MINDFULNESS AND ANXIETY AS PREDICTORS OF SWIMMING PERFORMANCE UNDER PRESSURE

by

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STATEMENT BY AUTHOR

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Abstract

Choking under pressure is a devastating experience for athletes who have invested their time and energy to master a sport. This study reviewed the mechanisms of choking under pressure to further understand the phenomenon and identify possible remedies. Twenty-eight competitive swimmers from the University of Arizona swim team were assessed on measures of dispositional mindfulness and trait anxiety, while three current staff members rated each athlete on measures of skill transfer and receptiveness to feedback. Athlete performances were recorded over the course of one season, and assigned a pressure rating of low, medium, and high. Results indicated significant effects of pressure on change in performance, and revealed non-significant trends between trait anxiety, mindfulness, and performance improvements as a function of pressure. Significant relationships were also found for trait anxiety with mindfulness and gender. Coach ratings were not found to be accurate predictors of improvements in swimming performance. These findings call into question theory suggesting trait anxiety is facilitative when low and detrimental when high, instead suggesting it may distribute as an inverse-u relative to performance. They also suggest dispositional mindfulness may be facilitative of performance under pressure, an endorsement for continued research into the efficacy of mindfulness training in athletics. Finally, they call into question the accuracy of coach ratings of athletes, and reveal a need for further investigation in that area. Implications for choking under pressure are discussed.

Chapter 1: Introduction

General Overview of Field

Every four years, around 2,000 of the most elite of USA Swimming's more than 350,000 year-round and seasonal members compete at the U.S. Olympic Trials for one of fewer that 50 total spots on the Olympic team roster—there were 45 athletes on the 2016 roster for the USA. In other words, of the less than 1% of the total membership competing for the opportunity, 95% will fail to make the team. Given the limited opportunities, the stakes are incredibly high. One might expect most athletes to turn in performances of a lifetime with so much on the line; but few are up to the challenge. At the 2012 Olympic Trials, merely 19% of women and 32% of men outperformed their seed times (Mering, 2016).

The author competed at those 2012 Olympic Trials, and was one of nearly three-quarters of male athletes that failed to match or surpass his lifetime best performances in his qualified event(s). I've since sought explanation and solutions for this specific phenomenon, and more generally athletes' failure to perform in high pressure situations, particularly in swimming.

Problem

While surely not the sole contributor, I believe it is fair to say that the unique pressure of the Olympic Trials is largely to blame for this disproportionate number of substandard performances turned in by participants. The national coverage the sport receives every four years for the Olympic Games is unmatched by that for the other major national and international meets in the years between, including the bi-annual World Championships. Many competitive swimmers grow up fueled by an Olympic dream, so it is understandable that some may be overwhelmed at the Olympic Trials with that goal in arms reach.

For all the pomp and circumstance associated with the Olympic Trials, nothing is won for the U.S.— or any other national team—until the Olympic Games. If athletes are failing to perform to their potential at the qualifying meet, this may prevent a national team from fielding the best possible roster for the Games, and furthermore may manifest itself in substandard Olympic performances. The ability to perform under circumstances of high pressure and expectations is a necessity for individual and team success at the international level.

For the other 99% of athletes not competing at the Olympic Games, failing to perform under pressure still has consequences. Not qualifying for a national team could be the difference between thousands of dollars in sponsorship monies; missing out on a championship final could harm team standings at an NCAA meet; failing to achieve a qualifying time could cost an athlete scholarship offers or a spot on her desired college team. In a sport where only one person can be the "winner," the best a swimmer can ask for is to maximize his or her own potential. Unfortunately, even for the well-trained athlete, the potential to crumble under the weight of expectations can erase years of hard work and dedication. For these reasons, understanding how and why some athletes may "choke" under pressure, and creating strategies to overcome this mental hurdle, can help swimmers at all levels.

Theoretical Basis

The following theoretical considerations inform the design of this study and general exploration into the issue of choking under pressure.

Anxiety and Choking Under Pressure

Research demonstrates that stress or pressure can hinder motor-skill performance (Arora et al., 2010; Baumeister, 1984; Lazarus, 1952; Liao & Masters, 2002; Yerkes & Dodson, 1908).

Of interest to this study are the two dimensions of state anxiety (cognitive and somatic), trait anxiety, and the different roles of each in mediating the stress-performance relationship. Specifically, heightened cognitive anxiety appears to be related to diminished athletic performance because athletes are more likely to adopt maladaptive coping strategies such as self-handicapping, or engage in internally-focused attention during performances (Burton, 1988; Jackson, Ashford, & Norsworthy, 2006; Masters & Liao, 2002). Meanwhile, trait anxiety may mediate this relationship by directing the cognitive response to stress. Operational definitions and contemporary research for these terms will be discussed in the subsequent sections. Unfortunately, efforts to solve this issue by reducing anxiety have not proven to be fruitful (Hardy, Jones, & Gould, 1996; Gardner & Moore, 2006).

Mindfulness and Performance

Mindfulness is presented as an alternative to anxiety-reduction strategies. Dispositional mindfulness and related interventions instead promote awareness and acceptance of experience—including anxiety—and may facilitate a more adaptive form of self-focus to aid skill performance (Gardner & Moore, 2012). Albeit often with small samples, several studies have shown dispositional mindfulness and mindfulness interventions to enhance athletic performance, with sustained effects (Gardner & Moore, 2004; Gooding & Gardner, 2009; Thompson et al., 2011; Zhang et al., 2016). Furthermore, mindfulness has been demonstrated to be moderately negatively correlated with anxiety, evidence that mindfulness may create a level of resistance to extreme anxiety (Walsh et al., 2009).

Coach Ratings of Athletes

Of additional interest in this study were coach ratings of athletes, particularly for skill transfer and receptiveness to feedback. Coach feedback has been demonstrated to vary as a function of coach evaluations, and subsequently impact the athlete experience (Black & Weiss, 1992; Sinclair and Vealey, 1996; Solomon, 1990). I suspect those most resistant to choking under pressure are effective at incorporating coaching feedback to make changes, and transferring the skills developed in a training environment into performances. Coach feedback may be threatening because it can reveal coach assessments of athlete ability (Conroy et al., 2010). This study will test the theory that the non-judgmental nature of mindfulness protects athletes from ego-threat, resulting in greater receptiveness to coaching feedback and ultimately improved performance.

Statement of Purpose

Performance situations in which expectations and stakes are high can engender anxiety within participants, which may subsequently harm performance. Counterintuitively, efforts to reduce anxiety do not appear to improve performance. This study set out to determine if high dispositional mindfulness helps alleviate the detrimental effects of performance expectations by promoting acceptance of anxiety, as well as improving receptiveness to coaching feedback due to a greater resistance to ego-threat. This was tested by comparing self-report ratings of dispositional mindfulness and trait anxiety, and coach ratings of skill transfer and receptiveness to feedback, to improvements in swimming performance times as a function of pressure. Secondary objectives of the study were to investigate the relationship between dispositional mindfulness and coach ratings of receptiveness to test the ego-threat theory, the accuracy of coach ratings in swimming to determine the utility for future research and practical application, as well as the previously demonstrated inverse relationship between trait anxiety and dispositional mindfulness.

Research Questions and Hypotheses

The following research questions were investigated:

Research Question 1: Does high dispositional mindfulness improve swimming performance as a function of pressure?

Hypothesis 1: Performance improvements will be significantly greater for participants with high dispositional mindfulness for the high-pressure swim.

Research Question 2: Does trait anxiety harm swimming performance as a function of pressure?

Hypothesis 2: Performance detriments will be significantly greater for participants with high trait anxiety for the high-pressure swim.

Research Question 3: Are coach ratings of athlete skill transfer accurate predictors of improvements in swimming performance?

Hypothesis 3: Performance improvements under all conditions will be significantly greater for participants rated "over-performing" on coach ratings of skill transfer, and significantly less for participants rated "under-performing."

Research Question 4: Are coach ratings of athlete receptiveness to feedback accurate predictors of improvements in swimming performance under all conditions?

Hypothesis 4: Performance improvements under all conditions will be significantly greater for participants with higher coach ratings of receptiveness to feedback, and significantly less for participants with lower ratings.

Research Question 5: Is trait anxiety predictive of dispositional mindfulness?

Hypothesis 5: Trait anxiety will be predictive of dispositional mindfulness scores, such that lower trait anxiety will correspond with higher dispositional mindfulness.

Research Question 6: Does dispositional mindfulness improve athlete receptiveness, as indicated by coach ratings?

Hypothesis 6: Mindfulness will predict coach ratings of athlete receptiveness, such that higher mindfulness corresponds with higher receptiveness ratings

Chapter 2: Literature Review

Stress, Pressure and Anxiety

Theoretical Overview

Lazarus (1993) reviewed the development of understandings of stress within psychology and related fields. From his evaluation, stress can be defined as a physical or psychological demand that violates a state of equilibrium, eliciting a response which includes an evaluation, a coping mechanism, and subsequent physical and psychological reaction. Stress is therefore quite literally a "call to action" (Sarason, 1984). Lazarus (1993) identified three different types of stress: harm, threat, and challenge. Harm is a negative effect that has already occurred, while threat is the expectation of harm. Challenge is a demand an individual expects to overcome using coping mechanisms. The classification of a stressor, as well as the response, is determined by expectations and motivations (Lazarus, 1952). Subsequently, the classification of the stressor should have an impact on the nature of the response—either problem-focused or emotion-focused coping (Lazarus, 1993). An individual can act on the stress by either dealing directly with it, or changing his interpretation of it.

From this, it can be inferred that athletic performance is a form of stress. An athletic performance may be viewed as either a threat or a challenge, depending on an athlete's expectations of success, achievement motivation, and fear of failure. The thought and act of performing elicits both physical and psychological responses, which the athlete will cope with by either acting on the desire to have a good performance or by conceptualizing the performance in a different way—presumably to reduce undesirable emotions. An example of problem-focused coping could be "trying harder," which could potentially improve performance or make it worse.

Alternatively, using self-talk such as "stay calm" would be an emotion-focused coping strategy that attempts to address the anxiety rather than the stressor causing it.

While stress is often used loosely to refer both to the stressor and stress response, I will refer to stress exclusively as a physical or psychological demand. Baumeister (1984) defined pressure as "any factor or combination of factors that increases the importance of performing well on a particular occasion" (p. 610). Therefore, it can be deduced that pressure can induce stress. The assumption that this study operates under is that for some athletes, pressure creates stress. In agreement with Lazarus' (1952) claim that motivation and expectations determine the nature of the stress experience, Apter's (1989) reversal theory claimed that stress can be experienced psychologically as either excitement (if accompanied by a positive hedonic tone) or anxiety (if accompanied by a negative hedonic tone). In other words, an individual's state of mind, no doubt informed by their expectations and underlying motives, determines whether the experience of stress is positive or negative. Intuitively, reversal theory rejects the notion that an experience as complicated as stress is simple and linear, instead allowing that an individual can, and is likely to, switch back and forth between both the positive and negative. It is also noted that personality likely plays a role in determining individual tendencies towards one or the other (Apter, 1989).

Anxiety, like many or all stress responses, is now widely considered multidimensional (Davidson & Schwartz, 1967; Martens & Burton, 1990). Schachter and Singer (1962) demonstrated that individuals first experience a state of physiological arousal, then use cognitions to assign an emotion to the feeling. Among their methods for discovering this were studies that involved injecting participants with epinephrine, then manipulating their available cognitions by use of a scripted confederate. In these instances where no appropriate explanation existed for the arousal experienced by the participants, the researchers influenced the emotion assigned to the arousal, providing support for the conclusion that emotions are determined by a combination of arousal and available cognitions. Martens and Burton (1990) refer to the two dimension of anxiety as cognitive and somatic anxiety. They define cognitive anxiety as a conscious awareness of unpleasant feelings, brought on by negative self-evaluations or expectations for success, such as a sense of worry. Somatic anxiety includes both the physical and emotional components of anxiety, such as rapid heart rate, shortness of breath, excessive perspiration, etc. (Martens & Burton, 1990). According to Speilberg's (1972) definition of stress, stress stimulus brings on an appraisal of the level of threat brought on by the stressor, which informs the intensity of the anxiety response. While there is not perfect agreement, there appears to be consistent support for anxiety as a stress response containing physical, psychological, and emotional components.

When an athlete is in a performance setting, factors such as the perceived importance of the competition, and the intensity of the desire to succeed, determine the extent to which she feels pressure. Pressure causes stress, in that it is a performance demand that requires a response. Stress is accompanied by both physiological arousal as well as relevant cognitions that may be interpreted— and subsequently experienced—as such emotions as anxiety, excitement, or a combination of both. The personality of the athlete, expectations for success, achievement motivations, and available information to form cognitions all interact to determine the stress response, which may ultimately impact the outcome of the performance. The impact stress and stress responses have on performance are explored in the next section.

Relationship to Performance

Seminal in research on stress is Yerkes and Dodson's (1908) study of mice. The researchers set out to determine how stimulus intensity impacted rate of learning, and so conducted a series of studies in which mice were confronted with two boxes within a chamber; one black and the other white. Each time the mouse chose the white box it was permitted to enter; however, when it chose the black box, it received a shock. Mice were given 10 tests each morning, and the study was completed when each individual mouse correctly entered the white box on three consecutive days, for a total of 30 straight tests. Varying by condition was the intensity of the shock: weak, medium, or strong. The researchers then recorded the number of errors (selection of the black box) made by each mouse for each day of testing, and measured learning speed by comparing the number of days that passed before zero errors were made. Yerkes and Dodson (1908) found that the mice learned significantly faster in the medium condition than both the strong and weak conditions—on average, it took about half the time (10 days) for the mice to learn in the medium condition as compared to the strong and weak conditions (20-21 days). While the mice in the strong stimulus condition made fewer errors at the outset than those in the weak stimulus condition, there were not significant differences in the time it took to reach zero errors. The relationship between the three conditions can be illustrated as an inverted-u, where learning performance as a function of stimulus strength is best at a moderate level, and decreases as it approaches both the low and high extremes. From this finding the inverted-u hypothesis was born—that moderate intensity is optimal for task performance. This was foundational to understanding the stress-performance relationship. However, the Yerkes and Dodson (1908) study involved only physiological arousal, which neglects the psychological component of the stress experience. For this reason, the inverted-u provides an important consideration for the impact of physiological arousal on performance, but not a complete understanding of the impact of stress in totality.

For a more directly applicable measure of the impact of pressure on human motor performance, Baumeister (1984) conducted a series of studies investigating the phenomenon of choking under pressure. In one (experiment five) 37 male and female undergraduate subjects were assigned to either a control condition or experimental "cash" pressure condition, then participated in a roll-up game. Participants first completed a practice trial, then two performance trials. In the pressure condition, prior to the first scored performance trial, the researcher took out $2 from his pocket and laid it on the table, instructing the subject that if they achieved a certain score (specifically a score 14 points higher than their practice trial) they would win the money. For the first trial, there was a significant effect for pressure, $t(33)= 2.26$, $p<.05$, such that those in the control significantly outperformed those in the pressure condition. Curiously, the effect was lost for the second trial, which Baumeister (1984) theorized was due to participants giving up after failing on the first trial, effectively reducing the pressure experienced. This would be consistent with contentions that stress is determined by expectations for success and achievement motivation, and may demonstrate an example of a maladaptive coping strategy called self-handicapping, in which people suppress effort to protect their self-esteem from the consequences of failure (Jones & Berglas, 1978).

To demonstrate the effect's generalizability beyond novel tasks, another study (experiment six) was conducted utilizing customers at a video game arcade playing "Pac Man" or "Ms. Pac Man" (Baumeister, 1984). Expertise was determined by observing potential participants' previous game scores, and by collecting self-reports of how recently they last played the game, and age (under 13 years excluded). Thirteen subjects ultimately participated as "expert" players. The researcher approached potential participants and offered them a free game if they agreed to participate. The researchers manipulated pressure by asking and recording the subject's name and age, then instructing them "I want you to get the best score you possibly can, OK? I can only give you one chance, so make it the best you can do." The researcher also pretended to time the participant with a stopwatch while observing his performance. The average observed change from practice trial to performance trial was a 25% reduction in performance, $t(12)= 2.91$, $p<.02$. These findings alleviated concerns that the pressure effect was not applicable to expert performers, and provide support for overt surveillance as a means of pressure manipulation. Taken together, the two studies suggest that the desire to perform well can ironically have a negative impact on performance. However, absent direct measures of anxiety, it is difficult to determine from these studies both if and how pressure may have impacted performer anxiety, as well as how somatic anxiety may differ from cognitive anxiety in its relation to performance.

Burton (1988) tackled this issue by directly measuring both somatic and cognitive anxiety. Using 28 collegiate swimmers from the Big-Ten conference, he found positive correlations between performance time and cognitive anxiety for the early season ($r=.40$, $p=.05$) mid-season ($r=.68$, $p=.001$), and Big-Ten meets ($r=.39$, $p=.03$). Although step-wise multiple regression analysis failed to find cognitive anxiety to significantly predict performance at either the early season ($F=1.54$, $p=.25$) or Big Ten meets ($F=2.15$, $p=.14$), it did significantly predict mid-season performance ($F=15.13$, $p=.001$). Furthermore, polynomial trend analysis revealed a significant negative linear trend between cognitive anxiety and performance ($t=3.87$, $p<.0002$). Overall, these findings suggested cognitive anxiety does not conform to the inverse-u hypothesis, and instead is negatively related to performance, such that the more psychologically anxious an athlete, the worse he performs.

Burton's (1988) findings regarding somatic anxiety specifically demonstrated the utility of the inverse-u theory some 80 years after the Yerkes and Dodson (1908) study, and generally solidified the need to examine anxiety multi-dimensionally. Polynomial trend analysis revealed a significant curvilinear trend between somatic anxiety and performance, such that swimming performance was best at moderate levels of anxiety, $t=2.03$, $p < 0.05$. These results were consistent with Burton's (1988) predictions—as he explained, most studies of anxiety in sport that found the inverse-u relationship for performance had utilized physiological measures of anxiety.

