PERFORMANCE UNDER PRESSURE: A COMPARISON OF NCAA DIVISION I ATHLETES WITH GENERAL COLLEGE STUDENTS

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A thesis submitted to the faculty of the University of North Carolina at Chapel Hill in partial fulfillment of the requirements for the degree of Masters of Arts in the Department of Exercise and Sport Science (Sport Administration).

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ABSTRACT

C. Alexander Rankin: Performance Under Pressure: A comparison of NCAA Division I student-athletes with general college students. (Under the direction of Erianne Weight)

College athletics have faced heavy criticism recently due to increasing revenue generation and cases of misconduct by high profile athletes. Contrarily, there is strong evidence that athletics have a positive effect on the development of individuals personally and professionally. The purpose of this study was to investigate the relationship between the student-athlete experience and the ability to cope with stress and perform in high pressure, non-athletic situations. This was achieved by testing student-athletes and general students in three trials under normal and pressure conditions. The findings suggest that student-athletes are better apt to handle pressure and are therefore less likely to give appraisal to stress, however performance differences were not significant. Findings were somewhat limited by sample size and further investigation into the topic is recommended.
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CHAPTER 1: INTRODUCTION

Division I college athletics have been transformed in major ways over the past few decades. Multi-million dollar facility upgrades are now necessary for most programs to compete at the highest level and new legislation has resulted in significant increases to grant-in-aid scholarship bills. As a result of these increases in spending, coupled with the reality that individuals are now media targets (Carter, 1999) and scandals are rampant (Marshall, 2014), there is an amplified spotlight on college athletics by mainstream media. Misconduct by college athletes, academic or otherwise, is exposed and scrutinized creating a negative reputation for the group as a whole (Chalfin, 2015; Weight & Cooper, 2015).

While past studies have examined vocational happiness and success of graduated student-athletes, not much has been examined regarding preparedness while still in school (Chalfin, 2015; McCann, 2013). This study will serve the field of college athletics by further exploring the concept of athletics as a tool for vocational preparation. These findings will either reinforce or contradict the supposition that college athletics prepare students for professional careers and are an important element of an individual’s development through college. With many public examples of misbehavior in college athletics there are loud arguments that athletics are at odds with the mission of higher education (Chalfin, 2015; Clotfelter, 2011; Marshall, 2014); this study explores whether there is a positive relationship between athletics and higher education by measuring the
difference in performance between Division I student-athletes and general students under simulated pressure.

**Statement of Purpose**

The purpose of this study is to determine the relationship between collegiate athletics participation and the ability to perform tasks in simulated high-pressure situations. Many athletes are faced with high-pressure scenarios during participation in athletic events (i.e. the pressure to play well and win), this study seeks to determine whether those skills are more common in individuals who participate in high level sport. Furthermore, this study seeks to determine whether the ability for athletes to perform under pressure can be generalized to non-athletic situations.

**Research Questions**

Based on the review of literature, the following questions were formed for this study:

RQ 1. Do students who are varsity athletes score significantly higher than students who are not varsity athletes when performing a non-athletic task under simulated psychological pressure?

RQ 2. Do students who are not varsity athletes have a stronger physiological response (heart rate) to simulated pressure than varsity athletes?

RQ 3. Do participants consciously recognize their responses to stress in simulated “high pressure” situations?

**Assumptions**

1. The research methods in this study are valid and reliable.
2. There is minimal difference in performance on simulated task attributed to a “learning” effect.

3. Participants will answer the survey questions truthfully and completely (i.e. limited social desirability bias).

Delimitations

1. This study is only testing UNC student and student-athletes. A suggested future study would be to replicate these research methods with participants from a wide range of NCAA member schools.

2. This study focuses on collegiate varsity student-athletes only, and discounts college graduates that may have participated in athletics at high school, club, or intramural levels.

Limitations

1. This study is limited by the fact that the pressure is simulated. An individual’s reaction to a scenario in a non-experimental environment will differ greatly from their reaction in a controlled environment.

2. The scope of this study is limited in determining the root of any significant findings. The primary similarity of participants is limited to class standing.

Definition of Terms

1. Student-Athlete: For the purpose of this study, the term “student-athlete” will refer to anyone who has participated in an intercollegiate sport at the varsity level for at least one full season. Each student-athlete in the sample will have a class standing of Junior or Senior.
2. Non-Student-Athlete: Anyone who has not participated in an intercollegiate sport at the varsity level for at least one full season. Each non-student-athlete in the sample will have a class standing of Junior or Senior.
CHAPTER 2: REVIEW OF LITERATURE

Educational Effects of Intercollegiate Athletics

Collegiate athletics began blossoming in the mid-19th century and consistently grew with the popularity of American football (Clotfelter, 2011; Smith 2011). Today, many institutions are recognized for their athletic programs and use them as the front porch to their educational endeavors (Bass, 2015; Mixon, 1995; Toma & Cross, 1998). As fan bases have grown and technology has advanced, collegiate athletics have become even more publicly accessible and lucrative. In 2014, the NCAA reported revenue of just under $1 billion (Berkowitz, 2015). These astronomical profits have led many critics to condemn the NCAA and athletic departments for sacrificing educational values and exploiting student-athletes in order to maximize profits. Many of these critics cite a long history of special treatment and academic leniency afforded to high profile student-athletes (Chu, 1989; Clotfelter, 2011; Gayles & Hu, 2009; Pony Express, 2010; Smith, 2011). Chu (1989), for example, discusses instances of grade forging, transcript alterations, and the funneling of athletes into less demanding courses as evidence of this treatment. The desire to keep athletes eligible to play can result in a sacrifice of the academic mission. In a randomly sampled survey by the Chronicle of Higher Education, over 75% of respondents believe college athletes are not held to the same academic standards as traditional students (Suggs, 2003).
There is a growing body of literature that argues these instances of foul play are exaggerated and are not reflective of the overwhelming majority of athletes who use athletics as a supplemental educational experience (Adelman, 1990; Astin, 1993; Brand 2006; Chalfin, 2014). There have been multiple studies supporting the theory that athletic participation and extra curricular activities are beneficial in the emotional, social, and cognitive development of young people (Bonfiglio, 2011; Doty, 2006; Kuh, 2003). Bonfiglio (2011) claims, “the viewpoint widely shared across the academe is that participation in intercollegiate athletics has a positive impact on students and contributes to learning and moral development” (p. 29). These scholars have argued athletics offers a setting for learning that stretches beyond the classroom.

