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Stress and Social Media: Can Using Facebook Impact the Anticipatory Stress Response in Athletes?

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STRESS AND SOCIAL MEDIA: CAN USING FACEBOOK IMPACT THE ANTICIPATORY STRESS RESPONSE IN ATHLETES?

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by

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Chapter 1: Literature Review

The Stress Response

Humans, like many organisms, control their body functions by maintaining homeostasis in the face of a changing environment. The system is not a perfect one, however, and the homeostasis can be thrown out of balance by a number of internal and external influences. Some of these include mechanical influences such as injury, physical influences such as heat, chemical influences such as poison, biological influences such as infection, lack of food, water, or sleep, disturbances in social interaction, and severe threat in dangerous situations (Schedlowski & Tewes, 1999). Schedlowski and Tewes (1999) define a "stress response" as an inability to re-establish homeostasis, either through involuntary mobilizations of biological resources or by spontaneously changing behavior. The event that triggers this response is called a "stressor". In life-threatening situations, this acute stress response is biologically advantageous; however, humans often react in this manner to situations that are not life-threatening, such as receiving unpleasant news or when relationship problems arise. In these situations, the stress response occurs because the individual's psychological rather than biological well-being is endangered (Schedlowski & Tewes, 1999). Even in cases where the stressor is perceived identically, a difference in the psychological appraisal of the stressor can modulate the physiological stress response of the organism (Sapolsky, 2004).

During a stress response, the body responds to the stressor by increasing heart rate, blood pressure, and respiration rate as well as releasing hormones into the blood. The adrenal cortex mobilizes a class of hormones called glucocorticoids, which aid in metabolism and anti-inflammation responses (Schedlowski & Tewes, 1999). A major glucocorticoid that is released is cortisol, colloquially known as the "stress hormone". This response takes place via the hypothalamus-pituitary-adrenal (HPA) axis. A stressor stimulates the hypothalamus, and the hypothalamus secretes corticotropin-releasing hormone (CRH) into the hypothalamic-pituitary portal system. From there, CRH binds to receptors in the anterior pituitary and causes the release of adrenocorticotropic hormone (ACTH). The ACTH binds to receptors in the adrenal cortex, which triggers the release of cholesterol that is subsequently transported to the mitochondria. The cholesterol becomes a substrate for the synthesis of glucocorticoids, and in humans, the primary glucocorticoid produced is cortisol (Moyes & Schulte, 2008) (Figure 1).

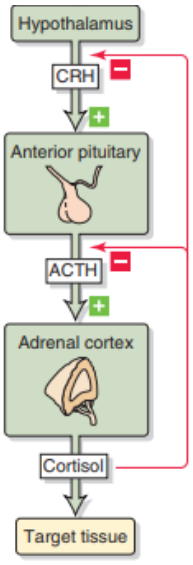

Figure 1. The hypothalamus-pituitary-adrenal (HPA) axis. Adapted from Boron and Poulpaep, Medical Physiology, 1st edition, Saunders 2003.

The benefits and costs of this stress response vary depending on the degree of stress and how long it is sustained. The effect of stress on cognition and memory demonstrates this idea. Mild acute stress tends to increase cognitive function, specifically in the formation of implicit memories (which includes unconsciously remembering how to do things procedurally), performance of simple declarative tasks, or during times when cognitive load is not excessive. Conversely, exposure to very high acute stress can acutely or chronically impair the formation of explicit memories (which includes conscious recollection of facts) (Sandi, 2013; Sapolsky, 2004).

Psychological stressors tend to increase salivary cortisol levels in undergraduate students (Campisi, Bravo, Cole, & Gobeil, 2012; Murphy, Denis, Ward, & Tartar, 2010). After 23 undergraduate students completed the Perceived Stress Scale-10 (a self-report scale asking about their stress) and submitted saliva samples during an exam period and during a non-exam period, the students showed a significant increase in both salivary cortisol concentration and perceived stress during the exam period compared to the non-exam period (Murphy, Denis, Ward, & Tartar, 2010).

In another study, 15 undergraduate students underwent a mock job interview to induce stress rather than a real-life stressor like the exams in the previously mentioned study (Campisi, Bravo, et al., 2012). In this study, the subject submitted a saliva sample, and their resting blood pressure and heart rate were measured. Then, the subject had to prepare and execute a five-minute extemporaneous speech and perform mental arithmetic. Once that was complete, the subject submitted saliva samples and had their heart rate and blood pressure measured during a 30-minute rest period after the stressor.

Subjects' salivary cortisol levels increased (similar to the previous study) but so did their heart rate and blood pressure. After the recovery period, which Murphy et al. (2010) did not include, subjects' heart rate and blood pressure returned to baseline values, but their salivary cortisol remained elevated, indicating that they were still experiencing the effects of the stressor (Campisi, Bravo, Cole, & Gobeil, 2012).

In addition to an increase in cortisol production, anxiety-inducing stress tasks are associated with significant dopamine release, which might dampen the stress response (Pruessner, Champagne, Meaney, & Dagher, 2004). Here, Pruessner et al. (2004) recruited 10 people (1 woman and 9 men) to complete mental arithmetic tasks while in a PET scanner. The investigators further induced additional stress by increasing the difficulty of the problems so that the average subject performance was 20-30% correct. The subjects, however, were told that the average college student gets 80-90% of the problems correct, and they were given 2 minutes of negative verbal feedback. The investigators collected saliva samples, heart rate, temperature, and skin conductance measurements at regular intervals during the experiment. They found that the subjects' salivary cortisol and extracellular levels of dopamine increased during the stress period. Furthermore, cortisol and dopamine increases were positively correlated (Pruessner et al., 2004). Since dopamine is thought to function more as a reward signal and increases proportionally in response to the amount of cortisol present, dopamine may dampen the stress response, making it more difficult to accurately measure physiological stress. This study, however, included mainly male subjects, so this response might not be as pronounced in females.

As a general rule, the stress response is beneficial only for a limited duration of time. The antigrowth, antireproductive, catabolic, and immunosuppressive effects of the stress response benefit the individual because it enhances the fight-or-flight response; however, prolonged or chronic stress responses can lead to a number of disorders resulting from the increased/prolonged secretion of glucocorticoids (Charmandari, Tsigos, & Chrousos, 2005). The homeostatic changes caused by chronic stress together are called the "general adaptation syndrome" and can result in smaller thymus glands, enlarged adrenal glands, weight loss, and the formation of gastric ulcers (Schedlowski & Tewes, 1999).