While apparently distinct constructs, cognitive and somatic anxiety may nevertheless interact. Apter (1989) theorized as a part of reversal theory that personality can influence the emotional experience of stress, consistent with Schachter and Singer's (1962) findings. Specifically, Apter (1989) suggested a personality characteristic called telic-dominance determined whether high arousal was more likely to be interpreted as excitement or anxiety. Individuals can be more telic-dominant (serious and goal directed) or more paratelic-dominant (playful and focused on task enjoyment). The former would be more likely to experience high arousal as negative anxiety, whereas the latter would more likely experience it as positive excitement. Worth noting is that telic-dominant individuals tend to experience higher arousal under stress in general than paratelic-dominant individuals (Apter, 1989).

Perkins, Wilson and Kerr (2001) recruited 28 elite athletes (22 males, 6 females) from predominantly strength and explosion sports, and induced both telic and paratelic states in them to measure differences in strength performance under conditions of high arousal. Telic state was manipulated through guided imagery scripts, while arousal was manipulated using paced respiration. Measures of handgrip strength in kilograms were taken to measure the impact on strength. Handgrip strength was found to be significantly greater for the paratelic condition than for either the neutral, $t(27) = 8.70$, $p < .001$, or the telic condition, $t(27) = 3.49$, $p = .002$. Handgrip strength was also greater in the telic condition than the neutral condition, $t(27) = 3.66$, $p = .002$. These results suggested that, at least regarding performance on strength related tasks, positive cognitive appraisals of high arousal improve performance—although negative appraisals did not appear to harm performance. However, although grip strength was higher in all conditions under 20 bpm than 10 bpm respiration, the effects were non-significant. In support of the underlying theoretical assumptions, participants rated themselves as more anxious during the telic induction than during the neutral induction $t(27) = 14.12$, $p < .001$, or the paratelic induction $t(27) = 13.21$, $p < .001$. During the paratelic induction participants rated themselves as more excited than when experiencing the neutral induction $t(27) = 18.57$, $p < .001$ or the telic induction $t(27) = 17.23$, $p < .001$.

As previously mentioned, the relationship between arousal and cognitive experiences of stress appears to be that arousal originates as a neutral physical response to stress, which is then ascribed a negative or positive emotion based on available cognitions. As it pertains to choking under pressure, the physical manifestation of somatic anxiety does not appear to facilitate choking under pressure, although inappropriate amounts of arousal may lead to sub-optimal performance. Cognitive anxiety, on the other hand, has a much simpler relationship with performance: the more intense the negative appraisal, the worse the performance will be. It may be that a change in arousal follows the anxiety response and facilitates the poor performance; for example, self-handicapping could result in insufficient levels of arousal, while increasing effort might result in overstimulation and an athlete tightening up. Nevertheless, it seems the root cause of choking under pressure originates with the cognition, and so it is most appropriate to focus there to explore the mechanism(s) that debilitate performance in the presence of high anxiety.

Trait Anxiety and Competitive A-Trait

A potentially important antecedent to the stress response is trait anxiety. To test this, Martens (1977) developed the sport competitive anxiety scale (SCAT). The SCAT measures a construct called competitive-A trait, a tendency to perceive competitive situations as threatening and respond by entering an A-state—a nervous cognitive state accompanied by physiological arousal—and attempting to resolve by avoiding or reduce the state (Martens & Burton, 1990). This is consistent with the Schachter and Singer (1962) theoretical perspective that emotional responses are determined by cognitive appraisals of arousal states. The measure was designed specifically to the competitive sport situation in response to evidence suggesting this construct is a better predictor of behavior when the measure is situation-specific.

The SCAT is a trait measure birthed from sport-specific competitive anxiety theory, that assumes that individuals higher in A-trait are more likely to respond to stress or stimuli in an A-state and/or perceive the stressor as more threatening (Martens, 1977; Martens & Burton, 1990). Subsequently, it is suggested that high state anxiety will be always lead to poor performance, as seen in Burton (1988). Hardy et al. (1996) refuted this prediction, arguing instead that the impact of state anxiety is mediated by trait anxiety, such that low trait anxiety will result in high cognitive anxiety being facilitative. This is supported by Apter (1990) and findings by Carver et al. (1983) that will be discussed in relation to attentional focus in a subsequent section. In support of the latter perspective, Hanton et al. (2002) found that trait anxiety was predictive of cognitive and somatic anxiety scores, such that higher trait anxiety scores yielded higher scores for both dimensions of state anxiety, and that participants low in trait anxiety were significantly more likely to report both dimensions of anxiety as being facilitative as compared to their high trait anxiety counterparts. Based on this theoretical framework, I expect trait anxiety to be negatively related to performance in this study. Confirmation of this would provide indirect evidence that trait anxiety can mediate the impact of state anxiety on performance, and for the general conceptualization of anxiety as a threat response to stress.

Effectiveness of Anxiety Reduction Strategies

Initial efforts by researchers to solve the anxiety problem for athletes focused on anxiety reduction. It served to reason that if anxiety can harm performance, then reducing anxiety should improve performance. However, Gardner and Moore (2006) reviewed the efficacy of psychological skills training (PST) to enhance athletic performance. Their review included goal-setting, imagery, self-talk, arousal regulation, and combined methods of PST interventions. Regarding goal-setting, none of the studies reviewed found significant performance effects for goal-setting, imagery, self-talk, or arousal regulation (Gardner & Moore, 2007). Six of twelve studies that used PST interventions in combination had significant effects, suggesting greater efficacy for multicomponent methods of PST. Even so, their findings cast doubt on the efficacy of traditional methods of PST to improve performance, specifically for methods that attempt to reduce anxiety. This is especially noteworthy because while many of these studies succeed in reducing anxiety and/or increasing positive affect, they did not improve performance (Birrer et al., 2012).

This calls into question the validity of claims that anxiety is highly influential for performance, and not simply a trigger for a more direct mechanism. Craft et al. (2003) conducted a meta-analysis to investigate the accuracy of traditional assumptions about the anxiety relationship to performance, including the assumptions that cognitive anxiety is negatively related to anxiety, and somatic anxiety distributed as an inverse-u. Their review of 29 studies revealed both cognitive and somatic anxiety-performance relationships to be not significantly greater than zero. Multivariate fixed analysis revealed an $r=.01$ ($SE=.02$) CI [-.03,.04] for cognitive anxiety, and for somatic anxiety an $r=-.03$ ($SE=.02$) CI [-.08, .01]. However, exploratory modeling for the relationship between performance and the individual subscales revealed both to be significantly different from 0—for cognitive anxiety $\beta = .13$ (*CI* = .08, .18), for somatic anxiety $\beta = .09$ (*CI* = .03, .14). One offered explanation for these findings, particularly as they are related to cognitive anxiety, is that a simple conceptualization of the anxiety-performance relationship fails to consider such factors as personality traits, differences in coping strategies, as well as expectations for success and achievement motivations. The lack of effect for somatic anxiety may also underscore the neutral nature of arousal prior to cognitive appraisals.

Attentional Focus

While it is therefore useful to demonstrate that anxiety can harm performance, lack of agreement in research underscores that this alone provides insufficient information to solve the issue of choking under pressure. Perhaps this is why anxiety reduction strategies have not been demonstrated to be effective for improving athletic performance. There is therefore a need to understand “how” anxiety can harm performance, and attempt to focus interventions on those mediating variables.

There is evidence that emotion can induce self-focused attention (Wood, Saltzberg, & Goldsamt, 1990). Wood, Saltzberg and Goldsamt (1990) randomly assigned 31 university students to either a sad or neutral mood-induction condition. Mood was induced through an imagination task that involved either recalling personal events or imagining hypothetical ones. Self-focus was measured indirectly through a task where participants were prompted to circle pronouns in sentences. As predicted, participants in the sad mood condition had higher self-focused attention ($M=10.07$) than those in the neutral condition ($M=7.65$), $F(l, 29) = 4.91$, $p =.035$.

Research done by Carver et al. (1983) suggested that self-focused attention only harms performance for individuals high in trait anxiety. 72 female undergraduates were sampled (41 low in test anxiety, 31 high in test anxiety) and were tested on their ability to solve a series of timed anagrams; 12 anagrams total with a limit of 100 seconds per anagram. Self-focused attention was manipulated by either the presence or absence of a mirror on the wall. While the low test anxiety participants did solve significantly more anagrams than the high test anxiety participants, the effect was moderated by the interaction between test anxiety and self-focus, such that the difference in scores was only significant in the mirror-present self-focus condition $t(68) = 3.11$, $p < .01$. Mirror presence significantly reduced performance for participants in the high test-anxiety condition, and improved performance for those in the low test-anxiety condition. The researchers concluded that self-focused attention impairs high anxiety subjects by introducing task-irrelevant thoughts, while facilitating performance for low anxiety subjects by increasing concentration and confidence.

Liao and Masters (2002) built on this theoretical foundation to test the prediction that self-focused attention is heightened by anxiety. Anxiety and self-focused attention measurements were taken for 21 university hockey players at three separate points: two days before, one hour before, and two days after a semi-final match. Anxiety was measured using the CSAI-2, and self-focused attention measured using the Private Self-Consciousness Scale (PSC). It was predicted that anxiety would be highest immediately before the competition, and lowest immediately after. While there was a significant difference between anxiety scores immediately before as compared to both two days before and immediately after, there was no significant difference found between the two days before and immediately after. As predicted, self-focused attention increased as a function of anxiety. Specifically, cognitive anxiety had an inverse-U relationship, $F(1,60)= 3.32$, $p=.04$, accounting for 10% of the variance, while somatic anxiety had a positive linear relationship, $F(1,61)= 4.95$, $p=.03$ (Liao & Masters, 2002). This suggested that self-focused attention increases as a function of arousal (somatic anxiety). The more complicated relationship between cognitive anxiety and self-focused attention is theorized by the researchers to be a function of self-regulation, such that individuals will self-regulate to a point in the face of anxiety, but once at a threshold will feel overwhelmed and give up.

To test the relationship between anxiety, self-focused attention, and performance, Liao and Masters (2002) conducted a second study involving 40 university students (12 male, 28 female), assigned to either a self-focused or control group. Participants were novice basketball players and partook in a free throw shooting task. Participants began with a practice phase of 10 blocks of 10 trials, during which self-focus condition participants focused on their performance process, and control condition participants simply practiced. Following the practice condition, all participants were scored on a high-stress test phase on one block of 10 shots. Prior to the practice trials, participants were instructed that they could earn 10 pence per made shot. Participants in the self-focus condition were instructed to "be aware of what you are doing" and "pay close attention to the mechanics of your shooting process." Furthermore, a mirror was placed under the basket so participants could view what they were doing. During one-minute rest intervals between rounds, participants wrote down as much as they could recall about their shooting process. The control group participants were given no instructions, and there was no mirror under the basket. During the rest intervals, they performed a concentration exercise intended to restrict their ability to reflect on their performance. To collect information on the amount of attentional focus generated in each condition, following the final practice trial, participants were instructed to write down as many specific rules as possible that they could recall utilizing related to the mechanics of their shooting technique. To induce stress for the test trial, participants were told the amount they could earn per made shot would increase by 10 pence, but that they would lose 20 pence for each missed shot. Furthermore, a camera was set up facing the performer as he or she faced the basket (Liao and Masters, 2002).

As a manipulation check, there was a significant difference between utilization of technical rules between groups $t(38)= 5.68$, $p<.001$. Participants in the self-focus condition reported more rules utilized ($M=5.15$, $S.D.= 1.62$) than those in the control ($M=2.47$, $S.D.=1.34$). There were no significant differences between groups on free-throw performance pre-stress, but significant differences post-stress $F(1,76)=3.60$, $p<.05$. Participant performance in the self-focus condition was significantly worse post-stress as compared to pre-stress $F(1,19)= 8.93$, $p<.01$, whereas there was not a significant performance change for the control group. It was concluded that high stress triggers self-focused attention for individuals with large amounts of information on the mechanics of the skill, disrupting the automaticity of performance and ultimately harming it.

Further development of research in the field has provided some specificity regarding the type of focus that harms performance. There is a breadth of literature that suggests that internal attentional focus is likely to disrupt automatic processing, whereas external attentional focus facilitates it (Wulf, 2007). Internal focus is defined as attention to one's individual movements, while external focus is attending to the impact one's actions have on the surrounding environment (Wulf, Höß, and Prinz, 1998). There are clear parallels between the definition of internal attentional focus, and the experience described as self-focused attention in the previously reviewed research. I believe there is a convergence of research at this point and that studies that investigate self-focused attention often involve the same construct as internal attentional focus. Importantly, utilizing internal attentional focus as the construct of focus allows for consideration of the merits of its opposite, external attentional focus, a performance enhancing alternative.

Wulf, McNevin, and Shea (2001) demonstrated that internal attentional focus interferes with automatic control processes that regulate movement as compared to an external focus of control. Twenty-eight university students were randomly assigned to either an internal or external focus of control group, and their performances on a balance task were recorded and compared. Participants in the internal focus group were instructed to focus on their feet, whereas those in the external focus group were told to focus their attention to markers on the balance board. Two days of practice trials were conducted where participants were given the specific instructions regarding their feet, and one day of retention trials was conducted on the third day without the instructions. While there was no significant difference between groups on balance performance in the practice trials, there was in the retention trials, $F(1, 166) = 24.23$, $p < .01$, with the external group ($M = 3.26$, $SE = 0.091$) stabilizing the balance board better than the internal group ($M = 4.12$, $SE = 0.129$). The researchers hypothesized that this effect would be due to external attentional focus interfering less than internal attentional focus in automatic processing. To support this, the trials included a secondary task, during which a participant would hit a button in her hand every time she heard an auditory tone while balancing on the board. Participant reaction times were recorded, and it was hypothesized that faster reaction times would be evidence of less cognitive processing interference. There was a significant difference between the two groups on reaction times in the retention trials, $F(1, 166) = 9.91$, $p < .01$, with the external group ($M = 312$, $SE = 4.89$) having faster reaction times than the internal group ($M = 341$, $SE = 7.70$).

Research efforts similarly support the benefits of an external attention focus to movements. In a series of studies, Wulf and Su (2007) tested the effect of attentional focus on the golf performance of both novice and expert golfers. In the first study, 30 undergraduate novice golfers were randomly assigned to either an internal focus, external focus, or control condition. Externally focused participants were instructed to focus on the motion of the club swinging, whereas those in the internal focus group were told to attend to the motion of the swinging of their arms. They each participated in 60 practice trials in which they attempted to hit a golf ball into a target, and were scored according to proximity to the target. The day following the 60 practice trials, the participants performed a retention test consisting of 10 trials. There were no significant differences between groups on the practice trials, but external focus group significantly outperformed both those in the internal focus and control group at retention, $F(2,27)=5.38$, $p=.011$. The same procedures were used to test six expert golfers, who instead participated in counterbalanced trials of each condition. Again, there were no differences between performances for the practice trials, but there were for the retention test $F(2,10)= 9.66$, $p=.005$, with significantly greater accuracy in the externally focused group ($p<.05$, $d= 2.40$). This demonstrated the superiority of externally focused attention over internally focused attention in both skill acquisition and performance for novice and expert performers.

Marchant, Clough and Crawshaw (2007) produced similar findings in a study of dart throwing. 67 undergraduate students and staff were randomly assigned to either control, external, or internal focus groups. Participants in the internal focus group were instructed to focus on the movements they carried out during each throw, whereas those in the external focus group were told to focus on the task outcome (Marchant et al., 2007). Participants participated in a practice round of 10 throws, followed by 10 test rounds of 4 throws each for a total of 40. Dart-throwing accuracy was measured based on proximity to the target's center on a scale of 0-9, with lower scores being better. There was a significant difference on scores found between conditions $F(2,62)= 5.42$, $p=.01$, $\eta^2=.15$. Specially, participants performed better when given externally focused instruction ($p=.02$, $d= .52$). There was also a significant difference in rating of instruction effectiveness, $F(2,62)= 3.75$, $p=.03$, with participants also rating the externally focused instructions as more effective ($p=.01$, $d=.88$).

Conclusions

Anxiety appears to cripple performance for many athletes, although trait anxiety may mediate this relationship. Cognitive anxiety particularly has been routinely demonstrated to harm athletic performance. Among the most prevalent explanation for this is that anxiety influences attentional control strategies, such that high anxiety is associated with the drawing of attention inward towards specific movements and/or psychological and emotional experiences. Further supporting the theory that internal attentional focus explains performance detriment under mounting pressure are findings that demonstrate the efficacy of external attentional control to facilitate performance.

Initial efforts to solve this problem attempted to simply reduce anxiety. However, anxiety reduction strategies have not proven to be effective for improving performance. This calls for an investigation into attentional focus strategies. If stress conditions can induce harmful self-focused attention, efforts to improve athlete performance under anxiety conditions should focus on addressing the attentional strategies that emerge, as opposed to trying to reduce anxiety. The subsequent section focused on mindfulness, an alternative approach to anxiety reduction that instead emphasizes awareness and acceptance of emotional states to promote adaptive self-focused attention.

Mindfulness

Theoretical Overview

Mindfulness may be broadly defined as an enhanced state of awareness of present experiences (Bernier et al., 2009; Walsh et al., 2009). Bishop et al. (2004) set out to operationalize the construct, and proposed a two-pronged model. The first component involves enhanced attention, specifically self-regulation and heightened present awareness. The second component is related to orientation, characterized by objective evaluation, acceptance, and openness to experience. The authors see mindfulness as distinct from other forms of self-focused attention; and in fact, describe it as an alternative, adaptive type of self-focus. Bishop et al. (2004) characterized mindfulness as “investigative” regarding the internal experience, such that a mindful individual would observe the experience process to ultimately alter conceptualizations of stimuli. This relates directly to the stress experience process previously outlaid—as proposed, mindfulness involves awareness of how cognitions influence emotions—and so ultimately a highly mindful individual may be able to conceptualize a stressor as a positive rather than a negative, and alter the corresponding emotional experience.