Studies chronicling the benefits of athletics on its participants range from educational achievements like higher GPA (Long & Caudill, 1991), career and life skills (Olivia, 1989), and in social and interaction skills (Doty, 2006). While it is extremely important to note classroom performance and graduation rate, Elias, Wang, Weissburg, Zins, and Walberg (2002) recognize that it is also important to look at the deeper benefits of athletic participation beyond test scores. These include the ability to cope with stress, time management, goal setting, and confidence. Furthermore, these skills are associated with adaptive behaviors outside of the realm of sport, perhaps most importantly in the pursuit of a career (Adelman, 1990; Hardcastle, Tye, Glassey, Hagger, 2015).

Astin (1991) explains the adoption of these skills through the pedagogical theory of student time as a resource. This theory states that student development and achievement is a direct function of the time and effort they devote to attaining their goals. This applies to an athlete’s endeavors towards a college degree as well as their commitment to
collaboration, willingness to receive instruction, and perseverance in athletics. The demands on a collegiate student-athlete’s time are unrivaled, but in most cases the dedication towards their craft and educational interest result in increased personal development (Gayles & Hu, 2009). Another assertion evolving out of this theory is the development of an increased work ethic in student-athletes (Long & Caudill, 1991). While there certainly are exceptions to this notion of an amplified work ethic, it is important to note that the majority of student-athletes in the NCAA are participating and shouldering these commitments voluntarily (How to Register, 2015).

These skills are said to be valuable and necessary after graduation in the labor market (Chalfin, 2014; Long & Caudill, 1991; Shulman & Bowen, 2011). To quantify these claims and determine if college athletic participation yields an advantage in the pursuit of a career, Henderson, Olbrecht, and Polachek (2006) examined wages of former athletes versus non-athletes in a sample of 4,209 subjects, 16 percent of which were athletes. The findings of this study showed that athletes do experience a wage premium, but it is not uniform across all occupations. In the fields of business, military, and manual labor former athletes earn higher average wages. On the contrary though, former athletes have an increased tendency to become high school teachers where they are paid lower wages relative to other teachers. The researchers suppose that this may be due to an inclination to coach while teaching and that former athletes may enter this field knowing their financial return may be lesser.

Much of past literature studying the future occupational rewards of collegiate athletic participation examined wages of athletes versus non-athletes. These studies recognize though, that the paucity of data and the reliance on pecuniary factors such as
GPA limit the ability to draw conclusions (Long & Caudill, 1991; Shulman & Bowen, 2011). The earning power of an individual is greatly affected by a wide array of factors and it is difficult to determine which factors best facilitate it (McNeely, 2011). The current study seeks to find differences in how the experience of a college student can alter their ability to cope in an occupational setting. Specifically, it seeks to determine whether the experience of a student-athlete better prepares them to handle some of the challenges faced in the employment world.

**Negative Emotions and Performance**

Individuals are faced with stressful situations daily in their career endeavors. Many studies have examined the effects of anxiety and burnout arising from workplace stress (Baruch, 2009; Strack, Lopes, & Esteves, 2015). In much of the literature, researchers focus on the negative implications of this psychological stress, but anxiety has also been found to increase productivity and performance in the workplace (Baruch, 2009; Baumeister, 2007; Strack et al., 2015;). The notion of a link between anxiety and an increase in performance originally was met with resistance due to the theory of self-regulatory feedback (Frijda, 1988). This theory states that negative emotions such as fear or anxiety signal to an individual the presence of a threat or a problem. While these negative emotions may be unpleasant or uncomfortable, they result in an increased effort to analyze information and attend to discrepancies (Strack et al., 2015). Originally, the majority of research done on anxiety and increased performance focused on its negative effect within competitive sport (Swain & Jones, 1996; Jones, 2004). Strack et al. (2015), however, found that while some individuals found anxiety to be a debilitating force at work, other subjects
thrive in adverse circumstances. The researchers attributed this boost in performance to the individual’s determination to work harder in order to overcome difficult situations.

Negative emotions have also been shown to have the ability to induce self-critical thinking and result in individuals learning from their mistakes (Baumeister, 2007). These findings lend justification to the idea that anxiety can result in increased performance whether on the playing field or in the workplace by making individuals more prone to critically examine their mistakes. These negative emotions arise from a discrepancy in desired and actual progression towards an individual’s goal. This incongruity then leads the individual to exert greater effort to reach those goals (Clore, 1994; Martin, 1993). This increase in effort and performance is a result of coping strategies that Lazarus and Falkman (1984) define as behavioral and cognitive labor that stems as a conscious reaction to internal and external demands. Individual differences exist in the manner and effectiveness of coping with stress (Moos & Schaefer, 1993). While these studies provide evidence for the theory that negative emotions can be harnessed for positive performance, the case is not the same for all individuals.

Emotional intelligence refers to an individual’s abilities to assess the emotions they experience and help it guide their actions rather than control them (Goleman, 1995). In other words, rather than let an emotion like anxiety or anger result in a rash decision an individual with high emotional intelligence can identify they are upset and think logically about what the most productive solution is. Similarly, there are individual differences in people’s ability to use their emotions for motivation (Goleman, 1998; Mayer, Salovey, & Caruso, 2008). This explains why one individual is hungry for a fast-paced, high-pressure situation while others may shy away. The arousal experienced in such a “do or die”
situation is exhilarating and motivating for some individuals. Given this theory, we can assume individuals will react differently to stress inducing situations and use the associated pressures in varying ways. An individual’s performance, therefore, is contingent upon how they internalize and react to a situation and any associated negative emotions.