Severe acute stress and chronic stress tend to exacerbate many health problems including, but not limited to, depression, cardiovascular disease, HIV/AIDS, and cancer (Cohen, Janicki-Deverts, & Miller, 2007; Lin et al., 2014). This exacerbation occurs because stressors inhibit the innate immune response by both suppressing inflammation and the formation of new lymphocytes, and by shortening the time that preexisting lymphocytes stay in circulation. This process is driven by increased glucocorticoids like cortisol. Glucocorticoids cause the thymus gland to shrink, which stops the formation of lymphocytes. Moreover, glucocorticoids cause the withdrawal of existing lymphocytes from circulation, and can even trigger the apoptotic pathway in these lymphocytes (Sapolsky, 2004). In the face of a physical stressor, this response makes sense; by suppressing immunity, the body can use that energy for a short time to engage in life-saving behaviors, like fleeing for life. In the context of typically longer-lasting psychological stressors, the immune system becomes depleted for longer periods, leaving

the body more susceptible to the onset of a new disease or the exacerbation of a pre-existing disease.

The Effects of Social Media on the User

My study will focus on the relationship between stress and social media in undergraduate student athletes competing at the club level. The use of social media has increased in teens, young adults and adults in recent years, with teens and young adults being the two age groups most likely to use social media (Lenhart, Purcell, Smith, & Zickuhr, 2010; Smith & Anderson, 2018). Estimates of social media use in young adults aged 18-29 range from 55-82%, with one-third posting and reading status updates on Twitter (Kuss & Griffiths, 2011; Lenhart et al., 2010). The percentage of young adults using social media increased to 88% in 2018, with the most popular sites among them being Facebook (80%), Snapchat (78%), and Instagram (71%) (Smith & Anderson, 2018).

The prevalence of social media in the young adult population can lead individuals to choose social media over in-person interactions to satisfy their need for interpersonal relationships. One explanation for this finding is that people who feel insecure about their real-life connections may use social media or virtual relationships to compensate for their feelings of loneliness and find feelings of comfort and community (Kuss & Griffiths, 2011). However, if social media is used excessively, coping skills may transition from problem-focused (i.e., in the face of a problem, the user acts to alter the source of the problem) to emotion-focused (i.e., the goal is only to reduce or eliminate

emotional distress). This transition to a more dysfunctional coping approach can lead to more stress since the problem's source is not addressed effectively (Sriwilai & Charoensukmongkol, 2016).

Using social media can cause both stress and anxiety in the user (Labrague, 2014; Thompson & Lougheed, 2012). When 268 undergraduate students completed a survey about their attitudes toward social media and the Internet, the female Facebook users were significantly more likely to develop an addiction and lose sleep over Facebook. This occurred because looking at Facebook photos caused more negative body image and stress compared to their male counterparts (Thompson & Lougheed, 2012). In these instances, Facebook use is a source of stress rather than a stress reliever. However, despite that correlation and the fact that teens report decreasing enthusiasm for Facebook use due to people sharing excessively and creating stressful "drama", teens continue to use Facebook because it is important for socialization (Madden et al., 2013). In undergraduate nursing students, depression, anxiety, and stress are significantly correlated with time spent on Facebook (Labrague, 2014). Smartphone use in teens and young adults correlates positively with depression and a myriad of other problems including an increased risk for suicide, sleep deprivation, feelings of loneliness as well as increased negative feelings due to cyberbullying (Twenge, 2017). Additionally, smartphones can provoke anxiety while also serving as an avoidance strategy, which only leads to more anxiety (Denizet-Lewis, 2017).

While some studies have shown that social media use negatively impacts the user, other studies have found either a positive correlational relationship between stress and

social media or a neutral relationship, although the volume of evidence for a neutral relationship is not as large. In a study by Garett, Liu, and Young (2017), 197 incoming college freshmen completed weekly surveys over twelve weeks regarding their ability and methods to deal with stressors, their sleep quality, and their emotions. The survey results demonstrated that male students experienced less stress compared to female students, and that Internet usage was among the coping methods significantly related to higher stress levels. Social media, however, did not significantly influence stress levels, either positively or negatively, signifying that the relationship between social media use and stress is ambiguous (Garett, Liu, & Young, 2017).

One possible reason why Facebook has grown in popularity is because Facebook generates positive emotional feedback that results in more Facebook use (Mauri, Cipresso, Balgera, Villamira, & Riva, 2011). Thirty subjects aged 19-25 had their skin conductance, blood volume pulse, pupil dilation, respiratory activity, brain activity, and muscle activity measured during a three-minute exposure to three different things. The first was a slide show of natural panoramas (used as a relaxation condition), the second was the subject's personal Facebook account, and the third was a mathematical task (a stress condition). The investigators found that the physiological response to Facebook differed significantly from the response in both the relaxation and stress conditions, and that Facebook use can evoke a psychophysiological state characterized by high arousal. They hypothesize that this positive affective state may have been what led to the success of Facebook (Mauri et al., 2011). Additionally, because social media sites can provide real-time details during crisis events (e.g., during an event such as an active shooting in a

public space), it has enabled people to know sooner if a loved one is all right and to track their welfare, a feature that can decrease stress (Brummette & Sisco, 2014).

Some users' stress levels when using Facebook depends both on what they are seeking when they go to their Facebook account and whether they obtain it. Facebook users seeking social support who perceive it experienced a decrease in depressed and anxious moods, whereas those who did not perceive it experienced an increase in depressed and anxious moods (Frison & Eggermont, 2015). Similarly, a study conducted by Campisi et al. (2015) found that users' quality of life is impacted by their motivation for using social networking. Those users who reported that they use social media "to stay connected to friends" demonstrated higher quality of life scores (based on the World Health Organization Quality of Life Scale Abbreviated Version) while those using social media "for dating purposes" or "for boredom" reported lower quality of life scores (Campisi, Folan, Diehl, Kable, & Rademeyer, 2015). One study focusing on individuals' "friendship network position" and how it relates to stress found that the quality of social networking is correlated with stress (Kornienko, Clemans, Out, & Granger, 2013). In this study, 74 students in an accelerated nursing program answered questionnaires about their demographic characteristics, personality, friendship network, and perceived stress, and they submitted a saliva sample to test for salivary cortisol. The investigators found that the participants with a low level of gregariousness (i.e., the lowest number of outgoing ties) had a higher level of salivary cortisol, but those students with a high level of gregariousness did not exhibit any increase in salivary cortisol (Kornienko et al., 2013). Individuals with more Facebook friends tend to have stronger perceptions of social

support, leading to reduced stress, less physical illness and greater well-being (Nabi, Prestin, & So, 2013) Thus, people with fewer Facebook friends may be more depressed, stressed and anxious when using Facebook because they perceive less social support (Nabi et al., 2013; Wright, 2012). This finding corroborates previous studies showing that having social support during a stressful situation reduces the physiological stress response, both in terms of the cardiovascular response and cortisol production (Sapolsky, 2004).

Interestingly, Kornienko et al. (2013) also found that those students with a higher popularity status also had higher cortisol levels. Kornienko et al. argued that being near the top of a social hierarchy poses unique psychosocial challenges, like the stress of constantly supporting friends or the fear of status loss once the popularity is attained. Furthermore, popular individuals also tend to be viewed negatively by peers, exacerbating stress levels (Rose et al., 2011). Kornienko et al. (2013) concluded that being somewhat popular would be the most advantageous for individuals in terms of receiving the benefits of social support without the detrimental stress that comes from having too many friends. One of the impacts associated with a large amount of Facebook friends specifically in undergraduate students is an increase in the incidence of upper respiratory infections (Campisi et al., 2012; Campisi et al., 2017). Given that information, it appears that an individual's relationship with stress and social media is more complicated than it may first appear.