Most studies exploring the impact of mindfulness on athletic performance induce levels of either “trait” or “state” mindfulness via mindfulness intervention. However, mindfulness is often measured in these studies with instruments used to assess “trait” or dispositional mindfulness (Brown & Ryan, 2003). It is not clear how and to what degree state and trait mindfulness interact, or to what extent the effects seen in mindfulness interventions are due to increases in mindfulness as a specific construct, as opposed to acquisition of adaptive strategies that are merely associated with mindfulness practice.

Brown and Ryan (2003) suggested that mindfulness practice facilitates greater dispositional mindfulness. Further supporting this assumption is a structural analysis of five mindfulness questionnaires by Baer et al. (2008) that conceptualize dispositional mindfulness. Five factors were discovered: observe, describe, act aware, non-react, and non-judge. Coffey et al. (2010) ran a different exploratory factor analysis and concluded dispositional mindfulness consists broadly of 1) present-centered attention and 2) acceptance of experience. Both support the conclusion that dispositional mindfulness includes both attention and orientation components, and that mindfulness intervention induce dispositional mindfulness.

Relationship Performance

Dispositional mindfulness.

The relationship between mindfulness and flow provides indirect evidence of dispositional mindfulness facilitating sport performance, as there is evidence linking flow to peak performance (Aherne et al., 2011; Jackson, 1992; Jackson et al., 2001). In a study of 182 Singaporean university athletes from various sports, a cluster analysis was conducted by Kee and Wang (2008). Mindfulness was assessed using the Mindfulness/Mindlessness Scale (MMAS) while flow was assessed using the Dispositional Flow Scale (DFS-2), which assesses the nine dispositions of flow: challenge–skill balance, action–awareness merging, clear goals, unambiguous feedback, concentration on the task, sense of control, loss of self-consciousness, transformation of time and autotelic experience. Cluster analysis revealed four clusters that differed significantly in degree of flow measure $F(3, 178)= 9.10$, $p<.001$, $\eta^2=.09$. The high mindfulness cluster had significantly higher dispositional flow than the first and second cluster, which included the low mindfulness group. The overlap between flow states and mindfulness suggests the possibility that individual high in dispositional mindfulness may be more likely to experience flow and/or flow states.

Kee and Liu (2011) found participants high in dispositional mindfulness perform better and adopt more adaptive strategies during a novel motor task. Thirty-two Taiwanese students were assessed for trait mindfulness using the MAAS (Brown & Ryan, 2003). The participants underwent eight tests of a rollerball task (a hand-held gyroscope), one pre-trial, five practice trials, one post-test, and one retention test. Performance was assessed by recording the slowest rollerball speed as a measure of success (slower speeds are harder to attain). Results were assessed using non-parametric Mann-Whitney U. The high mindfulness group ($n = 13$, $Mdn = 15.50$ r/s) outperformed the low mindfulness group at post-test ($n = 16$, $Mdn = 18.66$ r/s). Differences—although non-significant—in choice-outcome decisions provided some insight into the mechanism by which mindfulness facilitates learning. Participants high in mindfulness were more likely to adopt an easier task difficulty after failure as compared to those low in mindfulness. The authors suggest this is due to mindful individuals being more flexible in their attitudes. This flexibility is perhaps indicative of a lower assessment of threat from failure by those in the high mindfulness group. While the statistical analysis utilized should provide pause when generalizing these results, they nevertheless provide initial support for the adaptive qualities of trait mindfulness for athletic performance.

Gooding and Gardner (2009) studied the predictive power of dispositional mindfulness on free-throw performance using 17 Men's Division I basketball players. Scores on the MAAS were found to be predictive of in-game free throw percentage, $t(17)= 2.46$, $p=.026$, such that higher mindfulness corresponded with a higher free-throw percentage, although the effect was lost when controlling for year in school. MAAS scores were also found to be predictive of the difference between practice and in-game performance, $t(17)=-3.67$, $p=.002$, with higher mindfulness predicting less of a difference in performance between practice and in-game settings. This suggests not only that dispositional mindfulness can improve motor-skill performance, but also that it may facilitate skill transfer from a practice to a performance setting.

Mindfulness interventions.

Birrer et al. (2012) argued that mindfulness interventions increase dispositional mindfulness. Therefore, it may be appropriate to consider the effects from these studies as evidence of the effects of dispositional mindfulness on performance, although caution is likely necessary in interpretation.

Forty-three university students were sampled for a study on the effects of mindfulness training on the performance of novice dart throwers (Zhang et al., 2016). Participants were assigned to either an attentional control group, or a mindfulness group, and underwent eight weeks of dart training. Participants performed five consecutive rounds of three throws, and were scored on a scale of 1-10 based on the accuracy of their throw relative to the bulls-eye. There was a significant difference between the groups on performance, $F(1,41)=27.79$, $p<.001$, $\eta^2=.40$. Participants in the mindfulness group significantly outperformed those in the attentional control group, $t(43)= 4.82$, $p<.001$, $d=1.47$. There were also significant differences at two-week follow-up, $t(43)= 4.79$, $p<.001$, $d=1.46$. This effect was due to the mindfulness group not experiencing a significant decline in performance at follow-up.

De Petrillo et al. (2009) provided mindfulness training to 25 recreational long-distance runners. Half received the training as an intervention group, while the other half received the training following the completion of the study as a delayed treatment control. While no significant difference was found between groups on runner performance for weekly mile times, in a follow-up study of the same 25 runners, Thompson, et al. (2011) found a significant improvement from pre-test ($M=7.36$) to follow-up ($M=6.54$) on weekly mile times, $t(9)= 3.06$, $p=.014$, as well as from post-test ($M=7.28$) to follow-up, $t(10)= 2.39$, $p=.038$. Both the Zhang et al. (2016) and De Petrillo et al. (2009) findings provide evidence for the efficacy of interventions of dispositional mindfulness to improve performance. Furthermore, the enduring nature of mindfulness effects at follow-up in both studies underscores an important consideration brought up by Birrer et al. (2012)—that mindfulness may have its greatest impact as an approach to sport training and performance, rather than simply as a state of mind.

Attentional Focus

Despite research supporting the idea that mindfulness facilitates performance in sport, the central idea of heightened attention and awareness inherent in mindfulness implies an internal attentional focus, which has been demonstrated to be an inferior strategy for motor performance as compared to an external one. However, while it is assumed that mindfulness leads to a greater tendency to engage in self-focused attention in general, it is suggested that the form of self-focused attention that emerges is adaptive (Baer, 2009). Specifically, because mindfulness involves non-judgement and non-reactivity, it guards against rumination and self-criticism, and so leads to enhanced psychological functioning. It is also theorized that mindfulness facilitates an ability to be flexible with attentional focus, such that mindful individuals can switch between an internal and external focus of attention as needed. This is supported by findings that demonstrate that mindfulness is associated also with higher levels of attention to external stimuli

(Baer, 2009). Studies with mindfulness interventions that explicitly endorse an external attentional focus cannot be used to draw conclusions regarding the impact of dispositional mindfulness on attentional control strategies, so instead I review research involving mindfulness and attentional focus absent attentional focus directives.

Birrer et al. (2012) implied that mindfulness can encourage an external focus of attention for athletes by inhibiting the reinvestment process. They argued that athletes are likely to disrupt automatic processing following performance discrepancy (a performance that is significantly better or worse than anticipated), and that the attitudinal components of mindfulness, such as non-judgement, enhance an athlete's likelihood to accept performance outcomes. Furthermore, a decreased tendency to ruminate similarly reduces the likelihood of dwelling on past experiences, particularly negative ones. Brown et al. (2007) noted that present-moment awareness that is characteristic of mindfulness both prevents thoughts that interfere with the task, as well as requires less energy, allowing for sufficient cognitive resources to be summoned for self-regulation when task demands are highest. Lakey et al. (2007) found that dispositional mindfulness related to less severe gambling outcomes, due to more accurate assessments and less overconfidence. It was concluded that these findings were in part due to mindful individuals being able to filter out task-irrelevant stimuli to make better risk assessments.

A study done by Kee et al. (2012) explored the impact of a mindfulness induction on attentional strategy utilized on a balance task, and the intervention procedure allows for inferences to be drawn regarding the impact of dispositional mindfulness on attentional strategy. Thirty-five male university students were assigned to either a control or experimental condition. Mindfulness was induced for those in the experimental condition through a task in which participants ran their hands through a basin of water, and were instructed to focus on the sensations of the water flowing over their hands. Independent t-tests revealed that those in the experimental mindfulness condition ($M=4.56$, $S.D.= 1.72$) reported significantly greater use of externally focus strategies $t(30)=-2.37$, $p=.03$, $r=.40$, as compared to the control group ($M=3.22$, $S.D.= 1.53$). While a comparison between subgroups of high and low mindfulness in the experimental and control groups on this measure would have been more telling, the nature of the task and findings introduce the possibility that the heightened attentional component of dispositional mindfulness can promote external focus of control strategies.

Despite the research being in its infant stages, what work has been done suggests mindful athletes are less susceptible to choking under pressure. Because they maintain a present state of awareness, they are less likely to dwell or reflect on prior performances or recent failures, shielding them from harmful behaviors such as self-focused attention, particularly unnecessary amounts of internal attentional focus. When mindful athletes do turn their attention inward, they do so without judgement to regulate their emotions. Mindful athletes appear to be highly adaptable and so can shift their attentional focus however the task demands. I therefore expect dispositional mindfulness to enhance performance under pressure situations, where cognitive distractions and emotional intensity are greatest.

Ego Threat

In addition to inducing anxiety, performance environments can introduce opportunities for social comparison or failure that might be threatening to an individual's self-esteem. Koka & Hein (2006) found that for students in PE courses over the course of four school years (6^{th} – 10^{th} grade), positive perceptions of coaching feedback were contingent upon low perceived ego-threat. Furthermore, for field hockey athletes, less corrective information from coaches has been linked to higher perceived competence (Allen & Howe, 1998). Coach feedback regarding an athlete's performance can carry undertones of competency assessment, depending on an athlete's interpretation. For example, when discussing the consequences of failure, athletes reported feelings of deflation, including loss of confidence and diminished self-efficacy (Conroy, Poczwardowski & Henschen, 2010). It follows that for some athletes, corrective feedback may be perceived as threatening information if it conveys a lack of ability or skill, and forecasts future failure. Rather than face the negative consequences to the self, athletes may instead choose to question or ignore the feedback—preventing an opportunity to incorporate the information to improve.

As a remedy to this maladaptive coping style, mindfulness may enhance athlete receptiveness to feedback because it involves a non-judgmental perception of experience. Brown et al. (2007) suggested mindful action is likely not governed by ego concerns. Highly mindful athletes should be better able to ignore the threat of failure or corrective feedback and re-orient towards task-specific information, including incorporating coaching suggestions.

Relationship to Anxiety

Walsh et al. (2009) tested the predictive nature of trait anxiety on dispositional mindfulness. 153 undergraduate students were tested on measures of trait anxiety and mindfulness, among other variables. A regression analysis revealed a significant predictive effect for trait anxiety, $B= -.37$, $SE=07$, $p<.001$, the best predictor of mindfulness. The authors comment on the negative relationship between trait anxiety and mindfulness as indicative of the tendency for anxious individual to be oriented towards the future, as they perceive and evaluate threats, while mindful individuals in contrast attend to the present moment. This also supports the predictions that highly mindful athletes would be less threatened by coach feedback, and less susceptible to the harmful effect of anxiety on performance in general. This study will attempt to replicate this finding, and build on its generalizability to athletes.

Conclusions

Research on mindfulness and athletic performance has only recently emerged in the last two decades or so. There remain many questions regarding the relationship between dispositional and state mindfulness, mindfulness and attentional focus, and its merits as a method to enhance athletic performance. Principles of openness to and acceptance of experience run counter to Western values of competitiveness that demonize failure, and may not be universally accepted. However, early research efforts show promise that mindfulness can alleviate the debilitating effects of pressure for some athletes by helping them to reinterpret anxiety as facilitative, to adapt their attention as needed and conserve cognitive resources, and remain present to avoid maladaptive cognitions such rumination, self-doubt, or excessive internal attentional focus.

Coach Ratings of Athletes

Theoretical Overview

Investigating the accuracy of coach ratings is important because coach assessments can have far-reaching consequences for athletes. Brophy and Good (1970) demonstrated in classroom settings that teaching expectations can impact student academic performance. Sinclair and Vealey (1990) found differences in the type of feedback from coaches between high- and low-expectancy athletes. In a study of Division I basketball teams, Soloman (1996) found that coaches gave more feedback to athletes of high expectancy $F(4,1189)= 2.80$, $p <.05$, specifically reinforcement, mistake-contingent technical instruction, and general encouragement. She also found that athletes perceived these differences, as high-expectancy athletes rated their coaches higher on the instructional nature of feedback and reinforcement than low-expectancy athletes.

Black and Weiss (1992) studied 312 competitive swimmers and ran a multivariate analysis testing the predictability of perceptions of feedback to measures of athlete satisfaction. They found a significant relationship, $F(30,290)=1.87$, $p<.005$. "15-18-year-old swimmers who perceived higher frequencies of information, praise, and encouragement plus information, and lower frequencies of criticism, had higher levels of self-perceptions of ability, enjoyment, effort, and challenge motivation" (pp. 319). These findings demonstrate coaching feedback has an impact on athlete satisfaction, which may influence task enjoyment, motivation, and longevity.

That coach feedback is so impactful creates concern, when considering that previous research has shown coaches are not entirely accurate in assessments of their own behavior—effectively preventing them from regulating in a way that standardizes feedback (Wandzilak, Ansorge, & Potter, 1988). This underscores the importance of research investigating the accuracy of coach ratings of athletes, to determine if coaches are accurate in the assessments on which they base their judgements.

It does not appear that much research has been done in this area. Allen and Howe (1998) asked coaches to rate athletes according to ability, and measured the extent to which that predicted athlete perceptions of competence. One hundred and twenty-three female field hockey players were sampled, and coach ability ratings were predictive of athletes perceptions of self-competence $F(1,121)= 4.33$, $p<.05$, $R^2=.035$. However, coach ratings were not triangulated with field hockey performance skills. DeGroot et al. (2012) found coach ratings of performance to be moderately correlated with performances on wheelchair basketball skill tests, but provided little information regarding the nature of coach ratings, allowing for minimal inferences.

Barroso et al. (2004) tested the relationship between coach and athlete assessments of exertion for swimmers as a function of age. Using a perceptual measure of exertion called Session Ranking of Perceived Exertion (SRPE), 160 swimmers were grouped into 11-12 ($n=46$), 13-14 ($n=65$), and 15-16 ($n=49$) year old age groups. Swimmers and coaches participated in nine training session for which they ranked load intensity of sessions using the SRPE. The intensity ratings were grouped into low, medium, and high intensity groups. There was a significant difference in agreement between athlete and coach ratings for the 11-12 age group, $F(2,435)=28.86$, and for the 13-14 age group, $F(2,606)= 20.78$ for all three intensity levels. There was only a significant difference in agreement for 15-16 athletes at the high intensity level $F(2,462)= 10.47$, such that athletes tended to give lower ratings than coaches on exertion. Overall, there was a positive correlation between coach and athlete SRPE ratings, $r=.60$, $p=<.001$, and correlations increased as a function of age group. This was interpreted as evidence that athletes become more accurate in their appraisals of exertion as they grow older, but it also demonstrated the potential for coach ratings to agree with athlete ratings on measures of exertion or effort. Redkva et al. (2017) similarly tested the relationship between coaches and athletes' exertion ratings for 24 Brazilian professional soccer players, and found a moderate correlation between ratings, $r=.60$, $p=.003$, and no significant differences between coaches and athletes on SRPE ratings. This further supported the notion that accuracy of athlete exertion estimates improves over time—and so too then does the relationship between coach and athlete ratings.

Conclusions

Coaches likely semi-consciously rate athletes according to ability and other related characteristics frequently as part of assessment. While difficult, there is therefore a need for research to test the accuracy of coach ratings of athletes, both because coach feedback has been empirically demonstrated to vary as a function of coach expectancies, and because coach feedback has been tied to athlete satisfaction and perceptions of the instructional climate. Limited research findings suggest coaches can be accurate in their assessments of athlete exertion, although less so for younger athletes. Little to no research appears to have been done assessing the accuracy of coach ratings of constructs such as athlete “talent”, receptiveness to feedback, or responses to pressure situations—particularly in relation to actual objective performance measures. This study hopes to break ground in that area and inspire further investigation in the future.

Chapter 3: Methods

Participants

Twenty-eight University of Arizona swim team athletes — 16 females and 12 males — and three University of Arizona coaching staff members (all male) participated in this study. Three of the 28 athlete participants were professional post-graduates who were currently training with the university team, while the remaining 25 were current team members.

Athlete ages ranged from 18-32 years. No additional demographic information was collected.

A convenience sample was gathered to reduce the variance in athlete skill level (all participants are Division I athletes swimming at the University of Arizona) as well as to stabilize the impact of coaching and training programs on swimming performance. Furthermore, coach ratings could only be meaningfully compared for athletes on the same team.

Measures

Sport Competition Anxiety Scale (SCAT)

The SCAT is a 15-item measure, with 10 scored items. To test item discriminability, the SCAT-A (adult version) measure was given to 153 university students, and had mean item analysis coefficients of .61 for high SCAT (n=42) and .67 for low SCAT (n=42) groups (Martens & Burton, 1990). Mean triserial correlation coefficient was .64, and mean discriminant function coefficient was .64. Additionally, a reliability coefficient r=.85 was obtained. In addition to the items analysis correlations and triserial correlation, KR-20 coefficients ranging from .95 to .97 provide support for internal consistency of the measure.

Research supports the concurrent validity of SCAT. Martens and Burton (1990) compared SCAT-C (children's version) to the previously validated general anxiety measure Children's Manifest Anxiety Scale Short Form (CMAS), the General Anxiety Scale for Children (GASC) the Trait Anxiety Inventory for Children (TAIC), and the Trait Anxiety Inventory for Adults (TAI). There is only one item difference between the SCAT-A (adult) and SCAT-C (child) versions of SCAT. The authors noted that moderate correlations would provide concurrent validity in that too little correlation would suggest the scale fails to measure anxiety, whereas too much would make the SCAT a general measure of anxiety rather than one specific to competitive sports performance, and therefore an unnecessary redundancy. Correlations ranged from r=.28 and r=.46, providing support for the concurrent validity of the SCAT-A and SCAT-C.