An individual’s level of emotional intelligence is vital in understanding how they interact and relate to their peers. Goleman, in his 1995 book introducing this concept, stated that a leader’s ability to perform is more determined by his or her emotional intelligence than by IQ or procedural prowess. The current study attempts to expound upon previous research by comparing two populations of students who interact daily, but experience vastly different routines. We hope to determine whether the experiences of a collegiate student-athlete can increase an individual’s ability to perform in the presence of negative emotions.

**Emotion Regulation**

When we are confronted with negative emotions we react either consciously or automatically in a positive or negative way (Clore, 1994). The process of staying positive in light of these negative emotions is defined as emotion regulation. This regulation of emotion is the process by which individuals stay positive in the face of adversity, keep calm under pressure and prevent being overwhelmed by their feelings (Christou-Champi, 2015). Individuals can either remain calm under stress or be inundated by negative emotions like anxiety and frustration. Furthermore, research has shown emotional regulation and the ability, or lack-thereof, to overcome negative emotions can influence attention, appraisal and physiological responses such as heart rate (Denson, Grisham, Moulds, 2011; Laborde, Lautenbach, Allen, 2015). These effects on the body and mind are
what can alter behavior and increase or decrease performance on a given task. When individuals cannot maintain composure and block out emotions like stress, their physical responses are altered and they may act differently than in non-stressful situations.

It is no surprise that if negative emotions have such a profound effect on an individual’s behavior they are significant factors in workplace performance. In a study examining service industry employee performance and ability to regulate emotions, researchers found employees who could display an outgoing, happy demeanor (despite their true feelings) earned significantly more tips than those who did not (Hülsheger, Lang, Schewe, & Zijlstra, 2015). This lends credence to the theory that individuals who can successfully harness or contain their negative emotions can be more successful in their endeavors. The necessity of employees maintaining their emotions as an element of their job was first introduced to the realm of scientific study by A.R. Hochschild (1983). While these are in reference to jobs in the service industry, similar conclusions were made in the job performance of business and sales people (Mulki, Jaramillo, Goad, Pesquera, 2015; Sheth & Sharma, 2008). Brown, Cron, and Slocum (1997) concluded that emotions are “a powerful psychological force that can affect behavior and performance in important ways” (p. 39) for salespeople.

**Workplace Performance Under Pressure**

In the career realm, the most commonly experienced negative emotions arise from pressure or stress. These consist of the pressure to perform well, to earn a good salary, and to attain achievements or promotions. In many cases, pressure is associated with a tangible incentive. These incentives and the stress they cause result in decreased performance due to loss aversion (Chib, De Martino, Shimojo, O’Doherty, 2012). When an individual’s
focus is more on what they stand to gain or lose from a situation their attention is drawn away from the current task.

Roy Baumeister (1984) trail blazed the study of pressure and incentivized performance. He examined the topic of the colloquial term “choking under pressure” and why performance may decrease in certain situations. His study utilized the “Executive Roll-Up” game, which has a metal ball resting on two rods. The rods are moved horizontally to guide the ball down their slight incline. This game was chosen because it requires motor and visual-motor coordination, but does not give advantage to naturally athletic individuals (Baumeister, 1984). Subjects were scored on their performance while operating in various arousing environments. In this study, self-consciousness was attributed to creating arousal, which in turn disrupts performance on tasks. In other words, when an individual is under pressure they become overtly aware of the importance to execute a behavior correctly. Individuals who rated highly in self-consciousness and awareness of their actions performed better in pressure situations than subjects with low self-consciousness (Baumeister, 1984).

Baumeister explained this by concluding that individuals who are aware of their emotions and behaviors on a regular basis would be able to internalize stressful feelings when under pressure. This is easily applied to the career realm where individuals face stressful emotions on a daily basis through conflict with coworkers, approaching deadlines, and split-second decision-making. Using interpretations from researchers such as Baumeister, it can be concluded that individuals who can better process their emotions are better prepared to succeed in their career.
Theoretical Foundation

The effect of pressure on performance has been classified into two theories, distraction theories and explicit monitoring. The first, distraction theories, suppose that pressure creates a distracting environment shifting attentional focus to extraneous cues, such as the consequences of a poor performance (Beilock and Carr, 2001; Lewis and Linder, 1997; Wine, 1971). Attention to performance competes with attention used for the execution of a given task (Beilock, Kulp, Holt, Carr; 2004). Pressure creates a dual-task environment in which mental resources have to be allocated to the completion of an assignment as well as the distress over the quality of performance. Under this theory we can reason an individual will experience difficulty focusing on the fundamentals or the process behind a task because their attention has been shifted to irrelevant details.

The second theory is of explicit monitoring which presumes the presence of a stressor rests the control of a behavior from a habit or practice-based system to a goal-directed system, in which actions are deliberately selected (Baumeister, 1984; Beilock and Carr, 2001; Beilock et al., 2004; Langer and Imber, 1979). This theory suggests when an individual experiences stress due to pressure they cannot rely on the rehearsed motor program or a practiced behavior and must instead choose each individual action. Whereas an individual will typically rely on automated processes and fluid movements, explicit monitoring suggests attention is narrowed onto each component of an action. In this cases mistakes are more common because the habit formed in practice cannot be relied upon. Beilock and Carr (2001), studied both of these performance theories using a high pressure versus low pressure paradigm in golf putting arithmetic tasks. Participants were split into 3 independent groups, (a) single-task, (b) distraction, and (c) explicit monitoring. The
researchers used a sample of 108 undergraduate students and found performance differences between each group with the single-task group performing the best. Furthermore, they concluded that, “complexity, proceduralization, or both determine susceptibility to choking,” and “a particular training environment can eliminate choking when it does occur” (Beilock and Carr; 2001; pg. 722). In other words, their findings supported the theories of distraction and explicit monitoring having a negative effect on performance. They also found that the decrease in performance could be neutralized by practicing the task in an environment similar to where it will be performed.

