought down to its starting point in 2024

was a testament to the effectiveness of the study materials and had a great impact on the team being in the best possible position for postseason games.

The second research question looked at the impacts soreness questions, and a soreness communication plan would have on player-led recovery initiatives. Player-led recovery initiatives increased as a whole throughout the 2024 season, reaching record-breaking statistics on individual recovery modalities. However, it is hard to determine what exactly led to the increase in these numbers. It could have been the soreness interview changes, the added communication plan, the increased discussion surrounding soreness and injuries (with changes return to play measures and added interpersonal communication between staff and players), the increased number of staff to help facilitate recovery or a combination of all of these efforts in The Applied Science Lab. While it is likely a combination of all of these efforts that led to the drastic increase in player-led recovery initiatives, another study could be run where some of these factors are controlled to determine which has the greatest impact on recovery.

The last research question looked at the number of players who reported soreness but chose not to take part in any recovery modalities in order to work on said soreness. In the 2024 season, the average number of players who fell into this category fell from 25 players (from 2021) to 17 players. Players were asked to report their soreness and then could choose to head over to the recovery area and talk with the same staff that had collected their data on how they could reduce that soreness. Building those relationships, rather than just collecting the data and moving on, seemingly made a big impact on results. From this study, it is apparent that interpersonal communication was more effective in getting players to report and do more player-led initiatives than impersonal data collection. While this is another great improvement, again, it is hard to determine what exactly led to The Applied Science Lab being able to help

more athletes bridge the gap between reporting soreness and taking the necessary precautions to reduce it. The inability to draw a concise conclusion on the improvement further highlights the need for a longitudinal study into next season, perhaps controlling for some of the extraneous factors like return to play and change in staff employment numbers.

Practical Implications

Soreness is a normal part of any sports activity, but prolonged soreness that isn't recovered can place players at a higher risk for injuries. With the college football seasons getting longer and the team size decreasing, keeping players healthy is more important now than ever. Soreness collection allows sports teams to be more informed on what is going on with their players and make any necessary changes to training/recovery plans. Knowing when most of the team is experiencing soreness in one particular area or when players aren't recovering is hugely beneficial for knowing what next steps to take to ensure the team stays as healthy as possible. If the majority of the team reports that one area is sore, then sports training staff should adapt training regimes. If individual players are reporting the same soreness each week, then it may indicate that they aren't recovering properly, which can allow staff to step in and recommend a new recovery routine. The soreness collection and communication plans evaluated in this study could be adapted to fit the training schedule of any sports team, making the findings of this study a practical implication for any sports team, not just football.

Limitations and Future Directions

The University Applied Science Lab runs performance data and recovery modalities for the team. In addition to the changes made for this study, the lab also changed how the return to play was tested and discussed during the 2024 season. Additionally, the lab hired more staff during the off-season (Spring 2024). All of these changes make it hard to pinpoint exactly what

led to the increase in recovery usage and the consistency in soreness reporting. This highlights the importance of a longitudinal study to evaluate if these results were a one-off or if these materials had lasting impacts on seasons to come. Now that a baseline strategy for return to play has been tested and implemented and the staff numbers are more constant, it would be worth re-evaluating next season to see if the results can be more confidently correlated to the changes made to the soreness interviewing and communication plans created in this study.

This study was evaluated at a division one, southeastern, public university football team, making the generalizability relatively low. It would be worth re-evaluating this study at another division level to see how access to recovery resources impacts recovery usage, even when players know they are sore and should do something about it. Additionally, it would be worth retesting these materials with other sports to see how different sports and sex change these outcomes. Football only has a game once a week, so another sport with more than one game a week may need to implement more than one soreness collection depending on the number of rest days those players have a week. That difference alone highlights the need to retest these materials in another sport to see how training and game schedules impact soreness self-reporting and recovery usage.

Conclusion

With 70-80% of athletes choosing to withhold soreness/injury-related information from sports staff (Jessiman-Perreault et al., 2016; Whatman et al., 2018), the need for more research in this sector of sports communication is apparent. This study aimed to take a step in closing that research gap by identifying warriors to soreness reporting and taking measures to try and work around those barriers in partnership with a division one, southeastern, public University football team over the course of the 2024 season; 2024 season's data was compared to data collected in

the 2021-2023 seasons. Prior exploratory research revealed that athletes are influenced by their athlete identity and warrior mentality in that they choose to withhold soreness out of fear of getting pulled from their sport or being judged by their teammates and coaches. Additionally, athletes seemed to be influenced by the cognitive dissonance model and health disclosure decision-making model when choosing what exactly to report when asked about their soreness. This study considered those findings when developing a new soreness collection strategy and communication plan for soreness self-reporting and player-led recovery strategies for reducing said soreness.

Introducing a more generalized soreness collection question and a soreness communication email plan to update players on soreness status and connect them with the resources they could choose to use to reduce that specific soreness led to a stabilization in soreness self-reporting throughout the entirety of the 2024 football season and an increase in player-led recovery initiatives.

Appendix 1

SORENESS REDUCTION MENU

GENERAL RECOVERY/ RELAXATION

CASL OPTIONS TO REDUCE SORENESS

1. DRY/WET FLOAT

Floats are like water beds offering sensory deprivation for relaxation. Can be used with normatecs.

2. COCCON/THERALIGHT

Cocoon combines spa grade red light with heat and vibration. Theralight uses medical grade red light to speed up recovery over time.

3. MASSAGE GUN

Breaks up tissue adhesions and promotes muscle release.

4. HYPERBARIC

Floods the body with oxygen to deliver more nutrients to the cells for faster cellular recovery.