Research also supports the construct validity of SCAT. Scanlan (1975) and Martens and Gill (1976) both demonstrated that performers who scored higher on SCAT would also report higher A-state than lower scorers in competitive situations. Scanlan (1975) gave the SCAT to 306 10-12-year-old boys, then selected the 41 lowest and 42 highest scorers and randomly assigned them to one of three conditions: a success condition, a neutral condition, and a failure condition. Participants competed on a motor maze for 20 minutes, and were deceived into believing they were competing against a participant on a computer. Participants were then told they won 80% (success), 50% (neutral), or 20% (failure) of their matches. A-state was measured using the SAIC. The interaction for the SCAT x A-state repeated measures ANOVA was significant such that participants in the high SCAT condition scored highest on A-state. Furthermore, participants had significantly higher A-states in the threatening failure condition than in the other two conditions, supporting the assumption that A-state is a product of perceived threat (Scanlan, 1975). Martens and Gill (1976) utilized the same design, but added a non-competition control. Additionally, the study included female students of the same age, and the top and bottom 90 (45 male and 45 female) students were assigned to the three conditions. A-state was once again measured using the SAIC, but this time was measured four times: baseline 2-weeks prior, pre-competition, mid-competition, and post-competition. Univariate analysis revealed that high SCAT participants scored significantly higher on A-state at pre-, mid-, and post-competition. Furthermore, a significant effect was found for success-failure $F(9,187)=4.5$, $p<.0001$ across pre-, mid-, and post-competition states, again demonstrating that A-state increases as a function of threat.

This measure was selected for this study as a means of determining if trait anxiety can be used to identify athletes who may be more prone to choke under pressure due to an increased tendency to view competitive situations as threatening, and/or a higher likelihood of entering an A-state. Furthermore, the measure was preferable over the CSAI-2, which includes a state-measure of anxiety, because this study did not measure swimmer anxiety while in competitive environments.

Mindfulness Attention Awareness Scale (MAAS)

The MAAS is a 15-item measure. 327 university students completed the measure to explore the factor structure of the scale. Internal consistency alpha=.82 indicates good reliability. For goodness of fit, “The fit indices of the model indicated that the correspondence between the single-factor model and the sample covariance matrix was satisfactory, 2(90, *N* 327) 189.57 (goodness-of-fit index [GFI] .92, comparative fit index [CFI] .91, index of fit [IFI] .91, parsimony-adjusted comparative fit index [PCFI] .78, root-mean-square error of approximation [RMSEA] .058) (Brown and Ryan, 2003).

Research supports the concurrent validity of the MAAS. Brown and Ryan (2003) compared the MAAS to NEO Personality Inventory (NEO-PI) and NEO Five-Factor Inventory (NEO-FFI) Openness to Experience, Trait Meta-Mood Scale (TMMS) Mindfulness/Mindlessness Scale (MMS), Self-Consciousness Scale (SCS), Rumination–Reflection Questionnaire (RRQ), Self-Monitoring Scale—Revised, Need for Cognition, and Absorption. The authors noted moderate correlations to NEO-PI Openness to Experience and NEO-FFI Openness to Experience, as well as MMS as expected. As predicted, it was not correlated with PSC.

Construct validity of the MAAS was supported as well. In a study of 50 New York locals, the first matched participants enrolled in a community Zen randomly to a person of matched gender and age in the general community (Brown & Ryan, 2003). It was hypothesized that individuals in the Zen center would participate in significantly more meditative practice than those in the general community, and so would theoretically score higher on the MAAS. A t-test revealed the expected effect, $t(98)= 2.45$, $p= .05$, $d= .50$, where the Zen group ($M= 4.29$, $S.D.= 0.66$) scored significantly higher than the control ($M= 3.97$, $S.D.= 0.64$).

The MAAS was chosen for this study over alternative measures for two reason. One, it is a unidimensional measure of mindfulness that emphasizes the present-awareness component of the construct, and the predictions of this study focus primarily on that aspect of mindfulness. Two, MAAS scores specifically have been demonstrated to be negatively correlated with anxiety, a major construct being considered in this study, and a specific prediction being tested (Brown & Ryan, 2003).

Athlete Skill Transfer Ratings

An unpublished measure was created to measure the quality of athletes' transfer of swimming skills from a workout to a performance setting (Appendix E). To measure this, coaches were asked to rate each athlete according to how well they perform in competitions as compared to coach expectations based on training performances. Because there are few objective measures of swimming skill beyond performance times, coach ratings provide an alternative measure. Coaches are assumed to be experts of swimming technique, and to be familiar with individual athlete stroke technique and training tendencies from daily workouts. The measure asks coaches to rate each athlete as performing at competitions either above (over-perform), at (average perform), or below (under-perform) expectations relative to training performances.

Athlete Receptiveness Ratings

An unpublished measure was created to measure how receptive athletes are to coaching feedback. To measure this, coaches were asked to rate each individual athlete according to their perceptions of each athlete's receptiveness to feedback. Because the coach is the primary source of feedback for the athlete, interacts with the athlete most of the time when delivering feedback, and often subsequently judges the receptiveness of the athlete to that information based on verbal and non-verbal cues, as well as the degree of change made in response, he would seem to be the best judge of this variable. The measure asks coaches to rate each athlete on receptiveness to coaching feedback using a 1-item Likert scale with a 4-point, forced choice ranging from "very unreceptive" to "very receptive."

Swimming Performance

Swimming performances were measured by collecting all swimming performances from the summer of 2017 (April-August) in each athlete's self-reported "primary" event (Figure 3.1). The single fastest performance from the 2016 swim year was also collected. All performance times were recorded by using the USA swimming "Top Times" database, which records and archives all swimming performance times done at USA swimming sanctioned competitions.

The nature of swimming performance at the competitive level is that training suppresses performance in the early parts of the season (Burton, 1988). Training programs strive for peak performance at the most important competitions, when pressure and expectations are highest. To account for this, meet performances by the subjects were categorized into low-, medium-, and high-pressure performances. Locally hosted competitions were classified as low pressure, national Grand Prix meets that offer prize money were classified as moderate pressure, and State championship and national qualifying meets were classified as high pressure. While meet participation varied, there were 3 low pressure competitions, 5 moderate pressure competitions, and 5 high pressure competitions classified. The fastest performance from each of the three types of meets were used for analysis. It was necessary to standardize the number of swims, as well as the swimming performance times, to make between-groups comparisons. This is evident in review of descriptive data on the raw performance scores prior to standardization (Figure 4.1)

To make comparisons between swim performances of all distances, swim performances were standardized by dividing all performance times into a 50m per/lap average time. Then, 2017 performance was subtracted from 2016 baseline score for a difference score that indicated either an improvement (negative value) or gain (positive value) from baseline. Therefore, performance was measured as the degree of change in performance from baseline.

Research Design

An experimental mixed-factor design was utilized for this study. Within-subjects measurements of performance are utilized, as all participants completed each type of meet (low-, medium-, high-pressure) and performances were measured using differences scores established relative to individual baselines, while between subject differences were measured for numerous independent variables.

The independent variables in this study include: anxiety scores, mindfulness scores, athlete skill transfer ratings, and athlete receptiveness ratings. The dependent variables include: swimming performances in the primary event for the 2017 season, as well as the mean difference in fastest swimming performances in the primary event from the 2016 to 2017 seasons.

Major threats to validity are external, because the within-subjects design protects against most threats to internal validity. Possible threats to external validity include population validity, because all the athletes compete for the same team, it may not be appropriate to generalize results outside of the sample, specifically because these athletes are a collection of Division I swimmers, and have reached an uncommon level of excellence in the sport of swimming.

Procedures

On deck prior to a swim workout, athlete participants were briefed on the study and its purpose, and were asked if they would be willing to participate, while being assured participation was not mandatory. Those that agreed to participate first filled out and returned a consent form into a manila envelope, then were assigned a unique subject code (001-028) to protect subject anonymity, and given a packet labeled with that code with both the SCAT and MAAS forms attached. Subject codes could only be connected to individual athlete identities using a linkage key, which only the primary investigator had access to, and which was destroyed following the completion of data collection.

In addition to filling out the surveys, participants were asked to write their primary event on a tab on the front of the survey packet. Completed survey packets were placed in a separate manila envelope. Following return of the surveys, participants were debriefed.

Following workout, coach participants were briefed on the study and its purpose, and were asked if they would be willing to participate, while being assured participation was not mandatory. Those that agreed to participate first filled out and returned a consent form into a manila envelope, then were given a packet with both the athlete skill transfer and athlete receptiveness measures forms attached. Each packet was assigned a number (1-4) so athlete skill transfer ratings and receptiveness ratings could be connected, but to protect subject anonymity no information was collected connecting individual coaches to their responses, as that was not necessary for the study. One swimmer and one coach chose not to participate.

Data Analysis

Missing Data

There was no missing data on the trait SCAT or MAAS surveys, or on coach ratings scales. There were six athletes that did not compete in at least three meets this summer, which prevented those athletes from providing sufficient data points for their swims to be categorizes as low-, medium-, and high-pressure. For data analysis involving comparisons to performance, those data points were deleted listwise. Given the nature of sport performance, I decided it wasn't appropriate to attempt to use imputation or any other techniques to estimate these data points.

Hypothesis Testing

To test all hypotheses for within-groups differences on performance under pressure, a mixed repeated measures ANOVA was utilized to measure changes in performance between groups as pressure increased. This was chosen so that I could make between-subject comparisons regarding dispositional mindfulness, trait anxiety, gender, and coach ratings of athlete receptiveness and skill transfer.

A simple linear regression was conducted to determine if trait anxiety predicted dispositional mindfulness. For this analysis, the raw scores for both measures were compared. This was chosen because MAAS and SCAT scores are continuous variables prior to being grouped.

Three separate one-way ANOVA analyses were conducted to test if the three individual coach ratings of receptiveness predicted dispositional mindfulness. This was chosen because a repeated measures analysis would not have been appropriate due to lack of independence of observations.

An independent t-test was conducted to determine if there were gender differences for athlete trait anxiety and/or dispositional mindfulness scores. This was chosen because there are two groups (male and female) and I am making comparisons on two continuous dependent variables. Additional analyses were conducted as needed for to investigate post-hoc group differences.

MAAS

MAAS scores are determined by taking an average of the 15-item total, and scores can range from 1-6. To use dispositional mindfulness as a categorical independent variable for repeated measures analysis of swimming performance, MAAS scores were grouped into low, medium, and high groups using a cut-off at 33%. This technique was utilized by Palmer and Rodger (2009). Scores below 3.8 were considered "Low," between 3.8 and 4.4 "Medium," and above 4.4 "High." Following the listwise deletion, this resulted in 8 low, 7 medium, and 7 high participants. For all other data analyses, raw MAAS scores were used.

SCAT

SCAT scores range from 6-30. To use trait anxiety as a categorical independent variable for repeated measures analysis of swimming performance, SCAT scores were grouped into low, medium, and high groups as outlined by Martens (1990). Scores lower than 17 were "Low," 17-24 "Medium" or "Average," and greater than 24 "High." Following listwise deletion, this resulted in 7 low, 11 medium, and 4 high participants. For all other data analyses, raw SCAT scores were used.

Figure 3.1

Primary Event

	Frequency
100 Back	1
100 Breast	2
100 Fly	3
1500 Free	3
200 Back	3
200 Fly	3
200 Free	4
400 Free	1
400 IM	2
50 Free	6
Total	28

Chapter 4: Results

Descriptive Statistics

Performance Times

Figure 4.1 depicts N number of trials and raw performance times for each race competed in during the 2017 summer swim season.

Figure 4.1

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Race 1	28	22.07	1054.70	204.6511	289.08853
Race 2	27	21.99	983.07	170.4430	239.46612
Race 3	25	21.97	946.70	166.7328	241.59823
Race 4	24	22.72	966.82	135.3604	190.31336
Race 5	20	22.72	944.21	134.8780	201.09910
Race 6	15	22.03	294.74	103.9647	67.13576
Race 7	11	22.12	299.01	100.9309	78.81292
Race 8	9	21.95	294.92	95.2256	86.12025
Race 9	6	21.70	123.03	69.1650	44.24452
Race 10	1	52.26	52.26	52.2600	.
Valid N (listwise)	1				

Pressure and Mean Improvement

Figure 4.2 depicts mean differences between fastest 2017 standardized performance times for each meet type (low-, medium-, high-pressure) and fastest 2016 standardized performance time. A negative number depicts an improvement from 2016 performance.

Figure 4.2

Pressure * Performance[b]

	N	Minimum	Maximum	Mean	Std. Deviation
Low Pressure	27	-.10	1.69	.8176	.48968
Medium Pressure	23	-.92	1.40	.4039	.56632
High Pressure	24	-.90	.91	.0258	.45981
Valid N (listwise)	22				

b. Unit = Seconds

Dispositional Mindfulness and Performance

Figure 4.3 depicts mean differences between fastest 2017 standardized performance times for each meet type and fastest 2016 standardized performance time, categorized by grouping on MAAS (low, medium, high).

Figure 4.3

Mindfulness * Performance

	MAAS[b]	Mean[a]	Std. Deviation	N
Low Pressure	Low	.9550	.47285	8
	Med	.6940	.29722	7
	High	.5028	.60054	7
	Total	.7281	.48963	22
Medium Pressure	Low	.6434	.47040	8
	Med	.5925	.51991	7
	High	-.0987	.47079	7
	Total	.3911	.57624	22
High Pressure	Low	.1909	.47314	8
	Med	.0040	.44028	7
	High	-.1661	.50727	7
	Total	.0179	.47570	22

a. Unit = Seconds

b. MAAS = Mindfulness

Trait Anxiety and Performance

Figure 4.4 depicts mean differences between fastest 2017 standardized performance times for each meet type and fastest 2016 standardized performance time, categorized by grouping on SCAT (low, medium, high).

Figure 4.4

Anxiety * Performance

	SCAT[a]	Mean[b]	Std. Deviation	N
Low Pressure	Low	.9243	.35115	7
	Medium	.5117	.50922	11
	High	.9795	.47049	4
	Total	.7281	.48963	22
Medium Pressure	Low	.6542	.49322	7
	Medium	.2097	.68070	11
	High	.4295	.09548	4
	Total	.3911	.57624	22
High Pressure	Low	.0905	.53223	7
	Medium	-.0451	.49661	11
	High	.0640	.40709	4
	Total	.0179	.47570	22

a. SCAT = Anxiety

b. Unit = Seconds

Gender and Change in Performance

Figure 4.5 depicts mean differences between fastest 2017 standardized performance times for each meet type and fastest 2016 standardized performance time, categorized by gender.

Figure 4.5

Gender * Performance

	Gender	Mean[a]	Std. Deviation	N
Low Pressure	Female	.7166	.50770	12
	Male	.7418	.49392	10
	Total	.7281	.48963	22
Medium Pressure	Female	.3780	.68451	12
	Male	.4068	.44903	10
	Total	.3911	.57624	22
High Pressure	Female	.1143	.55071	12
	Male	-.0979	.36063	10
	Total	.0179	.47570	22

a. Unit = Seconds

Coach Ratings of Receptiveness and Change in Performance

Figure 4.6.A

Coach 1 Receptiveness * Performance

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
						Lower Bound	Upper Bound		
Low Pressure	Very Unreceptive	4	.7425	.67782	.33891	-.3361	1.8211	.09	1.69
	Unreceptive	8	1.0654	.42622	.15069	.7091	1.4218	.33	1.68
	Receptive	10	.6904	.52980	.16754	.3114	1.0694	-.10	1.43
	Very Receptive	5	.7355	.29528	.13205	.3689	1.1021	.33	1.11
	Total	27	.8176	.48968	.09424	.6239	1.0113	-.10	1.69
Medium Pressure	Very Unreceptive	4	.6788	.82751	.41376	-.6380	1.9955	-.45	1.38
	Unreceptive	7	.6171	.41386	.15642	.2344	.9999	.16	1.40
	Receptive	8	.0430	.49674	.17562	-.3723	.4583	-.92	.63
	Very Receptive	4	.4775	.43291	.21645	-.2114	1.1664	.15	1.11
	Total	23	.4039	.56632	.11809	.1590	.6488	-.92	1.40
High Pressure	Very Unreceptive	4	.2675	.36163	.18081	-.3079	.8429	-.10	.69
	Unreceptive	6	-.0097	.42790	.17469	-.4588	.4393	-.45	.48
	Receptive	9	-.1108	.50394	.16798	-.4982	.2765	-.90	.48
	Very Receptive	5	.1210	.51689	.23116	-.5208	.7628	-.41	.91
	Total	24	.0258	.45981	.09386	-.1684	.2200	-.90	.91

Figure 4.6.B

Coach 2 Receptiveness * Performance

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
						Lower Bound	Upper Bound		
Low Prssure	Very Unreceptive	2	.4550	.17678	.12500	-1.1333	2.0433	.33	.58
	Unreceptive	6	.9412	.57433	.23447	.3385	1.5440	.09	1.69
	Receptive	12	.8437	.55102	.15906	.4936	1.1938	-.10	1.68
	Very Receptive	7	.7704	.37319	.14105	.4252	1.1155	.33	1.34
	Total	27	.8176	.48968	.09424	.6239	1.0113	-.10	1.69
Medium Pressure	Very Unreceptive	2	.5150	.09192	.06500	-.3109	1.3409	.45	.58
	Unreceptive	5	.5735	.75325	.33687	-.3618	1.5088	-.45	1.38
	Receptive	10	.2891	.63644	.20126	-.1662	.7444	-.92	1.40
	Very Receptive	6	.4167	.40770	.16644	-.0112	.8445	-.04	1.11
	Total	23	.4039	.56632	.11809	.1590	.6488	-.92	1.40
High Pressure	Very Unreceptive	2	.0900	.07071	.05000	-.5453	.7253	.04	.14
	Unreceptive	5	.1815	.45547	.20369	-.3840	.7470	-.45	.69
	Receptive	10	-.0899	.46915	.14836	-.4255	.2458	-.90	.48
	Very Receptive	7	.0614	.54390	.20557	-.4416	.5644	-.66	.91
	Total	24	.0258	.45981	.09386	-.1684	.2200	-.90	.91