**Significance**

Studies have shown educational and social benefits to participating in athletics as a compliment to a structured education. Athletics build transferrable skills such as collaboration, dedication, and social skills required for life after a student graduates (Bonfiglio, 2011; Chalfin et al., 2015). One skill regarded as extremely valuable in the workplace is the ability to maintain composure and harness emotions during difficult times (Hülsheger, 2015; Pergert, Ekblad, Enskar, Bjork, 2008; Sheth & Sharma, 2008). This skill has been studied extensively and broken down into two theories, distraction and explicit monitoring. Individuals are either distracted by the pressure and the outcome of their performance or focus so much on each individual movement of a task that their performance falters (Beilock and Carr, 2001; Beilock, et al., 2004).

Performance under pressure is very closely associated with athletics as athletes showcase their talents in front of thousands of people and many games or competitions come down to a single play or skill execution. As such a lot of the studies on pressure performance have used athletes as participants (Bijleveld and Veling, 2014; Beilock, Carr,
MacMahon, & Starkes, 2002). This topic has also been studied widely in the realm of business where working employees are used as subjects (Mobbs, Seymour, Marchant, Weiskopf, Dolan, & Frith, 2009; Mulki et al., 2015). The current study seeks to further the literature by testing both populations at the same time. We seek to determine whether participation in athletics fosters an ability to perform positively in high-pressure situations; or whether individuals who choose to participate in sport at a high level are inherently superior in performing under duress. Our hypothesis is that student-athletes’ performance on tasks under simulated pressure will be more positive than the subject group that are not Division 1 athletes.
CHAPTER 3: METHODOLOGY

Subjects

The target populations for this study were current junior and senior Division I NCAA athletes and college students who have never participated in varsity collegiate athletics. For the purposes of this study, the non-athlete students were selected through a convenience sample drawn from junior and senior participants in Lifetime Fitness (LFIT) courses with a high proportion of upper-division enrollments at the University of North Carolina. The sampling method was selected for the non-athlete population because every student at this university must fulfill the course as a requirement. Therefore the classes present a good sampling of students from across all disciplines and majors. These classes consisted of 25-30 students each and over multiple classes provided enough participants for n = 28. The athlete sample was drawn through quota sampling utilizing athletes who were enrolled in the LFIT courses, and direct recruitment in order to fill the desired strataums of junior or senior athletes. Both groups were given the voluntary opportunity to take part in this study and the sample size was dependent on the rate of participation.

The researcher worked with departmental personnel to identify the LFIT courses with varsity athletes enrolled. Subjects were approached in their LFIT class by the researcher and told about the study (The in class visit lasted approximately five minutes per class). Informed consent forms were passed around for students to sign. Those who returned signed consent forms were chosen for participation. As a contingency plan after
low participation rates, the researcher contacted the Baddour Carolina Leadership Academy in an attempt to contact additional student-athletes.

**Data Collection**

When participants arrived, they were first asked to put on a fingertip heart rate monitor to track physiological responses during control and pressure test phases (Denson et al., 2011; Lautenbach et al. 2015). This heart rate monitor slips over the index finger of the non-dominant hand and records pulse in a manner that is non-invasive. Following this, participants were asked to fill out a demographic survey including information about race, gender, sport (for the athlete sample), class standing, and GPA.

Each subject then participated in trials consisting of three tests, the Executive Roll Up game, the game Perfection, and a short-term memory recall test of various neutral images. Each test was comprised of three trials, a practice run, a pre-treatment phase to serve as the control (with no simulated pressure), and the treatment phase (pressure induced). Participants completed all tasks on the same day. Three trials were chosen due to the adaptation of previous studies on performance pressure (Balk et al., 2013; Baumeister, 1984; Beilock and Carr, 2001). A practice trial was used to allow the participant to gain comfort with each of the tasks and to minimize any effect of practice between experimental groups.

The pre-pressure phase practice trial involved the subject completing the tasks for 30 seconds each without disclosing any time constraints to the participant. After this trial session two of testing began. In session two the subject was informed that they had a specific amount of time to complete each of the tasks, but that they should not focus on the score of their attempts or the time remaining. The researcher scored each test to serve
as a baseline. Following the completion of each test trial three of testing began. A camera and tripod was set up to force the participant to be more self aware and focus on their behavior, although no video recording took place (Balk, Adriaanse, Ridder, Evers, 2013). To further induce perceived pressure, the researcher told the participant that their score was in the 35th percentile. This was done in an attempt to make the participant focus harder on their performance in an attempt to improve their score (Baumeister, 1984).

After the completion of the third phase of testing, the subject completed a reflective survey from the Intrinsic Motivation Inventory to check whether experimental manipulation was successful in inducing pressure (Balk et al., 2013; Ryan, 1982). Items are answered on 7-point Likert scales (e.g., "I felt pressured", 1 = totally disagree, 7 = totally agree). Following this inventory subjects were debriefed on the study and the deception that took place and thanked for their participation. See Figure 1 for further illustration of the progression of trials.