Anticipatory Stress and Athletes

Of significance to my study, athletes experience a significant anticipatory stress response before an athletic competition. Van Paridon et al. (2017) conducted a meta-analysis comparing the salivary cortisol levels of athletes before a competition to their baseline (2017). The authors included 25 studies in their analysis, with the average sample size (±SD) being 13±5 and the average participant age being 23.7±6.8 years.

Cortisol levels significantly increased from baseline in response to competition in athletes competing individually and in team sports. To account for the influence of circadian rhythm on cortisol, they examined the effect of the time of competition and found no significant difference in cortisol reactivity between competitions that took place in the morning and those that took place in the afternoon. While cortisol levels in athletes competing at the regional and national levels significantly increased, cortisol levels in athletes competing at the international level did not. Furthermore, while cortisol responded positively in the 19 studies that included male athletes, there was only a marginally significant (i.e., $p=0.07$) response in the 7 studies that included female athletes. Additionally, the collection time of the saliva samples before the competition was significantly related to the cortisol response, with a higher response occurring closer to the start of the competition.

Previous studies indicate that social media may or may not cause stress, particularly in the young adult population. My study will focus on how using social media might influence the stress response demonstrated in a specific young adult population, undergraduate athletes before an athletic competition. I will use previously

established research on how stress leads to increased salivary cortisol levels to test if looking at social media sites before an athletic competition leads to an increase or decrease in the stress response. The results of this study may indicate either a strongly negative or a strongly positive correlation between the anticipatory stress response in athletes and social media because previous accounts of this relationship are conflicted. This will add to the growing body of knowledge about the impacts of social media on its users, particularly in the young adult population.

Chapter 2: Impact of Facebook Use on the Anticipatory Stress Response in Athletes Before an Athletic Competition

Abstract

The proportion of young adults on social media sites has grown in recent years. While some young adults find enjoyment in these sites, they cause anxiety in others. Additionally, although many athletes experience stress prior to competition, it is unclear if social media use could modulate this stress. The aim of the present study is to determine if Facebook use influences the anticipatory stress response demonstrated in athletes before the start of a competition. In this study, undergraduate students competing in club sports spent time before each of two competitions either engaging in their normal pre-game routine or on their Facebook account, and submitted a saliva sample before and after that time period to assess for salivary cortisol concentration. Athletes demonstrated a significant increase in cortisol concentration before competition ($p=0.001$) and Facebook use modulated the stress-induced increase in cortisol in females, as there was a significant decrease in cortisol concentration in the female athlete that did not use Facebook ($p=0.0325$). This suggests that social media use prior to an athletic competition might have differential impacts on stress levels in some users.

Introduction

When faced with stressful situations, humans go through a physiological reaction known as the "stress response". During this stress response, the body is thrown out of homeostasis in an attempt to better deal with the stressor, whether it be a physical or a psychological stressor. During a stress response, the individual's heart rate, blood pressure, and respiration rate increases, and hormones are released into the blood. Cortisol is one of the major hormones released during the stress response via the hypothalamus-pituitary-adrenal axis (Moyes & Schulte, 2008). In response to psychological stressors specifically, salivary cortisol levels increase in undergraduate students (Campisi, Bravo, et al., 2012; Murphy et al., 2010).

One psychological stressor that can induce this stress response is social media sites. Teens and young adults are the two age groups most likely to use social media, and estimates for social media use in young adults aged 18-29 range from 55-82% (Lenhart et al., 2010). In many teens and young adults, Facebook is a source of stress and anxiety. Female undergraduate students are more likely to lose sleep over Facebook because looking at photos causes negative body image (Thompson & Lougheed, 2012). In undergraduate nursing students, depression, anxiety, and stress are significantly correlated with time spent on Facebook (Labrague, 2014).

In some cases, however, social media sites are used to cope with stress and can cause stress levels to decrease. Individuals with more Facebook friends tend to have stronger perceptions of social support, leading to reduced stress and greater well-being

(Wright, 2012). Additionally, those who sought and received social support through Facebook can experience a decrease in depressed and anxious moods (Frison & Eggermont, 2015). Given the many factors of social media that can influence the user's stress, the relationship between stress and social media is ambiguous.

Of significance to this study, athletes experience a significant anticipatory stress response before an athletic competition. Salivary cortisol levels increased in athletes competing in both individual and team sports before their competitions, and this response increased closer to the start time of the competition (van Paridon et al., 2017). In their meta-analysis, the male athletes showed a significant anticipatory stress response, and the female athletes demonstrated a marginally significant response (van Paridon et al., 2017). Though the review and meta-analysis indicated that female athletes demonstrated only a marginally significant anticipatory salivary cortisol stress response before competition ($p=0.07$), I will be including them in this study because the p-value of 0.07 indicates female athletes may have a significant anticipatory cortisol response. They also included fewer studies with female athletes in their review compared to the studies that included male athletes, so perhaps they did not have enough power to detect an effect. Furthermore, since the average age of the athletes in this study will be within one standard deviation below the average age included in the meta-analysis, these athletes will likely demonstrate a similar response.

The purpose of this study is to investigate whether the use of Facebook by athletes during this anticipatory period before a competition can mediate their physiological stress response. My hypothesis is that Facebook use before an athletic competition will affect

cortisol concentrations in both the male athletes and the female athletes. These results could inform undergraduate student athletes on whether using their Facebook accounts before a competition can influences their stress levels, which might, in turn, impact their performance.

Materials and Methods

Participants

Participants were college undergraduates (n=7; 5 men and 2 women) who played club volleyball at Regis University. All athletes reported that they were not taking birth control and do not have known anxiety or depression. All procedures were approved by the Regis University Institution Review Board.

Procedures

Previous studies have indicated that athletes experience a significantly large cortisol response as they anticipate a competition, with their salivary cortisol concentration increasing as they approached the start of the competition (reviewed in van Paridon et al., 2017). Thus, thirty-five minutes before the start of the athletic competition, a saliva sample was collected from each participant. During the first pre-game interval, half of the athletes were randomly assigned to complete their normal pre-game routine during the five-minute interval and the other half were randomly assigned to look at their Facebook account. During the second pre-game interval, the athletes that completed their normal routine during the first game were assigned to look at their

Facebook account, while the other half completed their normal pre-game routine. After the five-minute interval had passed, another saliva sample was collected from each subject. One tournament was a competitive tournament against athletes from different schools, and the other tournament was a recreational tournament between Regis University athletes. The participants from the women's team only participated in one tournament, and one of the five male participants only participated in one tournament.