Figure 4.6.C

Coach 3 Receptiveness * Performance

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean Lower Bound	95% Confidence Interval for Mean Upper Bound	Minimum	Maximum
Low Pressure	Unreceptive	7	.8896	.57990	.21918	.3533	1.4260	.09	1.69
	Receptive	16	.7967	.50653	.12663	.5268	1.0666	-.10	1.68
	Very Receptive	4	.7750	.32535	.16267	.2573	1.2927	.33	1.11
	Total	27	.8176	.48968	.09424	.6239	1.0113	-.10	1.69
Medium Pressure	Unreceptive	7	.5550	.55645	.21032	.0404	1.0696	-.45	1.38
	Receptive	13	.2799	.60010	.16644	-.0827	.6425	-.92	1.40
	Very Receptive	3	.5883	.45542	.26294	-.5430	1.7197	.27	1.11
	Total	23	.4039	.56632	.11809	.1590	.6488	-.92	1.40
High Pressure	Unreceptive	6	.2479	.35111	.14334	-.1205	.6164	-.28	.69
	Receptive	14	-.1345	.45288	.12104	-.3960	.1270	-.90	.48
	Very Receptive	4	.2538	.48863	.24431	-.5238	1.0313	-.14	.91
	Total	24	.0258	.45981	.09386	-.1684	.2200	-.90	.91

Coach Ratings of Skill Transfer and Change in Performance

Figure 4.7.A

Coach 1 Skill Transfer * Performance

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean Lower Bound	95% Confidence Interval for Mean Upper Bound	Minimum	Maximum
Low Pressure	Under-perform	10	.8911	.65289	.20646	.4240	1.3581	-.10	1.69
	Average Perform	9	.7626	.43947	.14649	.4248	1.1004	.22	1.43
	Over-perform	8	.7875	.33049	.11685	.5112	1.0638	.33	1.34
	Total	27	.8176	.48968	.09424	.6239	1.0113	-.10	1.69
Medium Pressure	Under-perform	9	.4086	.51670	.17223	.0115	.8058	-.45	1.38
	Average Perform	7	.2784	.73919	.27939	-.4052	.9620	-.92	1.20
	Over-perform	7	.5232	.48845	.18462	.0714	.9749	-.03	1.40
	Total	23	.4039	.56632	.11809	.1590	.6488	-.92	1.40
High Pressure	Under-perform	8	.1339	.45025	.15919	-.2426	.5103	-.58	.69
	Average Perform	8	-.1013	.58470	.20672	-.5901	.3876	-.90	.91
	Over-perform	8	.0448	.34334	.12139	-.2423	.3318	-.41	.48
	Total	24	.0258	.45981	.09386	-.1684	.2200	-.90	.91

Figure 4.7.B

Coach 2 Skill Transfer * Performance

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean Lower Bound	95% Confidence Interval for Mean Upper Bound	Minimum	Maximum
Low Pressure	Under-perform	6	.6571	.71577	.29221	-.0941	1.4082	-.10	1.69
	Average Perform	16	.8558	.43949	.10987	.6216	1.0900	.22	1.68
	Over-perform	5	.8880	.37846	.16925	.4181	1.3579	.33	1.34
	Total	27	.8176	.48968	.09424	.6239	1.0113	-.10	1.69
Medium Pressure	Under-perform	5	.3750	.70082	.31342	-.4952	1.2452	-.45	1.38
	Average Perform	14	.3585	.58770	.15707	.0192	.6978	-.92	1.40
	Over-perform	4	.5988	.37243	.18622	.0061	1.1914	.27	1.11
	Total	23	.4039	.56632	.11809	.1590	.6488	-.92	1.40
High Pressure	Under-perform	5	.1450	.47969	.21452	-.4506	.7406	-.58	.69
	Average Perform	14	-.1144	.43553	.11640	-.3658	.1371	-.90	.48
	Over-perform	5	.2990	.43509	.19458	-.2412	.8392	-.14	.91
	Total	24	.0258	.45981	.09386	-.1684	.2200	-.90	.91

Figure 4.7.C

Coach 3 Skill Transfer * Performance

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean Lower Bound	95% Confidence Interval for Mean Upper Bound	Minimum	Maximum
Low Pressure	Under-perform	5	.7169	.73959	.33076	-.2014	1.6352	.09	1.68
	Average Perform	18	.8058	.41530	.09789	.5993	1.0124	-.10	1.43
	Over-perform	4	.9963	.55781	.27890	.1087	1.8839	.33	1.69
	Total	27	.8176	.48968	.09424	.6239	1.0113	-.10	1.69
Medium Pressure	Under-perform	4	-.2827	.54802	.27401	-1.1547	.5893	-.92	.39
	Average Perform	15	.4213	.38689	.09989	.2071	.6356	-.09	1.20
	Over-perform	4	1.0249	.45687	.22844	.2979	1.7519	.45	1.40
	Total	23	.4039	.56632	.11809	.1590	.6488	-.92	1.40
High Pressure	Under-perform	4	-.0082	.63581	.31791	-1.0199	1.0035	-.90	.47
	Average Perform	16	-.0235	.43575	.10894	-.2557	.2087	-.66	.91
	Over-perform	4	.2570	.42599	.21300	-.4208	.9349	-.28	.69
	Total	24	.0258	.45981	.09386	-.1684	.2200	-.90	.91

Dispositional Mindfulness and Coach Ratings of Receptiveness

Figure 4.8.A

Dispositional Mindfulness * Coach 1 Ratings

MAAS Score

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean Lower Bound	95% Confidence Interval for Mean Upper Bound	Minimum	Maximum
Very Unreceptive	4	4.1850	.60136	.30068	3.2281	5.1419	3.67	5.00
Unreceptive	9	3.7933	1.03892	.34631	2.9948	4.5919	2.47	5.47
Receptive	10	4.2060	.43321	.13699	3.8961	4.5159	3.20	4.73
Very Receptive	5	4.0940	.55595	.24863	3.4037	4.7843	3.33	4.53
Total	28	4.0504	.70878	.13395	3.7755	4.3252	2.47	5.47

Figure 4.8.B

Dispositional Mindfulness * Coach 2 Ratings

MAAS Score

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean Lower Bound	95% Confidence Interval for Mean Upper Bound	Minimum	Maximum
Very Unreceptive	2	3.9350	1.50614	1.06500	-9.5971	17.4671	2.87	5.00
Unreceptive	6	3.9683	.82179	.33549	3.1059	4.8307	3.20	5.47
Receptive	13	4.0554	.73650	.20427	3.6103	4.5004	2.47	4.93
Very Unreceptive	7	4.1443	.46198	.17461	3.7170	4.5715	3.33	4.53
Total	28	4.0504	.70878	.13395	3.7755	4.3252	2.47	5.47

Figure 4.8.C

Dispositional Mindfulness * Coach 3 Ratings

MAAS Score

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Unreceptive	7	3.6671	.93817	.35459	2.7995	4.5348	2.47	5.00
Receptive	17	4.1529	.62994	.15278	3.8291	4.4768	3.20	5.47
Very Receptive	4	4.2850	.41097	.20549	3.6310	4.9390	3.67	4.53
Total	28	4.0504	.70878	.13395	3.7755	4.3252	2.47	5.47

Gender, MAAS, and SCAT

Figure 4.9

Group Statistics

	Gender	N	Mean	Std. Deviation	Std. Error Mean
MAAS Score	Female	16	3.8462	.64428	.16107
	Male	12	4.3225	.72502	.20930
SCAT Score	Female	16	21.25	4.266	1.067
	Male	12	17.75	4.555	1.315

Statistical Analyses

Assumptions

Mixed Repeated Measures

All data met the assumptions of normality, sphericity, and homogeneity of variance unless otherwise indicated (Figures 4.14 – 4.20).

Simple Linear Regression

All data met the assumptions of normality, linearity, homoscedasticity, and normality of residuals (Figures 4.21).

One-Way ANOVA

All data met the assumptions of normality and homogeneity of variances (Figure 4.22).

Performance

Dispositional mindfulness and change in performance.

A mixed repeated measures ANOVA was conducted to compare the effects of mindfulness on change in performance in low, medium, and high pressure conditions. Mauchly's test of Sphericity was not violated $W(2)=.94$, $p=.61$, and all p-values for Levene's Test of Equality of Error Variances were non-significant.

There was a significant within-subjects effect for pressure on change in performance, $F(2,38)= 26.64$, $p<.001$, $\eta p^2=.58$. A paired samples t-test revealed significant differences between all three measures of performance (Figure 4.10).

Figure 4.10

	Mean Difference	S.D.	t	df	p
Low Pressure – Medium Pressure	.35	.46	3.65	22	.001
Medium Pressure – High Pressure	.37	.48	3.63	21	.002
Low Pressure – High Pressure	.74	.46	7.80	23	.000

There was no significant effect of mindfulness on change in performance $F(4,38)= 1.58$, $p=.20$, $\eta p^2=.14$. There were no significant between-subjects effects, $F(2,19)=3.21$, $p=.06$, $\eta p^2=.25$.

Trait anxiety and change in performance.

For SCAT x Pressure, the High SCAT- Low Pressure and High SCAT – Medium Pressure grouping failed to meet normality assumptions (Figure 4.12). However, because the normality assumptions were scarce, and because Glass et al. (1972) demonstrated that Type 1 error rate is not substantially effected by violation of this assumption, I proceeded with parametric testing.

A mixed repeated measures ANOVA was conducted to compare the effects of anxiety on swimming performance in low, medium, and high pressure conditions. Mauchly's test of Sphericity was not violated, $W(2)= .99$, $p=.88$, and all p-values for Levene's Test of Equality of Error Variances were non-significant.

There was no significant effect for trait anxiety on change in performance $F(4,38)= .89$, $p= .48$, $\eta p^2=.09$. There were no significant between-subjects effects, $F(2,19)= 1.42$, $p=.27$, $\eta p^2=.13$.

Gender and change in performance.

A mixed repeated measures ANOVA was conducted to compare the effects of gender on change in swimming performance in low, medium, and high pressure conditions. Mauchly's test of Sphericity was not violated, W(2)= .99, p=.90, and all p-values for Levene's Test of Equality of Error Variances were non-significant.

There was no significant effect for gender on change in swimming performance F(4,19)= .95, p= .39, ηp^2=.05. There were no significant between-subjects effects F(1,20)=.08, p=.79, ηp^2=.004.

Coach ratings of receptiveness and change in performance.

Mixed repeated measures ANOVA were conducted to determine the accuracy of individual coach ratings of athlete receptiveness to predict changes in swimmer performance under various points of pressure. The tests were run separately because the coach ratings were highly correlated. For all three coaches, p-values for Levene's Test of Equality of Error Variances were non-significant. Sphericity tests are below:

For Coach 1: Mauchly's test of Sphericity was not violated, W(2)= .99, p=.93

For Coach 2: Mauchly's test of Sphericity was not violated, W(2)= .98, p=.86

For Coach 3: Mauchly's test of Sphericity was not violated, W(2)= .98, p=.85

None of the three coach ratings of athlete receptiveness were significantly related to changes in swimming performance as a function of pressure. There were no significant between-subjects effects.

Figure 4.11.A

Within-Subjects				
	F	df	p	ηp^2
Coach 1	1.03	6,36	.42	.15
Coach 2	.36	6,36	.90	.06
Coach 3	.48	4,38	.75	.05

Figure 4.11.B

Between-Subjects				
	F	df	p	ηp^2
Coach 1	1.12	3,18	.37	.16
Coach 2	.33	3,18	.80	.05
Coach 3	.85	2,19	.44	.08

Coach ratings of skill transfer and change in performance.

For Coach 3 Skill Transfer x Pressure, the Underperform – Low Pressure grouping failed to meet the normality assumptions. However, because the normality assumptions were scarce, and because Glass et al. (1972) demonstrated that Type 1 error rate is not substantially effected by violation of this assumption, I proceeded with parametric testing.

Mixed repeated measures ANOVA were conducted to determine the accuracy of individual coach ratings of athlete skill transfer to predict change in swimmer performance under various points of pressure. The tests were run separately because the coach ratings were highly correlated. For all three coaches, p-values for Levene's Test of Equality of Error Variances were non-significant. Sphericity tests are below:

For Coach 1: Mauchly's test of Sphericity was not violated, W(2)= .99, p=.97.

For Coach 2:Mauchly's test of Sphericity was not violated, W(2)= .95, p=.68

For Coach 3: Mauchly's test of Sphericity was not violated, W(2)= .91, p=.43

There was a significant interaction between coach 3 ratings of skill-transfer and change in swimming performance over points of pressure $F(4,22)= 4.0$, $p= .008$, $\eta p^2=.30$. No other interactions were significant. There were no significant between-subjects effects. A one-way ANOVA was conducted to determine evaluate the within subjects effect for coach 3 ratings. A significant relationship between coach ratings and change in performance was found for the medium pressure condition, $F(2,20)=9.48$, $p=.001$.

Tukey HSD post-hoc testing revealed a significant differences between all three groups, such that change in performances for the under-perform group (M=-.28, S.D.=.55), was significantly different from those in the average perform group (M=.42, S.D.=.39) (M.D.=-.70, S.E.= .24, p=.02, CI [-1.31,-.10]) and over-perform group (M=1.02, S.D.=.46) (M.D.=-1.31, S.E.=.30, p=.001, CI [-2.10,-.55]).

Figure 4.12.A

Within-Subjects				
	F	df	p	ηp^2
Coach 1	.32	4,38	.87	.03
Coach 2	1.11	4,38	.37	.11
Coach 3	4.0	4,38	.008*	.30

*Significant

Figure 4.12.B

Between-Subjects				
	F	df	p	ηp^2
Coach 1	.30	2,19	.74	.03
Coach 2	.57	2,19	.57	.06
Coach 3	.23	2,19	.80	.02

Dispositional Mindfulness

Mindfulness and trait anxiety.

A simple linear regression analysis was conducted to predict dispositional mindfulness based on trait anxiety. There was not a significant regression equation $F(1,26)= 2.96$, $p= .10$, $R^2= .10$. However, there was a significant correlation between the two variables $r= -.31$, $p= .049$.

Mindfulness and coach ratings of receptiveness.

MAAS data is normally distributed (Figure 4.10). Levene's test of homogeneity of variance was violated for Coach 1 ratings of receptiveness $F(3,24)= 4.22$, $p=.016$. It was observed that although the MAAS data is normal, the Coach 1 Ratings x MAAS trends away from normal. The median measure is considered robust against non-normal data (Brown & Forsythe, 1974). The median did not violate Levene's test $F(3,24)=1.45$, $p=.25$, and so I decided to run the ANOVA. Levene's test was not violated for Coach 2 ratings $F(3,24)=1.68$, $p=.20$, or for Coach 3 ratings $F(2,25)= 1.49$, $p=.25$.

None of the three measures were significantly predictive of dispositional mindfulness.

Figure 4.13

	F	df	p	ηp^2
Coach 1	.58	3,24	.63	.07
Coach 2	.07	3,24	.97	.01
Coach 3	1.47	2,25	.25	.11

Mindfulness and gender.

An independent samples t-test was conducted to determine if there were significant differences in dispositional mindfulness between males and females. There was no significant difference between males ($M=4.32$, $S.D.= .64$) and females ($M=3.85$, $S.D.= .73$) on mindfulness scores, $t(26)= -1.83$, $p= .08$, 95% CI [-1.01, .06].

Reliability of Coach Ratings

To test degree of agreement between individual coach ratings of both athlete receptiveness and skill transfer, intraclass correlation analyses were conducted.

For athlete receptiveness, an excellent rating of reliability was found between the three coach ratings. The average measure of ICC was .86, with a 95% confidence interval from .732 to .930 ($F(27,54)= 7.86$, $p<.001$).

For athlete skill transfer, a good rating of reliability was found between the three coach ratings. The average measure of ICC was .61 with a 95% confidence interval from .25 to .81 ($F(27,54)= 2.49$, $p=.002$).

Trait Anxiety and Gender

An independent samples t-test was conducted to determine if there were significant differences in trait anxiety between males and females. There was a significant difference between males ($M=17.75$, $S.D.= 4.56$) and females ($M=21.25$, $S.D.= 4.27$) on trait anxiety scores, $t(26)= 2.09$, $p=.047$, 95% CI [.05, 6.95], such that females scored significantly higher on trait anxiety than males.

Additional Figures

Additional figures can be found in Appendix G. Figures 4.14-4.22 display results of normality tests, while figure 4.23-4.27 are graphical representations of key results.

Chapter 5: Discussion

Summary

The purpose of this study was to examine the impact of dispositional mindfulness and trait anxiety on changes in swimming performance to better understand the phenomenon of choking under pressure. Although mindfulness and anxiety were not significantly related to changes in swimming performance, trends emerged that can be compared to previous research in the area, and provide exciting avenues for future research. Significant relationships between gender and trait anxiety, as well as trait anxiety and dispositional mindfulness, contribute to developing understandings of these constructs. Finally, findings related to the accuracy of coach ratings may have implications for coach practice, and certainly demand more in-depth investigation into the broad category of coach assessments of athletes.

Conclusions

Pressure and Change in Performance

Although not a central focus of the study, there was a clear relationship between change in swimmer performances as a function of pressure. "Pressure" in this case did conform with Baumeister's (1984) definition—pressure ratings were assigned according to assessments of the stakes related to the meet performance. It could be concluded from this data that elite athletes are such because they have consistently performed well when the stakes are high. However, an important consideration for these results is that the swimming season is designed so that the athletes perform best at season's end. Swimmers engage in a "taper" prior to their most important competitions to recover them from the rigors of endurance training. These results can also be evidence of this phenomenon in action, and can be used to explain the unique nature of competitive swimming performance trends. While I suspect pressure did increase as assumed in this design, I would caution against overstating this aspect of the results.