Figure 1

Progression of Trial Conditions

<table>
<thead>
<tr>
<th>Practice Trial</th>
<th>Pre-pressure Trial</th>
<th>Pressure Trial</th>
</tr>
</thead>
<tbody>
<tr>
<td>No time cues</td>
<td>No time cues</td>
<td>False feedback</td>
</tr>
<tr>
<td>No score kept</td>
<td>Score is kept</td>
<td>Camera introduced</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Time cues given</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Score is kept</td>
</tr>
</tbody>
</table>

Building upon the Baumeister (1984) pressure simulation study, two games were chosen as test material. The first test used "Executive Roll-Up." Scores were calculated on a scale of 1-6 and were determined by how far the ball rolled. Participants were given a 45-
second testing period to record their highest score. Each score was recorded and at the end averaged to determine the composite score for each testing phase. The second test utilized the game "Perfection" where subjects had two, 30-second trials to complete the game. This game was chosen due to its audible countdown timer. In a study by Bowman and Wittenbaum (2012), it was found that in situations with time constraints causing pressure, performance could be affected negatively due to shifts in attentional focus. A score was determined by the quantity of shapes correctly inserted into the game board with a maximum of 25. The two scores were averaged after each trial to determine the composite score. During the practice and baseline trials the game’s timer was not used and the researcher kept track of time. During the pressure phase the game’s timer was employed so the participant was aware of time constraints. The memory test consisted of viewing a set of 10 ordinary (emotionally neutral) images for 15 seconds (Sligte, Lamme, & Scholte, 2008). After a 10 second break the participant recorded as many images as they could remember. The memory test was administered once per testing phase and a new set of images was used during each.

**Data Analysis**

After entering the quantitative data compiled from the testing into Statistical Package for the Social Sciences software (SPSS), various statistical tests were run to analyze the results. Eight independent sample $t$-tests were run to compare differences between group means (student-athlete, general student) on each trial. Ten paired sample $t$-tests were also run to compare differences within groups from the pre-pressure to post-pressure trials with an a priori p-value set to $p = .05$. 
CHAPTER 4: RESULTS

Demographics

Of the 28 participants for this study, 71.4% (n=20) have never played collegiate athletics, while the remaining eight (28.6%) are student-athletes. 21 participants (75%) were female and 25% (n=7) were male. The majority of the participants (67.8%, n=19) identified as being white, while four (14.28%) identified as African-American, and 17.8% (n=5) identified as other. A complete list of demographic information is presented in Table 1.

Table 1

Demographic information of participants

<table>
<thead>
<tr>
<th></th>
<th>%</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Student-athlete Status</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>28.6%</td>
<td>8</td>
</tr>
<tr>
<td>No</td>
<td>71.4%</td>
<td>20</td>
</tr>
<tr>
<td><strong>Sex</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>25%</td>
<td>7</td>
</tr>
<tr>
<td>Female</td>
<td>75%</td>
<td>21</td>
</tr>
<tr>
<td><strong>Ethnicity</strong></td>
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<td></td>
</tr>
<tr>
<td>White</td>
<td>67.8%</td>
<td>19</td>
</tr>
<tr>
<td>African-American</td>
<td>14.28%</td>
<td>4</td>
</tr>
<tr>
<td>Other</td>
<td>17.8%</td>
<td>5</td>
</tr>
</tbody>
</table>
Task Performance Results: Between Groups

All twenty-eight participants were tested while performing the 3 previously discussed trials. The average change in score from a participant’s first trial to their second trial is the measurement of interest. Executive Roll-Up was scored on a 1-6 scale based on performance. The mean change for student-athletes on Executive Roll-Up was -.1034 (SD = .56), while the mean change for general students was slightly lower (M = -.1032, SD = .76). Using an Independent Samples t-test this difference was not found to be significant at t(26) = -.001, p = .999.

In the Perfection task the number of pieces correctly inserted into the game board within the allotted time determined the task score with a maximum score of 25. Two trials per pressure condition were averaged into a composite score for each participant. On this task student-athletes experienced a positive mean performance change of .9375 (SD = 1.18) pieces while under enhanced pressure, while general student’s performance decreased from trial 1 (pre-pressure) to trial 2 (post-pressure) (M = -.45, SD = 2.7). This difference in means was approaching a significant effect for athlete status, t(26) = 1.39, p = .137.

The final trial was a short-term memory test involving 10 emotionally neutral images, with a new set being used for each condition. Scores were determined by the number of images correctly recalled after 15 seconds of studying and a ten second break. The student-athlete sample experienced a slight short-term recall decrease from the pre-pressure trial to the post-pressure trial (M = -.25, SD = 1.9) and the general student population also experienced a mean decrease of M = -.45 (SD = 1.96). These differences
were not found to be significant with \( t(26) = .246, p = .916 \). The results for these three trials are further illustrated in Table 2.

![Image](image-url)

**Table 2**

*Task Performance Results: Between Groups*

<table>
<thead>
<tr>
<th></th>
<th>( \Delta M )</th>
<th>SD</th>
<th>( t )</th>
<th>( p )</th>
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<tbody>
<tr>
<td>Executive Roll-up Change</td>
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<td></td>
<td>.999</td>
<td></td>
</tr>
<tr>
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<td>-.1034</td>
<td>.56</td>
<td></td>
<td></td>
</tr>
<tr>
<td>General Student</td>
<td>-.1032</td>
<td>.76</td>
<td></td>
<td></td>
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<tr>
<td>Perfection Change</td>
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<td></td>
<td>.137</td>
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<tr>
<td>General Student</td>
<td>-.45</td>
<td>2.704</td>
<td></td>
<td></td>
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<tr>
<td>Memory Task Change</td>
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<td></td>
<td>.916</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>General Student</td>
<td>-.45</td>
<td>1.959</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Notes.* Possible scores for Executive Roll-up scores ranged from 1-6, Perfection ranged from 1-25, and the Memory Task ranged from 1-10. The difference was calculated by subtracting participants’ score on Trial 1 from their score on Trial 2.

**Task Performance Results: Within Groups**

A paired samples \( t \)-test was run for each group comparing results on trial 1 to those on trial 2 within each group. Student-athletes’ mean change of -.1034 (\( SD = .56 \)) was not found to be significant in Executive Roll-Up, with \( t(7) = -.52, p = .619 \). General students’ change (\( M = -.1032, SD = .76 \)) was also found to not be significant for Executive Roll-Up at \( t(19) = -.61, p = .549 \). Student-athletes’ performance change in perfection (\( M = .94, SD = 1.18 \)) was significant at the \( p < .1 \) level with a positive direction at \( t(7) = 2.25, p = .059 \), while general students’ (\( M = -.74, SD = 2.7 \)) difference...
was negative with \( t(19) = -0.744, p = .466 \). Paired samples test for short-term memory also did not yield significant results with student-athletes (\( M = -0.25, SD = 1.91 \)) experiencing a level of \( t(7) = -0.37, p = .722 \) and general students (\( M = -0.45, SD = 1.96 \)) at \( t(19) = -1.027, p = .317 \). Full statistical results for this paired samples \( t \)-test can be seen in Table 3.