Assay

I collected saliva samples in salivettes according to manufacturer's instructions (Sarstedt, Newton, NC). Saliva samples were frozen at -20 °C until the time of assay. I quantitatively measured cortisol in the samples using commercially available EIA kits, according to the manufacturer's instructions (Salimetrics, State College, PA). Both the intra-assay and the interassay coefficient of variation for the assays was 10%. Samples were assayed at optimal concentrations and according to manufacturer's instructions.

Data Analysis

Repeated measures analysis of variance was used to analyze the cortisol concentration in each saliva sample. If significant main effects were present, Fischer's paired least-significant difference (PLSD) post-hoc analyses were conducted to quantify differences in salivary cortisol concentrations between groups. Alpha was set at 0.05. Figures are shown as mean ± SE. All statistical analysis was completed using StatView software, version 5.0.1.

Results

The purpose of this experiment was to determine if using Facebook before an athletic competition could modulate the anticipatory stress response in undergraduate student athletes. Although I expected that Facebook use would modulate the stress response in both the male athletes and the female athletes, this was not supported by the evidence.

As expected, the athletes demonstrated a significant salivary cortisol response both before the recreational tournament and before the competitive tournament when compared to baseline cortisol concentrations for Regis University undergraduate students ($p=0.001$) (Figure 1). The difference between the average salivary cortisol concentrations of male athletes compared to female athletes was not significant ($p=0.6962$) (Figure 2). The difference in salivary cortisol for all athletes that used Facebook before the game compared to the athletes that engaged in their normal pre-game routine was also not significant for the interaction between Facebook use and time ($p=0.2155$) (Figure 3). With the athletes separated based on sex and the experimental condition they received, there was a significant effect of time ($p=0.0088$), a significant interaction between time and sex ($p=0.0042$), a significant interaction between time and Facebook use ($p=0.0071$), and a significant interaction between time, sex, and Facebook use ($p=0.0325$) (Figure 4, Table 1).

Table 1. Repeated-measures ANOVA statistics for salivary cortisol concentrations based on the time before or after the five-minute period (*Time*), the sex of the athlete (*Sex*), and whether they used Facebook during the five-minute period (*Facebook*).

Source	DF	Mean Square	F	P-value
Time	1	0.059	12.923	0.0088
Time x Sex	1	0.079	17.333	0.0042
Time x Facebook	1	0.065	14.153	0.0071
Time x Sex x Facebook	1	0.032	7.068	0.0325
Error	7	2.272		

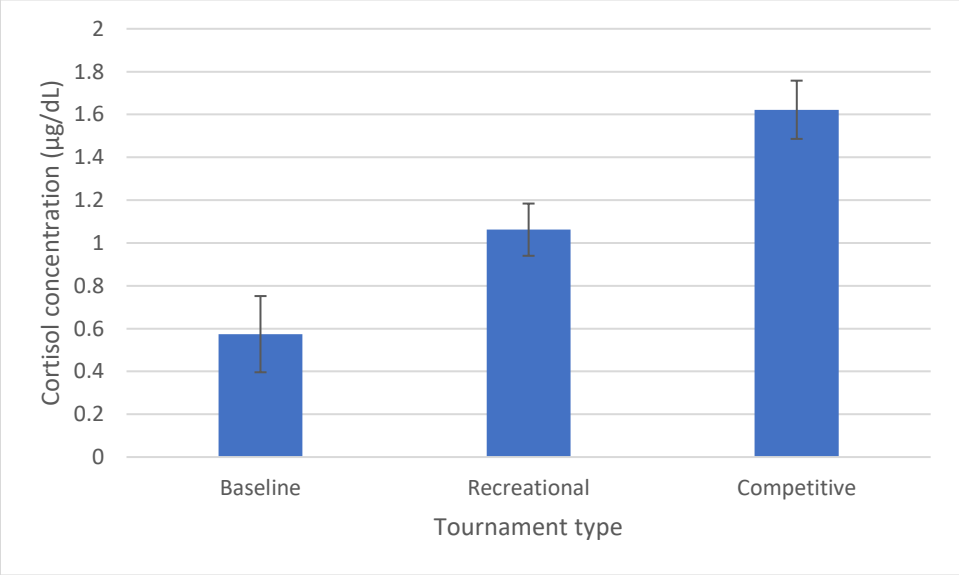

Figure 1. Average cortisol concentrations for Regis University undergraduate students at their baseline ± SE (data taken from an unpublished study), the athletes at the recreational tournament ± SE, and the athletes at the competitive tournament ± SE. Post-hoc analysis revealed significant differences between each time point.

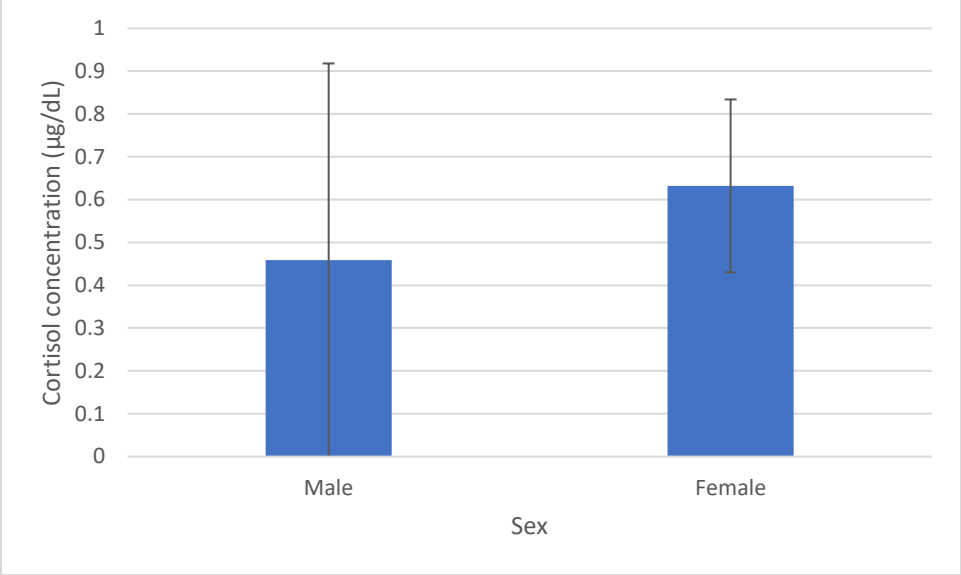

Figure 2. Average cortisol concentrations for the male and female athletes before any experimental treatments ± SE.