Dispositional Mindfulness and Performance

There were no significant relationships found between mindfulness and change in performance as a function of pressure. This may be interpreted to mean that trait mindfulness is not directly related to swimming performance. However, review of the descriptive statistics (Figure 4.3), along with graphical representations of the results (Figure 4.25), revealed an interesting trend that should be considered. At all levels of pressure, change in performance improved as a function of mindfulness, such that higher mindfulness was associated with greater negative change (time improvements) from 2016 baseline. The lack of significance may be partially explained by sample size. After listwise deletion, there were only 8, 7, and 7 athletes in the low, medium, and high-mindfulness groups, respectively.

One explanation for this pattern is that athletes high in trait mindfulness interpret high pressure situations in a positive way, which allows them to experience stress as positive excitement rather than negative anxiety. This is consistent with findings by Brown and Ryan (2003) that show mindfulness to be positively correlated with hedonic tone. Mindful athletes may also be more likely to enter flow states during important competitive situations, allowing them to stay poised and focused to optimize performance.

Despite the non-significant findings, the trend revealed also challenges the notion that self-regulatory behaviors induce debilitating internal attentional focus. Although no measure of self-focus was utilized in this study, one would expect performance to get worse as a function of pressure if mindful athletes engaged in internally focused attentional strategies during important performances. These findings justify a direct investigation into the interaction between dispositional mindfulness and attentional strategy.

Trait Anxiety and Change in Performance

There was no significant relationship found between trait anxiety and change in performance as a function of pressure. Once again, however, the descriptive statistics (Figure 4.4), and graphical representation of results (Figure 4.24), reveal an interesting trend, particularly when considered in relationship to previous research findings in the field of anxiety. Both appear to reveal an inverse-U relationship between trait anxiety and change in performance, such that moderate trait anxiety was associated with greater negative change (time improvement).

The inverse-U relationship is consistent with Burton's (1988) findings as it relates to somatic anxiety. Gould, Petlichkoff, and Weinberg (1984) found somatic anxiety scores for intercollegiate wrestlers to be moderately correlated with SCAT scores ($r=.34$, $p<.05$)—but did for cognitive anxiety as well ($r=.32$, $p<.05$). This could be interpreted as evidence that the multidimensional conceptualization of anxiety is misguided, given the relationship between arousal, cognition and emotions, consistent with the meta-analytical findings of Craft et al. (2003). An alternative interpretation is that trait anxiety interacts with performance differently than state anxiety. It may be that trait anxiety has an inverse-U relationship with performance because of its predictive nature of stress responses. Individuals high in trait anxiety may assign negative cognitions to feelings of arousal and engage in maladaptive coping strategies such as self-handicapping and giving up; as seen in Bauemister (1984). It is less clear why low trait anxiety is suboptimal for performance, but perhaps can be attributed to athletes being under-stimulated and failing to summon sufficient arousal to perform.

The flaw in the multidimensional conceptualization of anxiety may be that it fails to consider the possibility of interaction between arousal and cognitions. If cognitive appraisals direct arousal states, then efforts to predict performance based on pre-performance arousal may be misguided. We will likely learn more from pre-competition measures of cognitive anxiety and mid-competition measures of arousal.

Trait Anxiety and Mindfulness

While trait anxiety was not shown to be predictive of dispositional mindfulness as demonstrated in previous studies, the constructs were moderately negatively correlated, consistent with previous findings (Figure 4.27) (Brown & Ryan, 2003; Walsh et al., 2009). Furthermore, it suggests this relationship holds within the context of athletics. Since both are framed as antecedents to emotional responses following stress, it makes sense that they would be related. It may be that anxious athletes are preoccupied with worry and fear, distracting them from present-state awareness. Maintaining a highly focused, task-oriented attentional focus may also facilitate reductions is anxiety. However, it is difficult to draw conclusions on the mechanism from a simple correlation. Clearly, this is a relationship that should be examined more closely.

Coach Ratings

Change in Performance.

There were no apparent major relationships between coach ratings of skill transfer or athlete receptiveness and changes in swimming performances. There was one significant finding, between coach 3 ratings of skill transfer, and change in performance for medium pressure (Figure 4.26.C.) Interestingly, that difference indicated that there was inverse relationship between coach ratings of skill transfer and change in performance, such that the athletes that were rated “over-performers” improved the most (or didn’t improve the least), and vice versa. Review of the distributions (Figures 4.26), show the general trend, if any, to be an inverse-u relationship with change in performance. This may be indicative that coaches underestimate the low performers and overestimate the high performers on their teams. This would make sense; coaches may rely on their knowledge of an athlete’s absolute performances (ie. whether they qualify for a national meet) as opposed to their relative performances (ie. personal best time improvements) in evaluations. If coaches are using this type of information to make assessments regarding how to interact with their athlete, there may be errors in their judgements.

There were also design flaws that likely contributed to the lack of quality data produced. Because both constructs were measured using a single Likert-style question, it was not possible to average the results in any meaningful way, forcing individual coach ratings to be analyzed separately. Multi-item measures, such as the SCAT or MAAS instruments, would likely yield data that could be better utilized for the comparisons attempted in this study.

Generally, the results do not support the notion that coaches were accurate in predicting athlete changes in performance. Now, an alternative conclusion would be that skill transfer and receptiveness to coaching feedback are not predictive of swimming performances to begin with. This is supported by the high level of agreement between coach ratings on both measures. However, it is counterintuitive that receptiveness to feedback (athlete coach-ability), which should result in more technical changes and subsequent improvements in swimming technique, does not predict athlete performance. Likewise, one would expect that the athletes who are the best “gamers” or “racers” would see the greatest improvements, particularly under high pressure conditions. Again, the weaknesses of the measures likely prevent strong conclusions either way, but certainly are not a ringing endorsement for the accuracy of coach ratings.

The agreement between coach ratings does indicate that the ratings were accurate representations of coach perceptions of the constructs being measured. These findings would have benefited from corroboration from coach ratings of athlete ability, and perhaps from athlete ratings of the same constructs to measure agreement. Overall, there is a definite need for further research into the accuracy of coach ratings, as coaches use their daily assessments of athletes to inform their coaching strategies and interactions with the athletes. Furthermore, research has consistently demonstrated that coaching feedback can vary in quality and quantity as a function of coach evaluations—and often coaches are not aware of these discrepancies (Sinclair and Vealey, 1996; Solomon, 1990).

Mindfulness.

Coach ratings of athlete receptiveness failed to predict mindfulness. Review of the descriptive statistics revealed no noticeable trends. This refuted the hypothesis that highly mindful athletes would be less threatened by coach feedback because they are more open and accepting of threatening information. The lack of effect here may demonstrate that traditional coaching feedback is not threatening to most athletes, and that a specific coaching style, such as harsh criticism, or circumstance—like a major technical change—may be necessary for athlete receptiveness to be significantly impacted. That these athletes have reached an elite level in the sport of swimming might also suggest that they are generally more receptive to feedback than athletes in the general population. It is also possible that mindfulness is not related to athlete receptiveness, or that coaches are inaccurate in their assessments of athlete receptiveness. Another possible explanation for this finding is that the MAAS measurement was not sensitive to the acceptance concept. The MAAS is a unidimensional measure of present-centered attention and awareness, as in its development Brown and Ryan (2003) excluded items related to acceptance—such as openness and judgement—because Brown and Ryan (2001) found that those items did not explain additional variance (De Bruin et al., 2011). However, it is possible that the due to this exclusion MAAS fails to tap into the acceptance construct as predicted. If that were the case, then it is possible that the MAAS scores cannot be used to test this aspect of the hypothesized relationship between mindfulness and receptiveness to feedback.

Gender

Gender was not significantly related to swimming performance; however, there was a significant effect for gender and trait anxiety. Female swimmers had significantly higher trait anxiety than males. In fact, the mean for males fell in the “Low” grouping, while the mean for females was “Medium” or Average. This is a consistently demonstrated effect in personality research (Feingold 1994). However, it suggests that even among elite athletes, females are generally higher in trait anxiety than males. This should inform coaching practices, particularly as it relates to situations that might elicit anxiety.

Interestingly, while mindfulness scores did not vary significantly for males and females, males did have a higher mean for mindfulness. There does not appear to be many studies that have measured gender differences in dispositional mindfulness, particularly among athletes, and the trend demonstrated here should provide reason to continue to explore this possible gender difference.

Choking Under Pressure

Taken together, these findings have important implications for understanding of the phenomenon of choking under pressure in sports. First, the data suggest that assessments of trait anxiety can be used to identify athletes that are most at risk for choking under pressure. Specifically, the trend is that athletes with moderate trait anxiety improve the most at all levels of pressure; although surprisingly, the differences between the three groups of trait anxiety are least pronounced at high pressure. These findings also provide insight into the relationship between state anxiety and performance. Previous research has suggested that cognitive anxiety (a state measure) is facilitative for athletes with low trait anxiety, and harmful for those with high trait anxiety (Carver et al, 1983). While this study does not measure state anxiety, if it is assumed that the athletes in this study experienced cognitive anxiety during their performances, these data do not support that hypothesis. This would suggest that cognitive anxiety does not directly facilitate choking under pressure; or at least, that the relationship is more complicated than previously assumed. Furthermore, it appears trait anxiety has potential as a predictor of both performance improvement and choking under pressure. Although not significant, the clear differences between groups provide reason to consider the trend that emerged for moderate trait anxiety. Research on trait anxiety has potential implications for understanding the antecedents of choking under pressure, and should not be abandoned in favor of only those involving state measures.

The general trend that emerged regarding mindfulness also has potential in this area. Considering that mindfulness interventions have been demonstrated to increase dispositional mindfulness, particularly for those high in trait mindfulness, these non-significant differences are encouraging—since in this study no intervention occurred. The differences seen between mindfulness groups on changes in performance were entirely naturally occurring. This suggests individuals that are naturally present and aware are less likely to choke under pressure. This has multiple implications. First, it begs for further investigation into the personality traits that highly mindful individuals possess that aid them in performance. I suspect that superior self-regulatory skills, and a decreased tendency to fear future failure, contribute to this effect. Second, it suggests that mindfulness interventions could be very effective in combatting choking under pressure, because they have been demonstrated to increase dispositional mindfulness (Brown & Ryan, 2003). Finally, because the measure of mindfulness used was unidimensional and did not include a measure of the "acceptance" factor of mindfulness, either acceptance is inherently a part of mindfulness and contributes to performance enhancement, or the differences seen in this study were absent the acceptance factor, and could have been more pronounced had that been included.

Taken together, I believe there is preliminary evidence that choking under pressure is determined by an athlete's response to anxiety, rather than simply due to it. The inverse-u distribution between trait anxiety and change in performance, if valid, challenges both Burton's (1988) theory that cognitive anxiety is negatively related to performance, and contradicts conceptualizations that suggest cognitive anxiety is facilitative for those with low trait anxiety. Interestingly, the finding instead closely mirrors Burton's (1988) findings regarding somatic anxiety and performance, which was also found to distribute as an inverse-u. This is more consistent with the experiential descriptions of performance, where athletes use terms like "getting psyched up" to explain the need to be sufficiently aroused, and "over-anxious" when nerves are debilitating. One rarely hears the elite athlete say they are not nervous when performing; in fact, many athletes claim that the day that happens is the day they stop competing.

The mindful approach—one of experiential acceptance—is also consistent with the common refrains of the elite athlete. Athletes don't tell reporters that they eliminated their anxiety after a performance; instead, they report "managing" or "channeling" their emotions, "focusing on the task at hand," and being "in the zone." Both findings share similarities with the characterizations of great performances the sports fan hears when they turn on their television and listen to an interview with an elite athlete. I think that incorporating the athlete experience into interpretations of these findings lend insight into the trends found.

Limitations

There are numerous limitations to this study. First, the lack of a measure of attentional focus precluded testing the underlying predictions that 1) attentional focus mediates the anxiety-performance relationship and that 2) dispositional mindfulness heightens the probability that an individual will utilize an external attentional focus strategy. Granted, that measurement would have been highly invasive, if not impossible, with this study's design, but nevertheless would have contributed to greater understanding. The relationship between mindfulness and change in performance implies that athletes high in dispositional mindfulness were engaged in adaptive attentional focus strategies, but that conclusion could have been empirically tested with the addition of a measure of attentional focus.

Furthermore, the study did not collect data for state anxiety or mindfulness to corroborate predictions made regarding the relationship between state and trait measures of both constructs. The relationships identified generalize most immediately to dispositional constructs, and inferences must be made regarding the extent to which the findings extend to their state counterparts. Therefore, while it may be appropriate to draw conclusions regarding the way an athlete's personality may influence his performance in pressure situations, more caution must be exercised when prescribing treatments or interventions to manipulate either construct based on this data. However, previous research findings are relied upon to make informed predictions about state mindfulness and anxiety as they relate to dispositional measures and the findings of this study.

The coach rating measures, as discussed, were also flawed because the design did not allow for their data to be averaged together in any meaningful way. The greatest contribution those data make is to underscore the importance of concerted efforts to both measure the accuracy of coach ratings, and to develop sound measures of athlete receptiveness to coaching, skill transfer, and related variables. This limitation undercut one of the strengths of the design, which was that there were multiple opinions surveyed for the constructs of athlete receptiveness and skill transfer. More comprehensive measures, with multiple items meant to assess the many facets of both constructs, would have not only allowed for the data to be more readily combined, but also would likely have been more accurate representations of each.

The decision to measure performance improvement as naturally as possible was made with the intent of enhancing the generalizability of the data. It is difficult to experimentally test the impact of variables on performance in sport because of the infinite variables that might have an impact on outcomes. However, it seemed inappropriate to try to control these variables by having the athletes swim the same stroke and distance in a controlled setting. This design allowed for pressure to develop naturally rather than artificially, and for performance to be measured in the stroke and distance that the athletes were training for. With that being said, it made it necessary to standardize the performance data. It is not clear if the procedure used is a fair representation of improvement for each stroke and distance, although there did not appear to be any trends that emerged that would suggest the standardization procedures misrepresented any one race. Furthermore, it may be inappropriate to assume that the trends identified apply to all strokes and distances—in fact, Burton (1988) demonstrated that the anxiety-performance relationship can vary depending on stroke and distance swum.

As was briefly discussed previously, the study lacked a manipulation check for pressure. The findings related to pressure may not be entirely attributable to pressure, as the "typical" swim season would likely follow a similar pattern. This study would have benefited greatly from swimmer ratings of meet pressure or meet importance, as well as pre-race state anxiety measures—although the invasive nature of the latter would have made it unlikely, certainly for the number of competitions sampled. Specifically, this would have allowed for a distinction to be made between changes in performance due to pressure, and those due to the "taper" process and the natural progression of the season. Furthermore, a self-reported pressure measure would have been sensitive to differences in pressure experienced by the athletes, while this study assumes the athletes experienced the same degree of pressure at each meet—likely incorrectly.

Future Research

Future research should attempt to replicate the pressure-performance findings from this study, in a similarly naturalistic setting. I believe that more research in athletics needs to venture outside of the laboratory and into the field to bridge the gap between researchers and consumers (athletes and coaches). Any replication effort should operationalize pressure more precisely and triangulate measures of pressure to ensure that is the construct being measured.

There is also a need to investigate the effectiveness of mindfulness training on performance under pressure. This study suggested that dispositional mindfulness alone may impact performance outcomes under pressure. It is likely that mindfulness interventions, which have been routinely shown to increase dispositional mindfulness, could accentuate the differences seen here (Kaufmann et al., 2009). Particularly, a longitudinal study comparing the effects of mindfulness as a training philosophy would provide important insight into the appropriateness of this Eastern philosophy in the competitive world of Western sports.

Furthermore, research should be conducted that considers how mindfulness influences the use of attentional focus strategies in sport. There is some inconsistency in predictions regarding attentional focus and mindfulness, with theories ranging from mindfulness being inversely related with self-focus, to claims it promotes either internal or external attentional focus predominantly, to those that believe mindfulness facilitates both as needed. Of usefulness would be a study that concurrently relates use of attentional strategy to performance.

It would be worthwhile to approach anxiety studies in sport with a more practical approach. It is likely that physical and psychological experiences of stress and anxiety are interactive, and studies that account for that may yield more consistent results regarding the stress-performance relationship. This may involve combining physiological measures of arousal with self-report measures of both anxiety and emotional experience. We need to ask individuals what they are thinking and feeling and compare that to changes in arousal and performance. Obviously, this is time consuming and invasive—both limits of this study. Nevertheless, doing so may provide information that can be more readily used by coaches and athletes to optimize performance.

Finally, there appears to be a need for study of coach ratings and assessments of athletes. Coaches routinely judge athletes and use that information to inform their coaching practices. If coaches are not entirely accurate in their assessments, they need to be made aware of their biases so they can self-regulate to improve the quality and consistency of feedback given to their athletes.

Appendix A

The University of Arizona Consent to Participate in Research (Athletes)

Study Title: Mindfulness as a Predictor of Swimming Performance

Principal Investigator: Zachary Hojnacki

This is a consent form for research participation. It contains important information about this study and what to expect if you decide to participate. Please consider the information carefully. Feel free to discuss the study with your friends and family and to ask questions before making your decision whether or not to participate.

Why is this study being done? The purpose of this study is to determine the effect of mindfulness on sport anxiety, receptiveness to feedback, skill transfer and swimming performance. It also attempts to determine the accuracy of coach ratings of swimmers.

What will happen if I take part in this study? In this study, participants will be asked to take two surveys, one assessing mindfulness, and the other assessing sport anxiety. Participants will also be asked to provide their "primary" or "best" event as well. If you consent, your coaches will provide the PI with ratings of your individual receptiveness to coaching and ability to transfer training skills to competition performance. Furthermore, if you consent, the PI will utilize publically available data on your swim times from the USA swimming database.

How long will I be in the study? Expected completion time is 20 minutes.

How many people will take part in this study? There will be approximately 30-45 people in the study.

Can I stop being in the study? Your participation is voluntary. You may refuse to participate in this study. If you decide to take part in the study, you may leave the study at any time. No matter what decision you make, there will be no penalty to you and you will not lose any of your usual benefits. Your decision will not affect your future relationship with The University of Arizona or the swim program. If you are a student or employee at the University of Arizona, your decision will not affect your grades or employment status.