Table 3

Task Performance Results: Within Groups

<table>
<thead>
<tr>
<th></th>
<th>( \Delta M )</th>
<th>SD</th>
<th>( t )</th>
<th>( p )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student-athletes</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ExRollChange</td>
<td>-0.1034</td>
<td>0.56</td>
<td>-0.52</td>
<td>0.619</td>
</tr>
<tr>
<td>PerfChange</td>
<td>0.94</td>
<td>1.18</td>
<td>2.25</td>
<td>0.059</td>
</tr>
<tr>
<td>MemChange</td>
<td>-0.25</td>
<td>1.91</td>
<td>-0.37</td>
<td>0.722</td>
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<tr>
<td>General Students</td>
<td></td>
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<td>0.549</td>
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<td>PerfChange</td>
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<td>-0.744</td>
<td>0.466</td>
</tr>
<tr>
<td>MemChange</td>
<td>-0.45</td>
<td>1.96</td>
<td>-1.027</td>
<td>0.317</td>
</tr>
</tbody>
</table>

Notes. Possible scores for Executive Roll-up scores ranged from 1-6, Perfection ranged from 1-25, and the Memory Task ranged from 1-10. The difference was calculated by subtracting participants’ score on Trial 1 from their score on Trial 2.

Heart Rate Response: Between Groups

Heart rate was calculated throughout the experiment as a measurement of physiological stress response. For the purpose of analysis there were two comparisons of heart rate after being measured at a baseline, after the pre-pressure Perfection trial, and after the post-pressure Perfection trial. The mean difference in heart rate taken at baseline and post-pressure for student-athletes was 13.125 bpm (\( SD = 7.17 \)) while general students experienced less heart rate change with a mean of 7.2 bpm (\( SD = 8.65 \)). This difference was approaching significance with \( t(26) = 1.656, p = .110 \). Heart rate taken after the pre-pressure trial was also compared with heart rate after the pressure trial and student-
athletes experienced a mean change of 5.625 bpm \((SD = 7.17)\) while general students experienced less of a physiological response \(M = 3.3.5, SD = 6.499\), which did not prove to be significant at \(t(26) = .813, p > .05\). These means are further illustrated in Table 4.

\[
\begin{array}{llll}
& \Delta M & SD & t & p \\
\hline
HR Baseline – Post-pressure Difference & 1.656 & .110 &  \\
Student-athlete & 13.13 & 8.27 &  \\
General Student & 7.2 & 8.65 &  \\
HR Pre-pressure – Post-pressure Difference & .813 & .423 &  \\
Student-athlete & 5.63 & 7.17 &  \\
General Student & 3.35 & 6.5 &  \\
\end{array}
\]

*Note:* Difference was determined by subtracting heart rate at baseline or pre-pressure condition from the heart rate at post-pressure.

Heart Rate Response: Within Groups

A paired samples \(t\)-test was run to compare heart rate response change from baseline to post-pressure and from pre-pressure to post-pressure within each group.

Student-athletes’ heart rate increased by a mean of 13.13 bpm \((SD = 8.27)\) from baseline to post-pressure with a significant effect of \(t(7) = 4.488, p < .05\). General students’ heart rate increased by a mean of 7.2 bpm \((SD = 8.65)\) causing a significant effect at \(t(19) = 3.72, p < .01\).

When student-athletes’ heart rate was compared from the pre-pressure trial to the post-pressure trial there was a mean increase of 5.63 \((SD = 7.17)\), which approached significance at \(t(7) = 2.219, p = .062\). Though general students did not have a more
profound effect, with a mean change of 3.35 (SD = 6.5), the pressure effect on heart rate reached significance at $t(19) = 2.305, p < .05$. Full statistical analysis of these paired samples $t$-tests can be seen in Table 5.

<table>
<thead>
<tr>
<th></th>
<th>$\Delta M$</th>
<th>SD</th>
<th>$t$</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>HR Baseline – Post-pressure Difference</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Student-athlete</td>
<td>13.125</td>
<td>8.27</td>
<td>4.48</td>
<td>.003</td>
</tr>
<tr>
<td>General Student</td>
<td>7.2</td>
<td>8.65</td>
<td>3.72</td>
<td>.001</td>
</tr>
<tr>
<td>HR Pre-pressure – Post-pressure Difference</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Student-athlete</td>
<td>5.625</td>
<td>7.17</td>
<td>2.219</td>
<td>.062</td>
</tr>
<tr>
<td>General Student</td>
<td>3.35</td>
<td>6.499</td>
<td>2.305</td>
<td>.033</td>
</tr>
</tbody>
</table>

Note: Difference was determined by subtracting heart rate at baseline or pre-pressure condition from the heart rate at post-pressure.