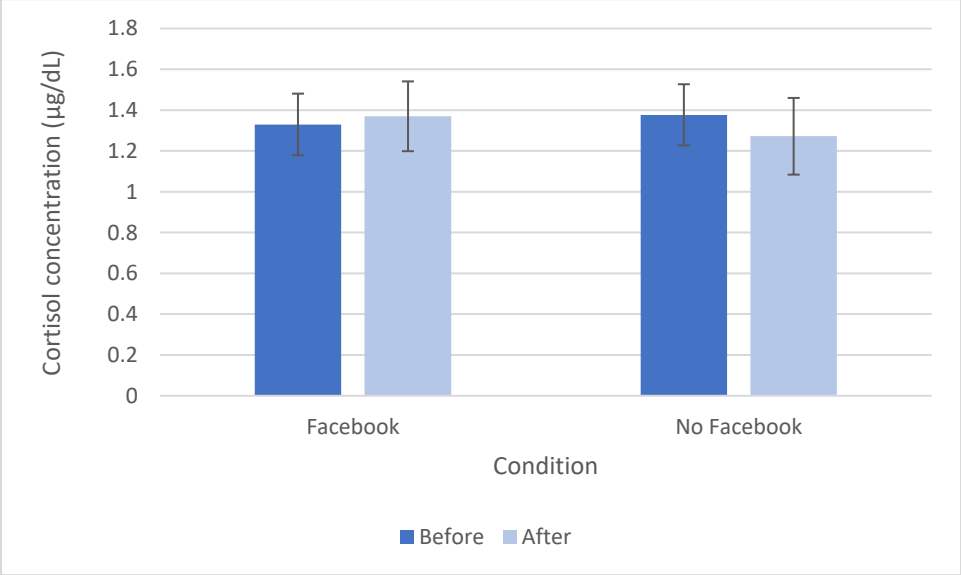

Figure 3. Cortisol concentrations before and after each experimental condition ± SE. The "before" bar is the first saliva sample, and the "after" bar is the second saliva sample, collected after the five-minute interval had passed.

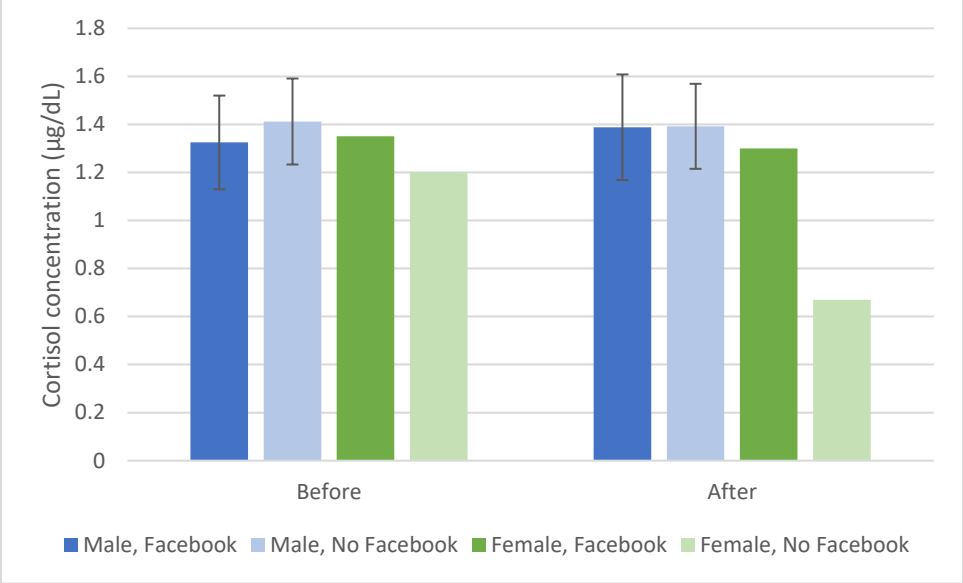

Figure 4. Cortisol concentrations for males and females before and after each experimental condition ± SE.

Discussion

The goal of this study was to understand how using Facebook could impact the anticipatory stress response in athletes. My hypothesis that Facebook use would affect the cortisol concentrations in both the male athletes and the female athletes was not supported by the data. Although there was no significant difference in cortisol concentrations between sexes and there was no significant difference in cortisol concentrations based on whether the athletes used Facebook, there was a significant interaction between time, sex, and Facebook use. In this case, this three-way interaction shows that while there was not a significant change in cortisol concentration in the male athletes based on whether they used Facebook nor in the female that used Facebook, there was a significant decrease in cortisol concentration in the female that did not use Facebook. Additionally, the results show that athletes do experience a significant

anticipatory stress response before a competition, regardless of how competitive it is. While this response was the strongest in the most competitive setting, even the lower-stakes recreational tournament was sufficiently competitive to elicit the stress response in these athletes.

These results corroborate previous research that shows that psychological stressors can increase salivary cortisol concentration in undergraduate students (Campisi, Bravo et al., 2012; Murphy et al., 2010). Additionally, the results are consistent with the meta-analysis by van Paridon et al. (2017) in that these athletes did experience a significant anticipatory stress response before competition. In their study, they found that the overall response was significant. When separating the studies based on the sex of the athlete, they found that the male athletes did experience a significant anticipatory stress response, whereas the female athletes exhibited only a marginally significant response. Although this study did not separate the athletes based on sex to measure the anticipatory stress response, it is consistent with their results in that the overall response of all athletes was significant in both types of tournaments.

On the other hand, the results also show that the effect of social media on stress is not the same in all cases, and it counters previous research that shows that females are more likely to be negatively impacted (i.e., more stressed) by using social media sites than males (Thompson & Lougheed, 2012). In their study, they found that males were less likely to report feeling stressed by using Facebook, and my results show that there was not a significant increase in their salivary cortisol concentrations after using Facebook. Conversely, even though the female participants in the study by Thompson &

Lougheed (2012) were more likely to report that Facebook use causes them stress, the female in my study did not show a significant increase in salivary cortisol concentration.

However, further investigation into this topic is needed. Since only two female athletes participated in the study, it is possible that the significant reduction in cortisol when not looking at Facebook was specific to the female in that treatment group. Furthermore, it is possible that these trends in each sex and treatment group would be different given a larger sample size due to more variation between participants.

One possible next study would be to analyze the performance of undergraduate female athletes after they went through each of these experimental treatments. Because there is a balance between acute stress and performance where both too much stress and not enough stress are detrimental to performance, it would be interesting to know if the reduction of stress seen the female athlete that did not use Facebook could contribute to a change in athletic performance (Mair, Onos, & Hembrook, 2011). My hypothesis is that the relationship between stress (as measured by salivary cortisol concentrations) and athletic performance (i.e., the ability of an individual volleyball player to score points for their team) would resemble a bell curve, where performance would increase as stress increased until a certain point, then as stress increases from there, performance would decrease.

Overall, this study shows that using Facebook might change the physiological stress response to anticipatory stress, and that the stress response of men and women might be different based on Facebook use. This relationship carries important implications on the effect of social media use on health as well. Since these results

indicate that using Facebook can impact the production of cortisol in females, and cortisol is linked to disease processes, using social media can be causing changes in the user's health that they could otherwise be completely unaware of (Sapolsky, 2004). If people were more aware that going onto their social media accounts could cause changes in their health, they could become more mindful of their social media habits.

Chapter 3: Anticipatory Stress in Other Contexts

The idea of anticipatory stress is not limited to athletes alone. Whether it is sitting anxiously in the waiting room of a dentist's office or five minutes before giving a speech to a room full of people, anticipatory stress is a widespread phenomenon. Anticipation of a stressful event is enough to elicit a comparable negative affect and physiological response as those that occur during the stressful event itself (Feldman, Cohen, Hamrick, & Lepore, 2004; Spacapan & Cohen, 1983). In many cases, this increase in stress before an event can lead to detrimental outcomes. The objective of this chapter is to examine this stress response in different contexts.