What risks or benefits can I expect from being in the study? There are minimal risks expected with the study. Participants may experience moderate, temporary distress from the survey questions, although this is unlikely. To minimize this risk, participants will be informed that they may withdraw at any time, and will be encouraged to vocalize any concerns they may have during the debriefing process. Potential benefits include identifying current sport anxiety and mindfulness levels, and contributing to a research base that may improve future coaching practices.

Will my study-related information be kept confidential? Your personally identifying information will be kept confidential. Only the PI will have access to personally identifying information.

Efforts will be made to keep your study-related information confidential. However, there may be circumstances where this information must be released.

Also, your records may be reviewed by the following groups:

- *The University of Arizona Institutional Review Board*

Who can answer my questions about the study?

For questions, concerns, or complaints about the study you may contact **Zachary Hojnacki at Hojnacki@email.arizona.edu** OR Dr. Mary McCaslin, Department Head of Educational Psychology mccaslin@email.arizona.edu.

For questions about your rights as a participant in this study or to discuss other study-related concerns or complaints with someone who is not part of the research team, you may contact the Human Subjects Protection Program at 520-626-6721 or online at http://rgw.arizona.edu/compliance/human-subjects-protection-program.

When may participation in the study be stopped? Participation may be stopped at any time by the PI or participants. Procedure to stop by participants will be to notify the PI of withdrawal of consent and wish to halt participation.

Will I be paid for taking part in this study? No compensation will be offered.

Signing the consent form

I have read (or someone has read to me) this form, and I am aware that I am being asked to participate in a research study. I have had the opportunity to ask questions and have had them answered to my satisfaction. I voluntarily agree to participate in this study.

I am not giving up any legal rights by signing this form. I will be given a copy of this form.

Printed name of subject	**Signature of subject**	**Date**

Appendix B

The University of Arizona Consent to Participate in Research (Coaches)

Study Title: Mindfulness as a Predictor of Swimming Performance

Principal Investigator: Zachary Hojnacki

This is a consent form for research participation. It contains important information about this study and what to expect if you decide to participate. Please consider the information carefully. Feel free to discuss the study with your friends and family and to ask questions before making your decision whether or not to participate.

Why is this study being done? The purpose of this study is to determine the effect of mindfulness on sport anxiety, receptiveness to feedback, skill transfer and swimming performance. It also attempts to determine the accuracy of coach ratings of swimmers.

What will happen if I take part in this study? In this study, participants will be asked to rate all participating athletes on measures of receptiveness to coaching and skill transfer (competition performances relative to training performances).

How long will I be in the study? Expected completion time is 30-45 minutes maximum.

How many people will take part in this study? There will be approximately 30-45 people in the study.

Can I stop being in the study? Your participation is voluntary. You may refuse to participate in this study. If you decide to take part in the study, you may leave the study at any time. No matter what decision you make, there will be no penalty to you and you will not lose any of your usual benefits. Your decision will not affect your future relationship with The University of Arizona. If you are a student or employee at the University of Arizona, your decision will not affect your grades or employment status.

What risks or benefits can I expect from being in the study? There are minimal risks expected with the study. Participants may experience moderate, temporary distress from the survey questions, although this is unlikely. To minimize this risk, participants will be informed that they may withdraw at any time, and will be encouraged to vocalize any concerns they may have during the debriefing process. Potential benefits include contributing to a research base that may improve future coaching practices.

Will my study-related information be kept confidential? Your personally identifying information will be kept confidential. Only the PI will have access to personally identifying information.

Efforts will be made to keep your study-related information confidential. However, there may be circumstances where this information must be released.

Also, your records may be reviewed by the following groups:

- *The University of Arizona Institutional Review Board*

Who can answer my questions about the study?

For questions, concerns, or complaints about the study you may contact **Zachary Hojnacki at Hojnacki@email.arizona.edu** OR Dr. Mary McCaslin, Department Head of Educational Psychology mccaslin@email.arizona.edu.

For questions about your rights as a participant in this study or to discuss other study-related concerns or complaints with someone who is not part of the research team, you may contact the Human Subjects Protection Program at 520-626-6721 or online at http://rgw.arizona.edu/compliance/human-subjects-protection-program.

When may participation in the study be stopped? Participation may be stopped at any time by the PI or participants. Procedure to stop by participants will be to notify the PI of withdrawal of consent and wish to halt participation.

Will I be paid for taking part in this study? No compensation will be offered.

Signing the consent form

I have read (or someone has read to me) this form, and I am aware that I am being asked to participate in a research study. I have had the opportunity to ask questions and have had them answered to my satisfaction. I voluntarily agree to participate in this study.

I am not giving up any legal rights by signing this form. I will be given a copy of this form.

______________________	______________________	__________
Printed name of subject	**Signature of subject**	**Date**

Appendix C

Sport Competition Anxiety Test

Assessing Your Anxiety

Read each statement below, decide if you "Rarely", "Sometimes" or "Often" feel this way when competing in your sport, tick the appropriate box to indicate your response.

	Rarely	Sometimes	Often
1. Competing against others is socially enjoyable	☐	☐	☐
2. Before I compete I feel uneasy	☐	☐	☐
3. Before I compete I worry about not performing well	☐	☐	☐
4. I am a good sportsman when I compete	☐	☐	☐
5. When I compete, I worryabout making mistakes	☐	☐	☐
6. Before I compete I am calm	☐	☐	☐
7. Setting a goal is important whencompeting	☐	☐	☐
8. Before I compete I get a queasy feeling in my stomach	☐	☐	☐
9. Just before competing, I notice my heart beats faster than usual	☐	☐	☐
10. I like to compete in games that demands a lot of physical energy	☐	☐	☐
11. Before I compete I feel relaxed	☐	☐	☐
12. Before I compete I am nervous	☐	☐	☐
13. Team sports are more exciting than individual sports	☐	☐	☐
14. I get nervous wanting to start the game	☐	☐	☐
15. Before I compete I usually get uptight	☐	☐	☐

Appendix D

Day-to-Day Experiences

Instructions: Below is a collection of statements about your everyday experience. Using the 1-6 scale below, please indicate how frequently or infrequently you currently have each experience. Please answer according to what *really reflects* your experience rather than what you think your experience should be. Please treat each item separately from every other item.

1	2	3	4	5	6
Almost Always	Very Frequently	Somewhat Frequently	Somewhat Infrequently	Very Infrequently	Almost Never

I could be experiencing some emotion and not be conscious of it until some time later.	1	2	3	4	5	6
I break or spill things because of carelessness, not paying attention, or thinking of something else.	1	2	3	4	5	6
I find it difficult to stay focused on what's happening in the present.	1	2	3	4	5	6
I tend to walk quickly to get where I'm going without paying attention to what I experience along the way.	1	2	3	4	5	6
I tend not to notice feelings of physical tension or discomfort until they really grab my attention.	1	2	3	4	5	6
I forget a person's name almost as soon as I've been told it for the first time.	1	2	3	4	5	6
It seems I am "running on automatic," without much awareness of what I'm doing.	1	2	3	4	5	6
I rush through activities without being really attentive to them.	1	2	3	4	5	6
I get so focused on the goal I want to achieve that I lose touch with what I'm doing right now to get there.	1	2	3	4	5	6
I do jobs or tasks automatically, without being aware of what I'm doing.	1	2	3	4	5	6
I find myself listening to someone with one ear, doing something else at the same time.	1	2	3	4	5	6

1	2	3	4	5	6
Almost Always	Very Frequently	Somewhat Frequently	Somewhat Infrequently	Very Infrequently	Almost Never

I drive places on 'automatic pilot' and then wonder why I went there.	1	2	3	4	5	6
I find myself preoccupied with the future or the past.	1	2	3	4	5	6
I find myself doing things without paying attention.	1	2	3	4	5	6
I snack without being aware that I'm eating.	1	2	3	4	5	6

Appendix E

Athlete Skill Transfer Ratings

To the right of each athlete's name, please indicate the response that *most closely* matches your assessment of the athlete's skill transfer — how well they perform in competition relative to their training performances.

1- Under-perform
2- Average performance
3- Over-perform

Swimmer Name	Skill Transfer Rating
Ex. Swimmer A	2 (Average)

Appendix F

Athlete Receptiveness Ratings

To the right of each athlete's name, please indicate the response that *most closely* matches your assessment of the athlete's receptiveness to coaching feedback. Designate a score of 1-4 using the scale below:

1-Very unreceptive
2-Unreceptive
3-Receptive
4-Very receptive

Swimmer Name	Receptiveness Rating
Ex. Swimmer A	2 (Unreceptive)

Appendix G

Additional Figures

Tests of Normality

Figure 4.14 – MAAS

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
MAAS Score	.119	28	.200*	.985	28	.950

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Figure 4.15 – Pressure

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Low Pressure	.099	22	.200*	.966	22	.611
Medium Pressure	.112	22	.200*	.969	22	.692
High Pressure	.125	22	.200*	.975	22	.823

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Figure 4.16 – MAAS x Pressure

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	MAAS	Statistic	df	Sig.	Statistic	df	Sig.
Low Pressure	Low	.163	8	.200*	.950	8	.712
	Med	.144	7	.200*	.959	7	.810
	High	.236	7	.200*	.876	7	.209
Medium Pressure	Low	.136	8	.200*	.983	8	.974
	Med	.234	7	.200*	.899	7	.325
	High	.175	7	.200*	.923	7	.495
High Pressure	Low	.168	8	.200*	.963	8	.842
	Med	.201	7	.200*	.909	7	.392
	High	.166	7	.200*	.950	7	.731

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Figure 4.17 – SCAT x Pressure

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	SCAT	Statistic	df	Sig.	Statistic	df	Sig.
Low Pressure	Low	.255	7	.187	.919	7	.464
	Medium	.245	11	.063	.868	11	.073
	High	.395	4	.	.736	4	.028
Medium Pressure	Low	.211	7	.200*	.912	7	.408
	Medium	.184	11	.200*	.959	11	.764
	High	.428	4	.	.674	4	.006
High Pressure	Low	.204	7	.200*	.891	7	.278
	Medium	.187	11	.200*	.950	11	.646
	High	.245	4	.	.927	4	.576

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Figure 4.18 – Gender x Pressure

Tests of Normality[a,d,e]

		Kolmogorov-Smirnov[b]			Shapiro-Wilk		
	Gender	Statistic	df	Sig.	Statistic	df	Sig.
Low Pressure	Female	.166	12	.200*	.932	12	.404
	Male	.128	10	.200*	.984	10	.983
Medium Pressure	Female	.162	12	.200*	.967	12	.883
	Male	.219	10	.191	.896	10	.200
High Pressure	Female	.154	12	.200*	.957	12	.743
	Male	.151	10	.200*	.927	10	.424

Figure 4.19.A – Coach Receptiveness 1 x Pressure

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Receptiveness 1	Statistic	df	Sig.	Statistic	df	Sig.
Low Pressure	Very Unreceptive	.330	4	.	.889	4	.380
	Unreceptive	.175	6	.200*	.977	6	.935
	Receptive	.222	8	.200*	.933	8	.545
	Very Receptive	.150	4	.	.995	4	.983
Medium Pressure	Very Unreceptive	.236	4	.	.906	4	.461
	Unreceptive	.301	6	.094	.865	6	.207
	Receptive	.228	8	.200*	.900	8	.286
	Very Receptive	.335	4	.	.828	4	.163
High Pressure	Very Unreceptive	.235	4	.	.942	4	.664
	Unreceptive	.238	6	.200*	.847	6	.150
	Receptive	.183	8	.200*	.897	8	.271
	Very Receptive	.358	4	.	.833	4	.175

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Figure 4.19.B – Coach Receptiveness 2 x Pressure

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Receptiveness 2	Statistic	df	Sig.	Statistic	df	Sig.
Low Pressure	Very Unreceptive	.260	2	.			
	Unreceptive	.168	5	.200*	.990	5	.981
	Receptive	.127	9	.200*	.972	9	.913
	Very Unreceptive	.170	6	.200*	.927	6	.559
Medium Pressure	Very Unreceptive	.260	2	.			
	Unreceptive	.197	5	.200*	.953	5	.758
	Receptive	.194	9	.200*	.961	9	.812
	Very Unreceptive	.198	6	.200*	.944	6	.691
High Pressure	Very Unreceptive	.260	2	.			
	Unreceptive	.230	5	.200*	.957	5	.786
	Receptive	.200	9	.200*	.917	9	.369
	Very Unreceptive	.239	6	.200*	.945	6	.696

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Figure 4.19.C – Coach Receptiveness 3 x Pressure

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Receptiveness 3	Statistic	df	Sig.	Statistic	df	Sig.
Low Pressure	Unreceptive	.151	6	.200*	.972	6	.907
	Receptive	.135	13	.200*	.973	13	.924
	Very Receptive	.224	3	.	.984	3	.761
Medium Pressure	Unreceptive	.227	6	.200*	.963	6	.841
	Receptive	.163	13	.200*	.951	13	.617
	Very Receptive	.339	3	.	.850	3	.242
High Pressure	Unreceptive	.198	6	.200*	.970	6	.895
	Receptive	.177	13	.200*	.921	13	.258
	Very Receptive	.370	3	.	.785	3	.080

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Figure 4.20.A – Coach 1 Skill Transfer x Pressure

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Skill Transfer 1	Statistic	df	Sig.	Statistic	df	Sig.
Low Pressure	Under-perform	.158	8	.200*	.926	8	.484
	Average Perform	.181	7	.200*	.885	7	.250
	Over-perform	.142	7	.200*	.963	7	.847
Medium Pressure	Under-perform	.227	8	.200*	.954	8	.747
	Average Perform	.162	7	.200*	.946	7	.689
	Over-perform	.183	7	.200*	.942	7	.659
High Pressure	Under-perform	.170	8	.200*	.920	8	.431
	Average Perform	.171	7	.200*	.968	7	.885
	Over-perform	.225	7	.200*	.881	7	.233

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Figure 4.20.B – Coach 2 Skill Transfer x Pressure

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Skill Transfer 2	Statistic	df	Sig.	Statistic	df	Sig.
Low Pressure	Under-perform	.266	5	.200*	.864	5	.244
	Average Perform	.115	13	.200*	.946	13	.539
	Over-perform	.188	4	.	.971	4	.846
Medium Pressure	Under-perform	.185	5	.200*	.971	5	.883
	Average Perform	.158	13	.200*	.961	13	.767
	Over-perform	.217	4	.	.918	4	.526
High Pressure	Under-perform	.213	5	.200*	.963	5	.830
	Average Perform	.146	13	.200*	.932	13	.364
	Over-perform	.276	4	.	.889	4	.379

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Figure 4.20.C – Coach 3 Skill Transfer x Pressure

Tests of Normality

	Skill Transfer 3	Kolmogorov-Smirnov[a] Statistic	df	Sig.	Shapiro-Wilk Statistic	df	Sig.
Low Pressure	Under-perform	.411	4	.	.713	4	.016
	Average Perform	.138	14	.200*	.962	14	.753
	Over-perform	.247	4	.	.956	4	.754
Medium Pressure	Under-perform	.151	4	.	.999	4	.997
	Average Perform	.161	14	.200*	.915	14	.187
	Over-perform	.285	4	.	.873	4	.308
High Pressure	Under-perform	.255	4	.	.852	4	.233
	Average Perform	.143	14	.200*	.946	14	.495
	Over-perform	.196	4	.	.973	4	.857

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Figure 4.21.A – MAAS X SCAT – Normality

Tests of Normality

	Kolmogorov-Smirnov[a] Statistic	df	Sig.	Shapiro-Wilk Statistic	df	Sig.
SCAT Score	.121	28	.200*	.971	28	.604
MAAS Score	.119	28	.200*	.985	28	.950

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Figure 4.21.B – MAAS x SCAT – Linearity

Correlations

		MAAS Score	SCAT Score
Pearson Correlation	MAAS Score	1.000	-.320
	SCAT Score	-.320	1.000
Sig. (1-tailed)	MAAS Score	.	.049
	SCAT Score	.049	.
N	MAAS Score	28	28
	SCAT Score	28	28

Figure 4.21.C – MAAS x SCAT – Homoscedasticity

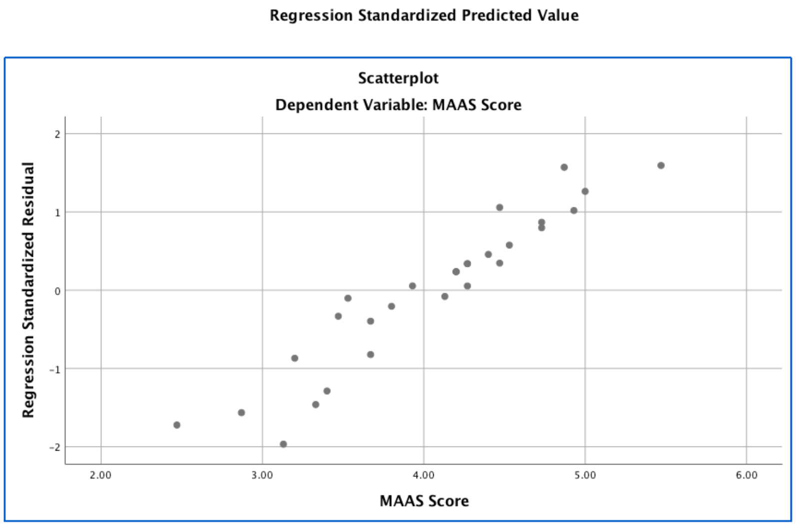


Figure 4.21.D – MAAS x SCAT – Normality of Residuals

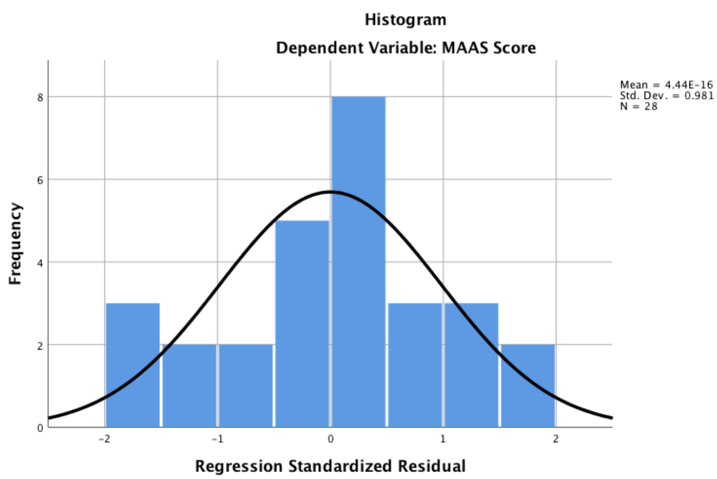


Figure 4.22 – Gender x SCAT & Gender x MAAS

Tests of Normality[a,d]