**Intrinsic Motivation Inventory**

Participants filled out a reflective survey after the completion of this experiment’s tasks. The survey’s intention was to quantify an individual’s effort on the tasks as well as his or her perception of pressure from the induced stimuli. The scale was split into 3 scores – Motivation, Pre-pressure, and Pressure and were scored on a scale of 1 to 7 with 1 being of the lowest intensity and 7 being of the highest. The motivation score measures the amount of effort an individual placed on trying to score well on the tasks. Student-athletes had a mean response of 5.325 (SD = 1.347), while general students responded similarly with a mean of 5.65 (SD = 1.03) indicating a moderate amount of pressure experienced. This $t$-test comparison was not found to be significant with $t(26) = -.69, p > .05$. 
The pre-pressure score measures how much pressure or stress an individual experienced before the external stimuli were introduced. Student-athletes had a mean response of 2.5 (SD = 1.53) indicating a minimal amount of pressure experienced, while general students reported feeling more pressure (M = 3.9, SD = 1.577). This difference was found to be significant with \( t(26) = -2.136, p < .05 \). The pressure score was a similar measure, but reflects the greatness of pressure experienced after the conditions were introduced. Student-athletes reported a mean response of 3.54 (SD = 1.58), while general students responded with a mean of 5.33 (SD = 1.002). This comparison was found to be significant with \( t(26) = -3.607, p < .001 \). See Table 6 for the statistical impact of each group on the Intrinsic Motivation Inventory.

Table 6

<table>
<thead>
<tr>
<th>Intrinsic Motivation Inventory</th>
<th>M</th>
<th>SD</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
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<td>Motivation Score</td>
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<td></td>
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<td>.496</td>
</tr>
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<td>Student-athletes</td>
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<td>1.347</td>
<td></td>
<td></td>
</tr>
<tr>
<td>General Students</td>
<td>5.65</td>
<td>1.03</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre-pressure Trial Self Report Score</td>
<td></td>
<td></td>
<td>-2.136</td>
<td>.042</td>
</tr>
<tr>
<td>Student-athletes</td>
<td>2.5</td>
<td>1.53</td>
<td></td>
<td></td>
</tr>
<tr>
<td>General Students</td>
<td>3.9</td>
<td>1.577</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Post-pressure Trial Self Report Score</td>
<td></td>
<td></td>
<td>-3.607</td>
<td>.001</td>
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<tr>
<td>Student-athletes</td>
<td>3.54</td>
<td>1.58</td>
<td></td>
<td></td>
</tr>
<tr>
<td>General Students</td>
<td>5.33</td>
<td>1.002</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note*: Scale ranged from 1 (no pressure) – 7 (extreme pressure).
CHAPTER 5: DISCUSSION

Theoretical Implications

There were many theories explored for the foundation of this study. Three theories will be used primarily in the interpretation of these results. The first, self-regulatory feedback, supposes that negative emotions are interpreted by an individual and are a catalyst to either improve or decrease performance (Baumeister, 2007; Strack, 2015). The second theory addresses the appraisal of stress using Lazarus and Falkman’s (1984) coping mechanism theory. Individuals that can successfully cope with stressful environments are less likely to report feeling that pressure or stressor (Denson, T. F., Grisham, J. R., & Moulds, M. L., 2011). The third theory used for the interpretation on this data is the concept of competitive nature and it’s effect on physiological arousal (Wankel, 1972). Athletes have been attributed with a higher than normal propensity for competition in previous studies and this has a direct implication into these conclusions (La Roche, 2013).

Task Performance: Student-athletes v. General Students

This study sought to empirically test findings of previous studies asserting that certain individuals are better apt to handle outside stressors and stimuli when performing tasks (Bijleveld and Veling, 2014; Beilock et al., 2002, Mulki et al., 2015), specifically exploring whether there was a difference between samples of collegiate student-athletes and general college students. The trends in the data demonstrate that a relationship may
exist in the ability to perform under pressure between collegiate varsity athletes and non-athlete populations, but further testing is needed to gain significant results.

Though significant differences were not found in the comparison of general students to student-athletes on performance change in the Executive Roll-Up task, there was a difference in mean change between student-athletes and general students of approximately .0002 units, and there was much more variability in the non-athlete sample with the non-athlete sample standard deviation nearly three times larger than the athlete sample. This illustrates that while each group averaged out in a similar fashion, there were far more extreme outliers in the general student sample. With such a small sample size the mean difference was obviously affected by these outliers and therefore is a clear indication that further study must be done to secure a larger sample.

While results on the perfection task were also not found to be significantly different between groups, it is interesting to note the direction of scoring for each sample. Student-athletes actually experienced a rather large performance increase from the pre-pressure trial to the pressure trial. This deviates from all other results as well as the hypothesis. This trend is possibly explained by the theory that negative emotions can induce self-critical thinking and cause individuals to learn from previous mistakes (Baumeister, 2007). The false feedback provided to each participant gave him or her the impression that they had performed far below average. This can either be interpreted as a sign that an individual is bad at a given task or it can be used as fuel to improve in the next trial.

Clore (1994) argues that an incongruity in desired and actual progression towards a goal results in a greater effort to reach those goals. Previous studies have found the
development of a higher level of work ethic in student-athletes as a result of the constant practice and necessity of improvement in their sport (Long & Caudill, 1991). This notion supports the idea that student-athletes would try harder on their second trial of Perfection and learn from their mistakes, especially after a critical review.

The short-term memory task was found to have no significant results between groups. This could be attributed to a simple fact of no difference between student-athletes and general students, or that short-term memory does not differentiate in a great enough manner in similarly aged groups to warrant significant results. The most cited figure for capacity of short-term memory is 7 (+/- 2) items (Miller, 1956). This figure is supported by the findings with an overall mean of 7.2 images recalled. Additionally, previous studies are uncertain whether short-term memory is significantly affected due to external stimuli. In fact, some studies assert that integration of outside information can increase memory accuracy and should be used as a strategy for improvement (Huttenlocher, Hedges, & Duncan, 1991; Huttenlocher, Hedges, & Vevea, 2000). Both group’s performance on the short-term memory test decreased slightly from trial 1 to trial 2, but by less than one full image. Therefore, we cannot argue that any group is more apt to handle this situation and we must examine further whether it is an accurate measure for this comparison.

**Intrinsic Motivation Inventory**

The Intrinsic Motivation Inventory was introduced in this study not solely to compare groups, but also to validate the study’s methods. Had respondents not exerted effort nor reported feeling pressure, the results would be invalid. The comparison of effort between the two groups using the motivation score was found not to be significant.
This is an important finding because it shows that neither group was statistically different in their desire to perform well on these trials. Had these responses been significantly different the study results could not be interpreted accurately because one group would not have participated on the trials with the same intention of success. Additionally, both groups responded with means above 5 out of 7 reflecting that there was a concerted effort toward achieving success on the trials.