Anticipatory Stress in Students: Test Anxiety

Exams frequently cause anticipation stress in students. About 25% of American primary and secondary school students suffer from lower academic performance due to test anxiety (Hembree, 1988). Test anxiety is composed of "individuals' cognitive reactions to evaluative simulations, or internal dialogue regarding evaluative situations, in the times prior to, during, and after evaluative tasks" (Cassady & Johnson, 2002). These cognitive reactions fall into a variety of categories, which include comparing self-performance to peers, considering the consequences of failure, low levels of confidence in performance, excessive worry over evaluation, causing sorrow for their parents, feeling

unprepared, and loss of self-worth (Cassady & Johnson, 2002).

Cassady and Johnson (2002) sought to establish the validity and reliability of a test anxiety measure called Cognitive Test Anxiety and correlate scores to gender, emotionality, and student performance. A total of 168 undergraduate students participated in their study (average age=21). To measure test anxiety, the investigators used a similar questionnaire called Reaction to Tests as well as the Cognitive Test Anxiety scale because they measured the same basic constructs as the existing test anxiety scales. Those students that scored in the top 33% of the Cognitive Test Anxiety scale were the high test anxiety group, those in the bottom 33% were the low test anxiety group, and those in the middle 33% were the average test anxiety group. To assess test performance, the authors used the students' scores on three exams in a psychology class and used their scores on their college entrance exams as a control for performance.

The high test anxiety group scored significantly lower on the verbal portion of the SAT compared to the average and low anxiety groups, and the high test anxiety group scored significantly lower on the math portion compared to the low test anxiety group (Cassady & Johnson, 2002). Additionally, the high test anxiety group scored significantly lower on the in-class exams compared to the low anxiety group, and for the second exam, both the high and average test anxiety groups scored lower than the low anxiety group. For the students' final grades in the class, the curve was skewed toward the A and B range for the low anxiety group and skewed toward C and D grades for the high anxiety students. While female students did report higher levels of cognitive test anxiety compared to the male students, the performance between the genders on exams

was not significantly different (Cassady & Johnson, 2002). These results demonstrate that experiencing test anxiety can have a significantly negative impact on exam performance.

A similar study by Chapell et al. (2005) confirmed that test anxiety was associated with reductions in GPA in both undergraduate and graduate students. In that study, 4,000 undergraduate students and 1,414 graduate students gave information about their majors, GPA, their parents' highest level of education, and then they filled out the Test Anxiety Inventory (TAI). Those students that scored at least one standard deviation below the mean score on the TAI were classified as "low test anxious", and those that scored at least one standard deviation above were "high test anxious". When correlating the test anxiety with GPA, the female undergraduates with low test anxiety had significantly higher GPAs compared to those with moderate test anxiety, and those with moderate test anxiety had higher GPAs compared to those with high test anxiety (Chapell et al., 2005). There was a similar result between the undergraduate males, with those in the low anxiety group having a significantly higher GPA than the moderately anxious group, however the moderately anxious and the highly anxious group did not have a difference in GPAs (Chapell et al., 2005). When looking at graduate students, there was no appreciable difference in the TAI scores of masters and doctoral students. This shows that test anxiety significantly impacts GPA in undergraduate students but suggests that graduate-level students might have different consequences of test anxiety.

This type of anticipatory stress has varied consequences depending on the importance of the exam. High-stakes testing has assumed an increasingly prominent role

in education, as the No Child Left Behind legislation uses test results as the main indicator of school effectiveness and student progress (Koretz & Hamilton, 2006; Embse & Hasson, 2012). In cases where primary school teachers use fear appeals to impress upon students the importance of, the timing of, and the consequences of failing upcoming tests, students reported higher levels of test anxiety and performed worse on exams compared to those students whose teacher did not use fear appeals (Putwain & Best, 2011). This emphasis on test results in these sorts of high-stakes exams is frequently associated with an increase in test anxiety, and this anxiety can especially impact those students with disabilities, women, and minority students (Putwain, 2007; Whitaker Sena, Lowe, & Lee, 2007).

Knowing that social factors such as those can differentially affect test anxiety, one study focused on examining the relationship between test anxiety and performance during a high-stakes test in an urban high school and a suburban high school in the United States. The urban high school chosen for the study had 96.5% of the students being classified as economically disadvantaged, and the suburban high school had 0% of the students being classified as economically disadvantaged. Before taking the Ohio Graduation Test (OGT), the participants took the FTAS, which is a 23-item survey used to measure test anxiety. The FTAS has three components, which measure social derogation (the social component of anxiety), cognitive obstruction (the influence of anxiety on memory and information recall), and tenseness (the physiological symptoms associated with test anxiety) (Embse & Hasson, 2012). The survey results showed that the school location (urban vs. suburban) did not have a significant effect on testing

anxiety, but participants in both settings with a high FTAS score scored lower on the OGT (Embse & Hasson, 2012). There were significantly negative correlations between the cognitive obstruction scores and the scores on the reading, math, social studies, and science sections of the exam. Similarly, there were significantly negative correlations between tenseness and scores in reading, math, social studies, and science. There was a weaker relationship between test anxiety and writing scores (Embse & Hasson, 2012). When examining the variance in scores, they found that 4%-15% of the variance in scores can be attributed to the test anxiety. Their results show that the effect of stress on memory and information recall as well as physiology negatively impacts high school students taking high-stakes tests, regardless of economic background.

Another high-stakes exam that can cause test anxiety is the United States Medical Licensing Examination (USMLE), and the connection between test anxiety and exam performance has important implications for medical students. One study comparing the USMLE scores and anxiety levels of second-year medical students taking a test-taking strategies course and the scores and anxiety levels of second-year students not taking the course confirmed that there is an inverse association between test anxiety and USMLE scores. However, while the test-taking strategies course did decrease test anxiety, those students that took the course did not experience an increase in their scores. The authors of the study posit that this occurred because although the course did include a component of relaxation techniques, most of the course was dedicated to strategies to answer multiple-choice questions, which may only indirectly affect anxiety and therefore only moderately increase performance (Green, Angoff, & Encandela, 2016). Because the

course mainly focused on indirect ways to decrease anxiety and the students in the course did not have an increase in their score, this suggests that there should be larger emphasis on relaxation techniques in test-taking strategy classes so that by decreasing anxiety, exam scores might increase.