		Kolmogorov-Smirnov[b]			Shapiro-Wilk		
	Gender	Statistic	df	Sig.	Statistic	df	Sig.
MAAS Score	Female	.120	16	.200*	.958	16	.627
	Male	.183	12	.200*	.938	12	.471
SCAT Score	Female	.152	16	.200*	.923	16	.191
	Male	.150	12	.200*	.952	12	.668

Key Results

Figure 4.23

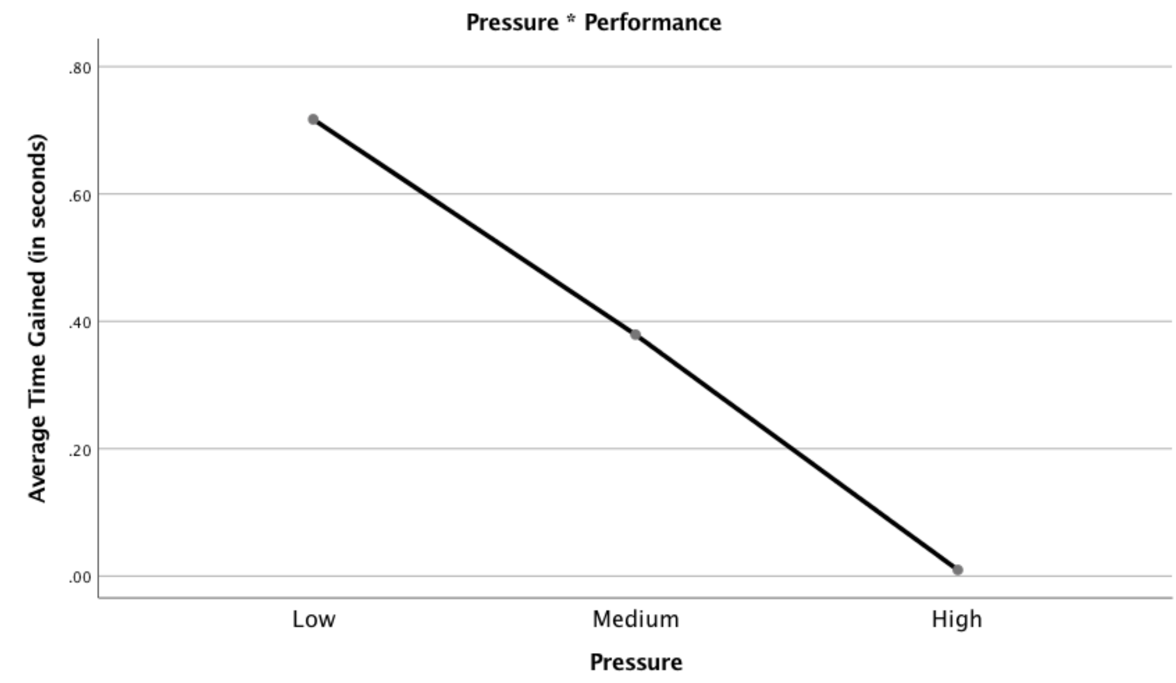


Figure 4.24

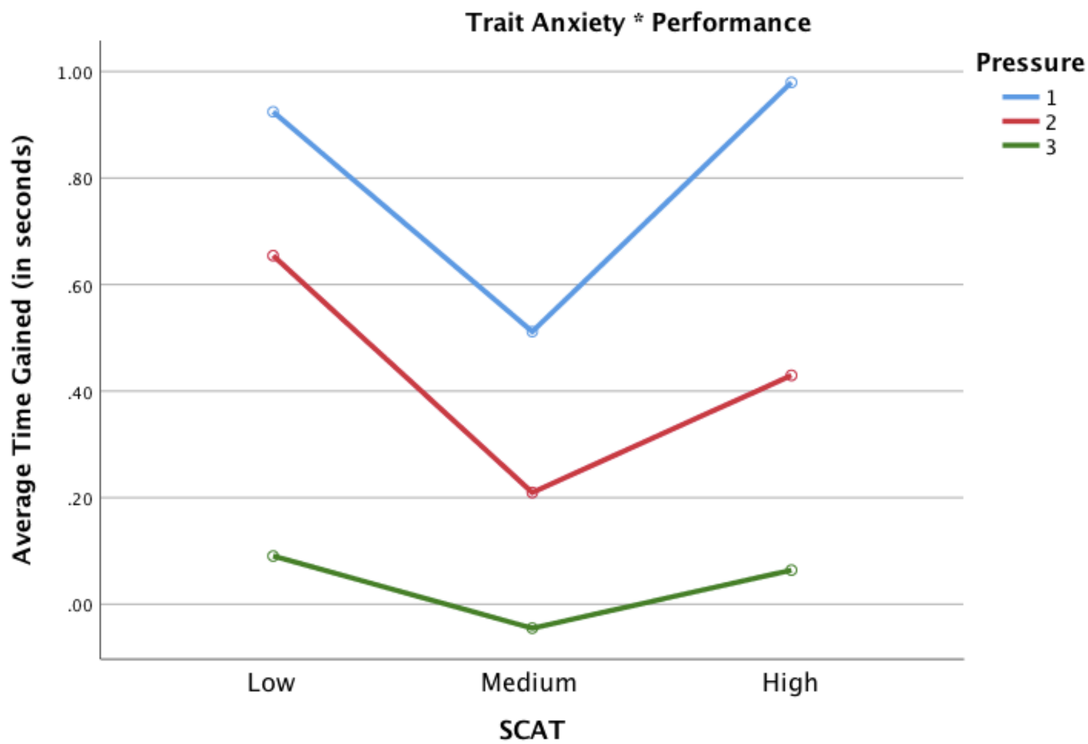

Trait Anxiety * Performance
Pressure
1
2
3
Average Time Gained (in seconds)
1.00
.80
.60
.40
.20
.00
Low
Medium
High
SCAT

Figure 4.25

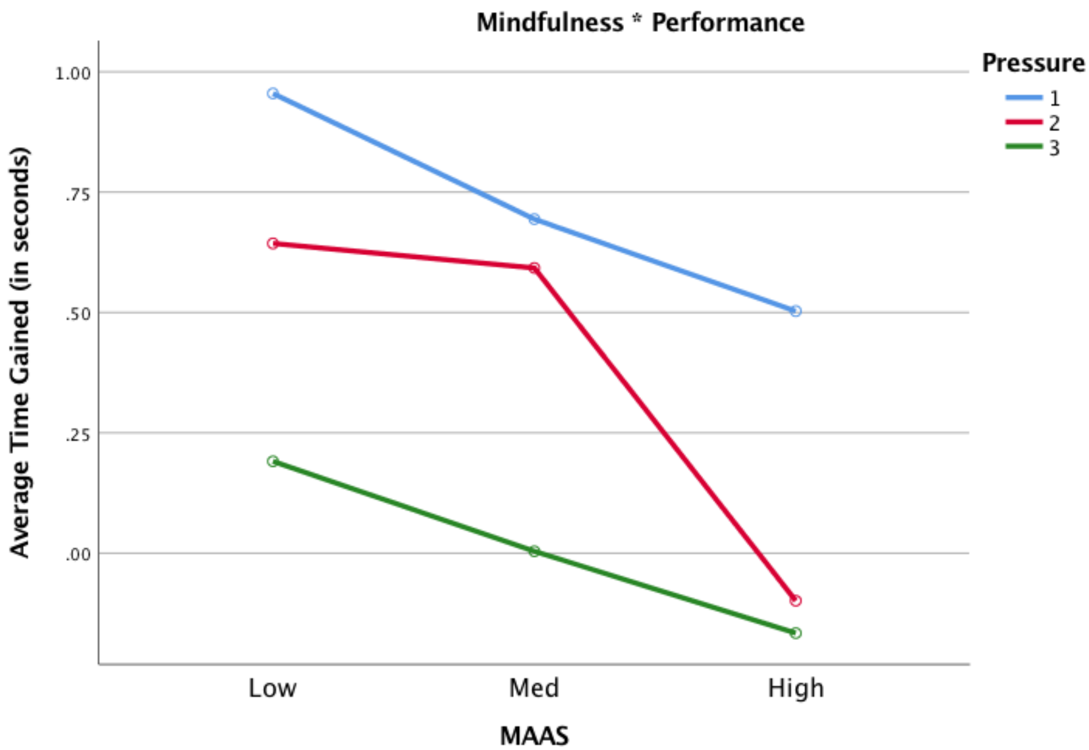

Mindfulness * Performance
Pressure
1
2
3
1.00
.75
.50
.25
.00
Average Time Gained (in seconds)
Low
Med
High
MAAS

Figure 4.26.A.

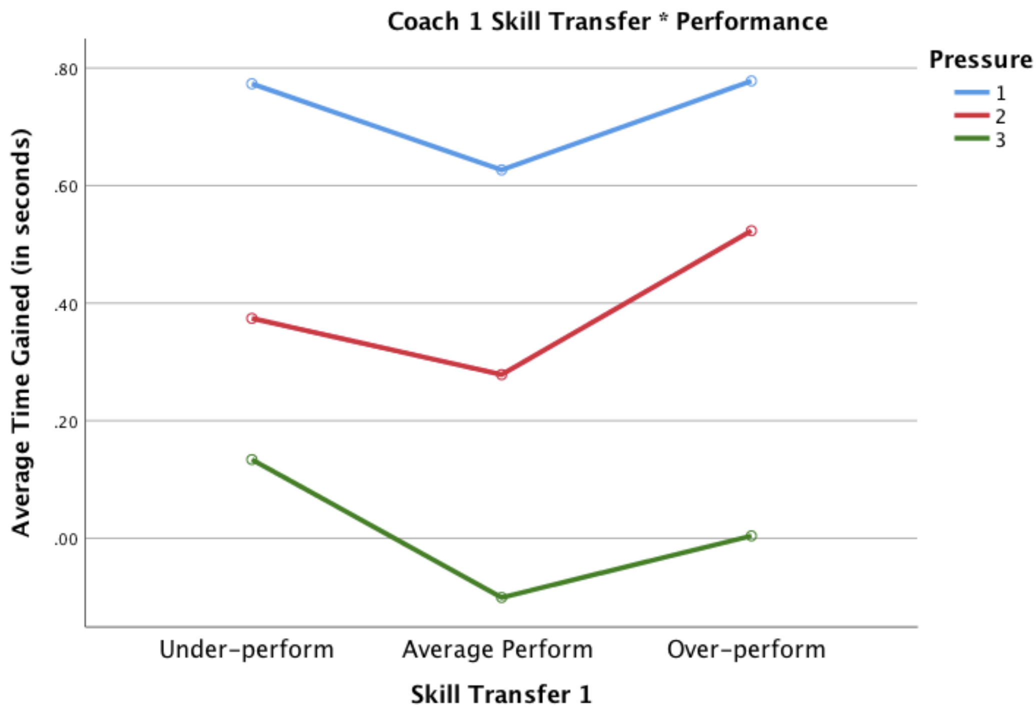


Figure 4.26.B

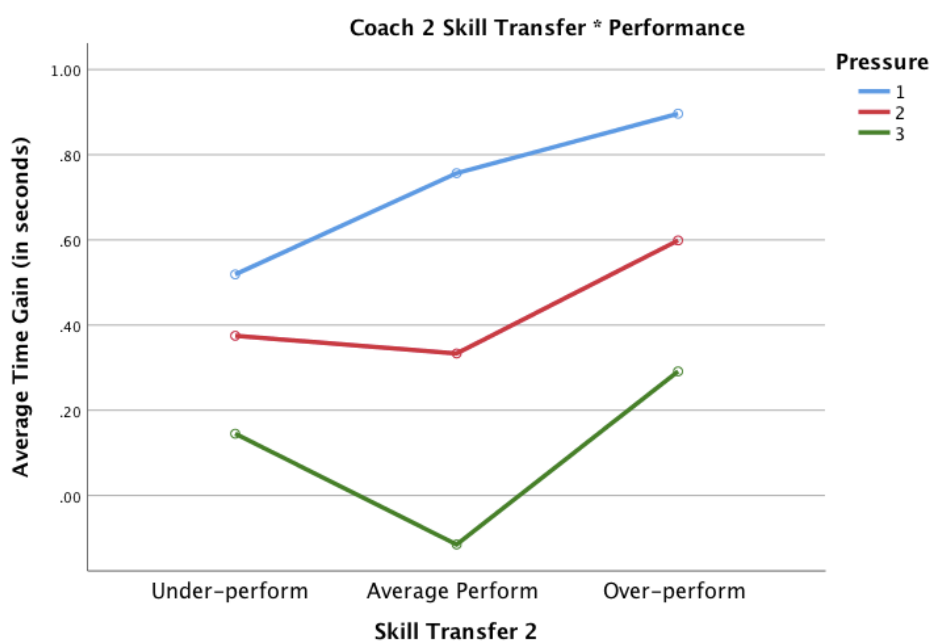


Figure 4.26.C.

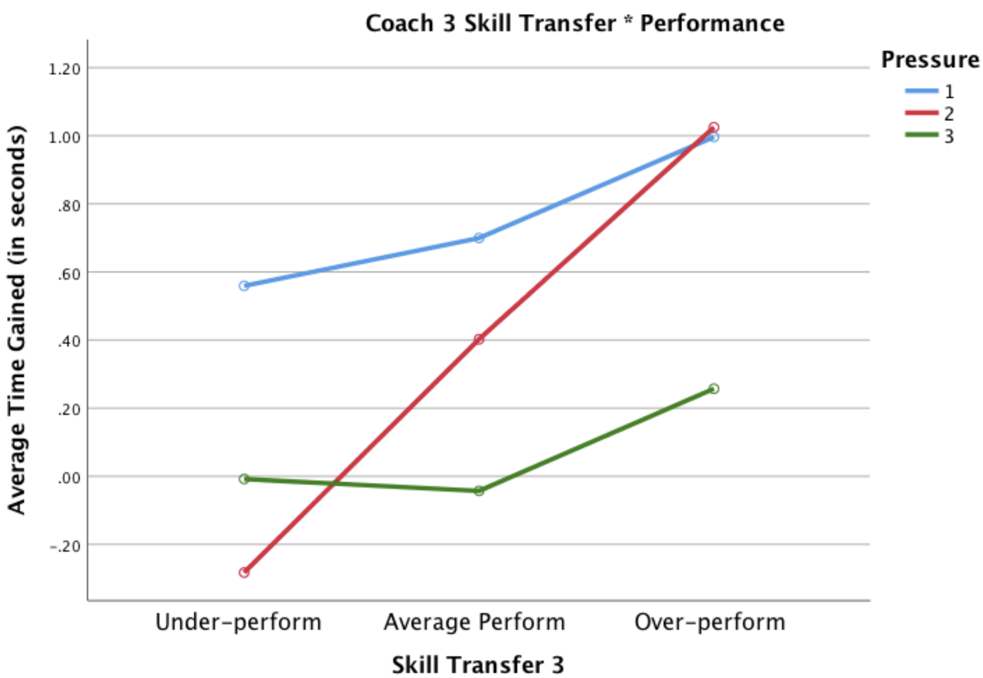
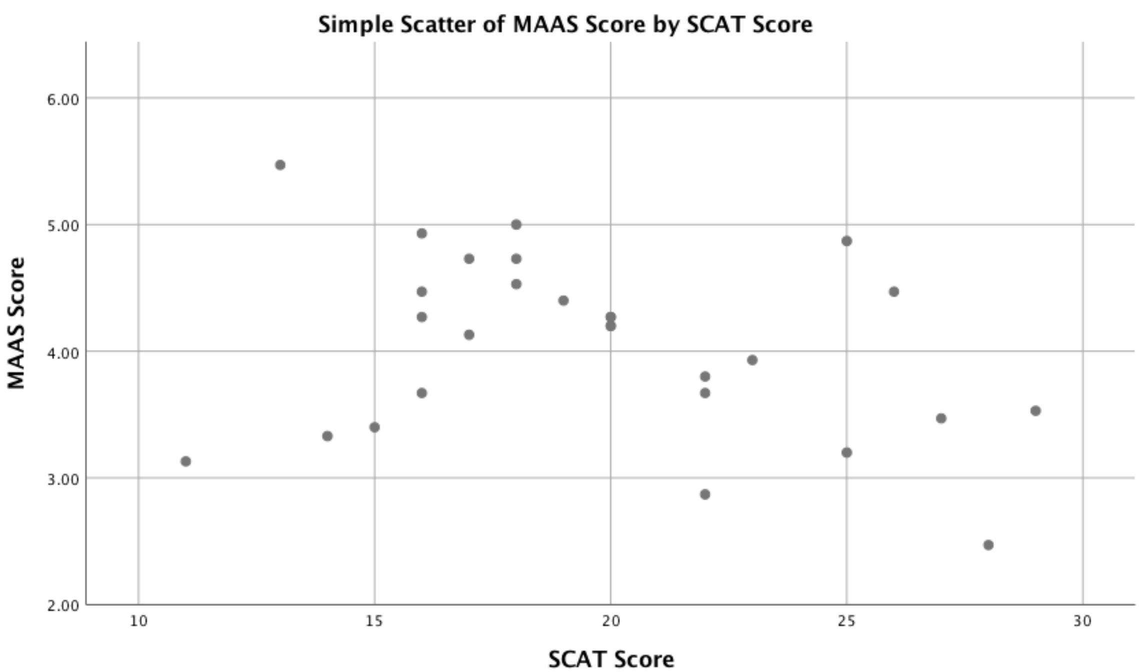


Figure 4.27



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