An interesting finding is the significant difference among pre-pressure scores. General students had significantly higher responses than student-athletes to feeling stressed before the conditions were even introduced. This supports assertions made in Balk et al. (2013) that athletes’ consistent performance under observation could make them more apt to coping with pressure. Merely entering the research environment and being observed induced more pressure on general students than it did on student-athletes, possibly in part to student-athletes’ day-to-day environment performing in front on an audience.

After the pressure stimuli were introduced the difference between the two groups’ response became even greater with a pressure score difference of 1.79 and a p < .001. Even after these stimuli were introduced student-athletes responded with a mean of 3.54 (SD = 1.58) on a 1-7 scale to questions such as, “I felt very tense while doing the 3rd trial activities.” This score means that the average student-athlete in the sample did not report feeling pronounced arousal during these tasks and would explain their ability to block out the external variables. Additionally, the ability to successfully cope with a stressful environment has been previously shown to decrease an individual’s appraisal of that stress (Denson, Grisham, Moulds, 2011). While student-athletes experienced all the same
stressors as the general students, their appraisal was lower possibly due in part to their ability to cope with the stress (Kimball & Freysinger, 2003).

**Heart Rate Change**

Heart rate was measured in this study in an attempt to quantify physiological response to stressors introduced to the testing environment. Heart rate change was found to be significant for both student-athletes and general students from the baseline measurement to the post-pressure measurement further validating the test’s introduction of pressure. The argument that simply being in a test environment could be responsible for this increase in heart rate can be discounted because there was an additional significant increase from the pre-pressure to the post-pressure measurement for general students. While student-athletes did not see a statistically significant increase from pre-pressure to post-pressure, at $t(7) = 2.219, p = .062$ it was very closely approaching significance and likely would have with a larger sample. This spike in heart rate can be attributed to the arousal experienced when the pressure conditions were introduced to the environment (Denson, Grisham, Moulds, 2011; Laborde, Lautenbach, Allen, 2015). These physiological responses paired with the IMI responses clearly indicate that test conditions successfully induced pressure.

While no significant result was found in the comparison between groups, it does not discount the possibility of an automatic response to pressure. After examining the mean heart rate change from each group we see that student-athletes beats per minute increased by an additional 5 beats compared to general students. While we cannot argue any correlation it is important to note Wankel’s (1972) assertion that rivalry and the presence of an audience are components of competition, which in turn increases arousal.
More data needs to be collected to make an assertion, but this trend of heart rate increase reflects the theory that athletes may display a greater tendency for competitive nature (La Roche, 2013). See Chart 1 for further illustration in the comparison of progression of student-athlete and general student heart rate.

Chart 1

Heart Rate Progression

An interesting finding was noticed when comparing responses on the Intrinsic Motivation Inventory with heart rate. General students and student-athletes had a very similar mean BPM during the pre-pressure measure, yet general students reported feeling significantly more stressed at this time. Student-athletes’ BPM then increases higher than general students’ despite reporting a lesser amount of stress during the post-pressure trial. These differences can be attributed to the physiological arousal stemming from a competitive nature and the intensity placed on improvement during the 2nd trial. While student-athletes had a more pronounced physiological response they did not report consciously
feeling pressured due to their ability to internalize the stress and use it as fuel for improvement (Baumeister, 2007, Clore, 1994; Martin, 1993).

**Further Experimentation**

This study could not make conclusions of the magnitude it intended because of its small sample size, especially in regards to student-athletes. Further study should be completed to increase the number of participants in both groups using this as a pilot. The trend in data shows the possibility that student-athletes may in fact perform better under pressure, as their mean performance decrease was lesser than general students across the board. The null hypotheses cannot be rejected between groups on the trials due to a lack of statistical significance.

The measures taken to induce pressure have been validated with physiological response (heart rate) and participant reflection both supporting an increase in arousal due to external stimuli. These methods can and should be employed in further study. A possibility for expounding on these methods is to use the video camera to record and code behavioral cues of participants. This would broaden the scope of comparisons made between groups. The trials used for measurement, while not significant in this study should not be ruled out in future studies. The Executive Roll-Up task, previously employed by Baumeister (1984), was proven valid but in this instance the variance in subjects was so great and the sample so small that outliers played a large factor in analysis. Similarly, Perfection began approaching significance in the between groups comparison with \( t(26) = 1.387, p = .137 \). Furthermore, student-athletes’ scores actually improved from the pre-pressure to pressure trial on Perfection contrary to the
expectations of the researcher and trends in all other trials. This is believed to be reason to further explore this measurement with a larger sample.

The exception to the conclusion on measurements is the short-term memory trial. With a widely accepted capacity of 7 items, +/- 2, in short-term memory, the researcher believes that there is not enough variance to warrant significant results (Cowan, 2015). While memory can still be used as a measure in future studies, the researcher believes that the process of immediate recall should be dropped, instead replacing it with measures of encoded memory. This could be done, for example, by presenting images at the beginning of each trial and having them recalled at the end of the trial rather than after a 10-second break. One possibility would be to use a system of cued recall in which a given item is paired with a probe item and the association must be correctly identified (Hunt, Smith, & Toth, 2016).

While we cannot make claims from this study that student-athletes do perform significantly better under pressure and are therefore better prepared for a high-intensity work environment, it is believed that the trend in results provides support for this assertion and further examination. The test procedures were for the most part validated and can be refined for further experimentation. This study should serve as a pilot for future studies examining differences in performance under pressure between collegiate student-athletes and general college students or other sub populations of interest.
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Miller, G. A. (1956). The magical number seven plus or minus two: Some limits on our capacity for processing information. Psychological Review, 63, 81–97