Although test anxiety can cause students to perform worse, in some cases, students under stress show an improvement in academic performance. One study analyzing this relationship examined the genotype of a specific gene in students to see how that might mediate their academic performance during a stressful exam. The authors of this study examined the role of a polymorphism in the gene that codes for catechol-O-methyltransferase (COMT), which is a methylation enzyme that catalyzes the first step in the dopamine degradation pathway. Dopamine can play an especially important role during exams, since there is evidence that a decrease in brain dopamine activity can contribute to impaired performance in tasks that involve prefrontal brain regions, and increases in dopamine levels can contribute to an increase in analytical intelligence (Previc, 1999; Volkow et al., 1998; Yeh, Chang, Hu, Yeh, & Lin, 2009). A single nucleotide polymorphism occurring at nucleotide 472 in exon 4 of the COMT gene that corresponds to a G to A substitution leads to a valine to methionine substitution at residue 158. This single amino acid difference changes the activity of COMT. The 158Met allele decreases the thermostability and activity of COMT, and because COMT is used to degrade dopamine, those with the 158Met allele have higher dopamine concentrations compared to those with the 158Val allele. Although having a heterozygous 158Met/Met genotype may be advantageous for prefrontal cortex function and cognitive abilities, it is

also associated with negative affective disorders. Because of the predisposition to develop negative affective disorders, carriers of the 158Met allele can be overwhelmed by emotional vulnerability when exposed to stress or educational adversity (Enoch, Waheed, Harris, Albaugh, & Goldman, 2009; Yeh et al., 2009).

In order to assess the relationship between a student's genotype for COMT and their academic performance, Yeh et al. (2009) recruited 779 Taiwanese students that were taking the Basic Competency Test (BCT), which is an exam that determines if a student can proceed to senior high school. At the time of the study, only 39% of those tested were allowed to proceed, so the students are subjected to extreme academic pressure due to their preparation for this exam as it has large implications for their future education. Out of the 779 subjects, 8% were homozygous for the 158Met allele, 50% were homozygous for the 158Val allele, and 42% were 158Val/Met heterozygotes. When comparing the BCT subtest scores between the different COMT genotype groups, the Met/Met group performed significantly poorer in the science and social science subtests when compared to the other two groups, and the Met/Met group also had lower—but not significantly lower—average scores in the other subtest scores (mathematics, English, and Chinese) (Yeh et al., 2009). This difference in scores suggests that the tendency of the homozygous 158Met students to perform poorly in all subtests in the BCT could stem from the stress of taking this high-stakes exam, and those that carry the 158Val allele might perform better than their 158Met counterparts in highly stressful academic settings.

Given the fact that test anxiety has differential effects on academic performance, stress reduction may not lead to increased academic performance in all students. For

those that do not thrive in high-stress settings, such as the students carrying the 158Met allele, interventions that reduce test anxiety have improved test performance; however, given the results of the study by Green, Angoff, & Encandela (2016), it appears that those interventions in a test-prep class setting are not sufficient to increase scores. If these students are able to reduce anticipatory stress before exams, they can perform at their optimal level, and that is especially crucial in the context of college and graduate school admissions exams. The results of these exams play a huge role in the student's ability to go to college or pursue a career of their choice, so an important part of test preparation for these students, in addition to content review, should be focused on reducing the anxiety and stress associated with the pre-testing period.

Anticipatory Stress in Emergency Professions

The differential effects of stress on performance can be seen outside of the academic realm in the world of emergency medicine. Because of the nature of emergency medicine, stress for the people working in that field is constant. By definition, an emergency requires a rapid response with no possibility of predicting the workload (Bedini et al., 2017; Bellagamba, Gionta, Senergue, Bèque, & Lehucher-Michel, 2015; Roth & Moore, 2009). One of the first groups of people usually contacted in the event of an emergency is emergency dispatch. Emergency dispatchers are in a unique position with respect to their stress because they have to assess the severity of the situation without directly seeing what is happening and determine what the appropriate

response is (Bedini et al., 2017; Vaillancourt, Charette, Bohm, Dunford, & Castrén, 2011).

The goal of a study by Bedini et al. (2017) was to assess when emergency dispatchers experienced the most stress (i.e., during shifts where they receive incoming emergency calls, are dispatching emergency services, or doing reassessments) using salivary cortisol as the stress marker. The investigators recruited 22 dispatchers and measured their cortisol levels during each of the three types of shifts as well as on a control day (a day off after at least 8 days of vacation). They randomized the order between the "incoming emergency call" shift and the control day for each dispatcher, as well as the order between the "dispatch" and "reassessment" shifts, but they chose to always have the incoming emergency call shift occur before the other two shifts. During the incoming emergency shift, the investigators sampled saliva at regular intervals starting fifteen minutes after their first life-and-death incoming call. The authors sampled the participants seven consecutive times during the other two types of shifts. The participants also completed an assessment of their perceived stress. The cortisol levels sampled at the ends of shifts tended to be higher after the incoming emergency call shifts than the other two types of shifts, but the difference was not statistically significant (Bedini et al., 2017). When comparing the values collected during the shifts, they found that the incoming emergency call shift and the dispatch shifts had similar kinetics, but the cortisol levels for the incoming emergency call shifts were significantly higher. Additionally, the incoming emergency call shifts and the reassessment shifts showed significantly different kinetics, where cortisol values increased during the incoming

emergency call shifts but decreased during the reassessment shift. Their results show that the dispatchers that work the incoming emergency call shifts anticipating the stressful calls experience more stress compared to the other shifts (Bedini et al., 2017).

The stress of receiving an emergency call also translates to first responders. Paramedics demonstrate an increase in blood pressure while in an ambulance en route to the scene of an accident as well as on the way to and at the hospital (Goldstein, Jamner, & Shapiro, 1992). The demands of paramedics are varied, from having to deal with critical incidents such as multiple casualties and violence being directed toward them to being subjected to a review of their performance. To assess this, paramedics were interviewed and listed several sources of stress due to their work. One commonly cited source of stress was the pace of the work. One paramedic explained that their workload is so much that "[you don't have] the time to dwell upon that call, 'cause the next call is right behind it, and you could be doing a critical incident call and have just brought in somebody who passed away, and then they're on the phone going 'Are you ready to go, are you ready to go, we've got another call'" (Regehr & Millar, 2007). These paramedics have grown to anticipate the lack of recovery time (both physical recovery and psychological recovery) between calls, which only piles on to the stress that they get from receiving calls.

Increasing stress in paramedics during their shift can lead to a decrease in their clinical performance. Leblanc et al. (2012) sought to determine how much stress the paramedics had in varying scenarios and how that stress translated to their clinical performance and the ability to recall relevant patient information. A total of 22 advanced

care paramedics were recruited and completed sessions in which they had to do two simulated clinical scenarios, one being low-stress and the other being high-stress. At the start of the session, the participants were given a rest period where their baseline salivary cortisol and subjective anxiety was measured. After that, they participated in the first clinical scenario, followed by completing the documentation regarding patient care details. They used a cross-over design so that half of the participants completed the low-stress scenario first, and the other half did the high-stress scenario first so that participants could serve as their own controls. Once the first scenario was complete, they had a rest period in which their cortisol levels could return to baseline levels. At the end of that rest period, they completed the second scenario. Their saliva samples and subjective anxiety were measured after completing each scenario.