5. MASSAGE CHAIR

Chairs knead, roll, and tap on the muscles to increase recovery and relaxation.

ADDITIONAL RESOURCES:

GRAYSON'S GROUP STRETCH CLASSES:
MOST MONDAYS AND THURSDAYS

Figure 1

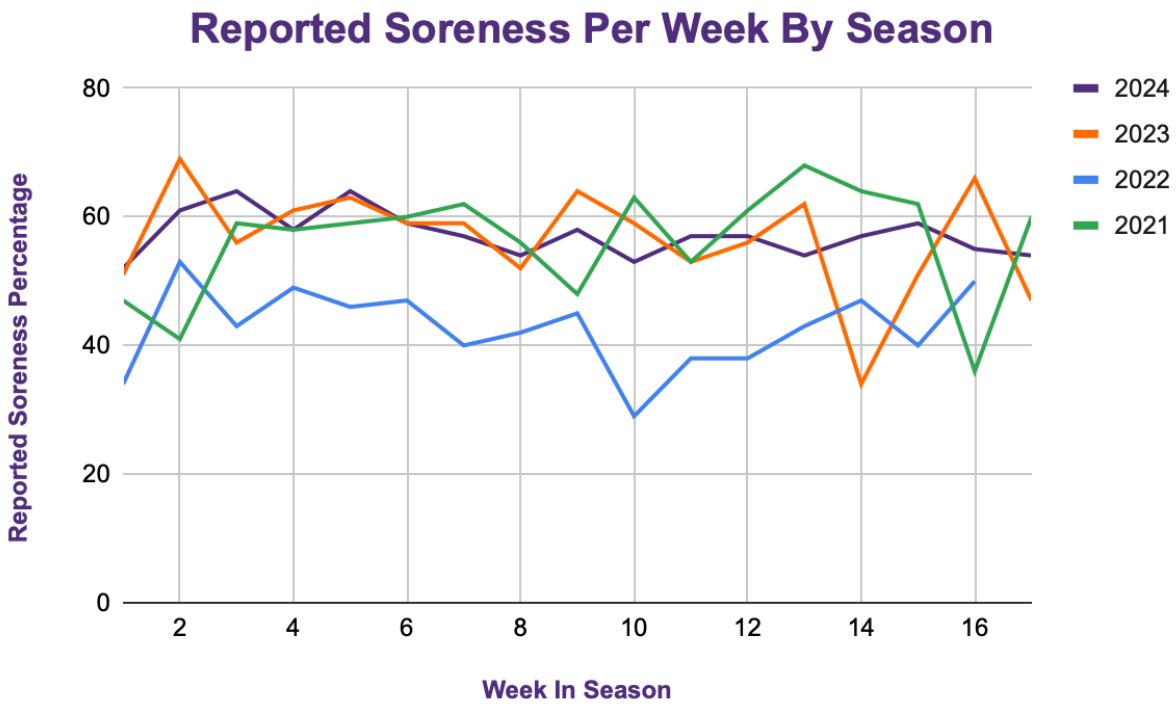
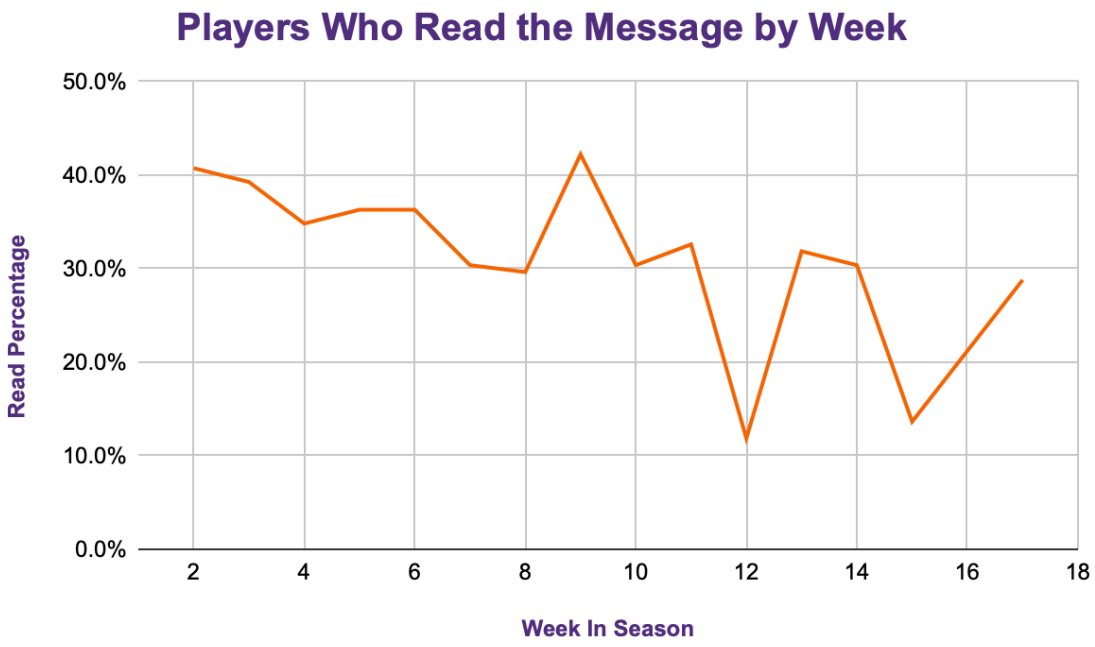


Figure 2

Figure 3


Players Who Read the Message by Week
Read Percentage
50.0%
40.0%
30.0%
20.0%
10.0%
0.0%
2
4
6
8
10
12
14
16
18
Week In Season

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