Each scenario had a similar patient presentation. In the low-stress scenario, the patient was a 50-year-old female presenting with chest pain, and in the high-stress scenario, the patient was a 54-year-old male presenting with chest pain. As the scenario progressed, the patient developed pulmonary edema and became hypotensive, and a 12 lead EKG showed that the patient was having an acute myocardial infarction. In order to create the high-stress situation, there were several additional stressors, including auditory noises (alarms on monitors set to the maximum volume, constant radio noise) and a socio-evaluative stressor in which the actor playing the role of the patient's partner was visibly distressed and challenging the paramedic's decisions (Leblanc et al., 2012).

The authors found that both anxiety and cortisol levels increased more as a result of participating in the high-stress scenario compared to the low-stress scenario. When

evaluating the paramedics' performance, the paramedics did not demonstrate an impairment in their ability to complete each individual task required for the scenario, but they had more errors of commission (i.e., reporting information that was not present in the scenario) in the high-stress scenario than the low-stress scenario. Examples of these include reporting procedures or symptoms that did not occur during the scenario (e.g., aspirin administration and distended jugular veins) and reporting the results of assessments that were not performed (e.g., reduction in chest pain after administration of nitroglycerin). There were no significant differences in the number of omission errors (i.e., failing to recall information present in the scenario) when comparing the low-stress and high-stress scenarios (Leblanc et al., 2012).

These findings of a change in performance under high-stress conditions have important clinical implications. Once the paramedics arrive at the hospital's emergency department with the patient, they must give a report of what happened and the interventions they performed on the patient. If this patient is undergoing cardiac failure to the point where paramedics are delivering chest compressions on arrival to the hospital, it is critical for the hospital team to know what EMS has already done, such as how many ampules of epinephrine have already been delivered. The team at the hospital uses this information to determine how likely it is that the patient has become acidotic, and then determine a course of treatment from there. If the information conveyed to the hospital team is inaccurate, such as more epinephrine being administered than what actually occurred, the hospital team could pursue a course of treatment that could

potentially harm a patient, such as giving them medication to raise their blood pH when that is not necessary.

Combining the increase in stress due to the patient's situation as well as the stress first responders have from anticipating calls and their lack of recovery time could lead to devastating patient outcomes. This is especially important because, in the case of paramedics, stress can affect whether their patient lives, so it is essential that more of paramedic training includes how to cope well with stressful situations to improve outcomes, and for those paramedics that work in understaffed areas, it's imperative that management allow them time to recover between calls so that they can reduce their stress and can perform at their highest level.

Anticipatory Stress: Public Speaking

Public speaking is a widespread cause of anxiety. A 2017 estimate reports that 25% of the general public has a fear of public speaking (Tsaousides). In a survey of public speaking anxiety of over 1,000 undergraduate students, 63.9% reported a fear of public speaking, and that fear is more prevalent among women, students not used to speaking in front of large groups, and those that had negative self-perception of their own voice (Ferreira Marinho, Mesquita de Medeiros, Côrtes Gama, & Caldas Teixiera, 2016). This anxiety leads to a number of consequences, including poor speech preparation, poor speech decision-making, and negative affect and effect in performance, which could further increases the stress experienced while giving the speech (Kangas Dwyer & Davidson, 2012). Additionally, there is evidence that anticipating a public speech

enhances the speaker's attention on social stimuli such as crowd faces, and that there is enhanced processing of angry facial expressions during the anticipation period (Wieser, Pauli, Reicherts, & Mühlberger, 2010).

One study focused on evaluating whether a "pure" psychological stressor (i.e., the silent preparation period before public speaking) is sufficient to elicit a psychologically stressed state and a cardiovascular response, and whether the public speaking task itself further accentuated the response (Feldman et al., 2004). In the study, 43 undergraduate students had their resting blood pressure taken, then watched a 15-minute nature video to induce relaxation. While watching the video, their blood pressure was measured to assess baseline heart rate and blood pressure, then they took a survey to assess their emotional state at the end of the video. Participants were then randomly assigned to the stressor condition (public speaking) or the non-stressor condition (reading written passages aloud). In the stressor condition, the experimenter placed a video camera in front of the participants and informed them that their speech would be evaluated at a later time. They were given a packet of information and were asked to give their speech extemporaneously using that information. The participants assigned to the control condition were asked to familiarize themselves with the packet and then read the information aloud during the task time. All participants' heart rates and blood pressures were measured multiples times during the preparation period, and at the end of the period, they filled out surveys to assess their appraisals and emotions about their speaking task.

During the presentation period, participants in the stressor condition presented their speech for five minutes, and those in the non-stressor condition read aloud from the packet for five minutes. Each participant's heart rate and blood pressure were again measured three times during the speaking task. At the end of the task, they completed the survey again, and after a resting period, they completed another survey called the speech anxiety scale (Feldman et al., 2004). During the preparation period, the participants that did the stressor condition had a greater cardiovascular response compared to those that did the non-stressor condition. Additionally, those that identified as high speech anxious in the stressor group had greater systolic blood pressure responses than the low-speech anxious participants in the stressor group during the preparation period (Feldman et al., 2004). During the task period, the participants in the stressor condition exhibited a greater cardiovascular response compared to the participants in the non-stressor condition. There were no significant differences in the responses of each gender. Contrary to what they expected, there were no additional effects of performing a stressor task on cardiovascular response above those found during the preparation period (Feldman et al., 2004).

These results have important implications, especially for those people that are highly anxious during public speaking tasks. A lot of jobs require good communication skills and working in teams, and speaking in front of groups can be a part of that. In 2014, Forbes found that 70% of employed Americans who give presentations agree that presentation skills are critical to their success at work, yet 20% of respondents said they would do almost anything to get out of presenting, including pretending to be sick or

asking someone else to do it (Gallo, 2014). Given that anxiety about speaking causes negative outcomes like poor preparation and a negative affect during the speech, it is crucial that those people with high public speaking anxiety are able to reduce their stress response before speaking, especially in the context of trying to get a job or giving a presentation in front of other professionals.

Given the results of my study, one way that could reduce the anticipatory stress response undergraduate female athletes is by advising them to stay away from their Facebook accounts; however, because the phenomenon of anticipatory stress can be found in contexts outside of the realm of athletics, it is possible that these results could apply to the greater population. In these contexts, female students taking high-stakes exams might be able to perform better academically, since test anxiety and academic performance are negatively correlated (Chapell et al., 2005). In the context of paramedics, female paramedics might see an increase in their clinical performance if they are able to avoid using their Facebook accounts before a highly stressful patient presentation, however this might not be the case as my study only evaluated undergraduate athletes. When considering public speaking, it is possible that the speaker could have better speech-preparation and a better affect during the speech itself if they are able to refrain from using Facebook during the anticipatory period. In all these cases, the individual could see positive benefits from not using their Facebook account, and given the widespread use of Facebook by teens and young adults, staying away from Facebook during the anticipatory period appears to be a simple and effective way to reduce stress in the female undergraduate athlete population.

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