Abstract

A COMPARISON IN MOOD STATES OF DISTANCE AND SPRINT SWIMMERS

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The aim of the present study was to compare mood states in distance and sprint trained swimmers and observe how these moods relate to performance and change throughout the swim season. Participants from the ECU swim team completed the Profile of Mood States (POMS) and Athlete Engagement Questionnaire (AEQ) at baseline, mid-season, max training and taper portions of the competitive season. Meets that fell within two weeks of an administered questionnaire were used to calculate performance as a percentage of the swimmer's best in-season time. There were changes over time in the POMS total mood disturbance (TMD) scores and fatigue subscale, where team averages in TMD and fatigue peaked in mid-season and declined after the taper period to values much lower than observed at baseline. The only significant difference observed with a Time * Training Type Interaction was in feelings of fatigue. Sprint and mid-distance swimmers were more fatigued than distance swimmers at pre-season and max training. All groups had similar values at mid-season and taper. Significant changes in the dedication and enthusiasm components of Athlete Engagement (AE) were found over time. All groups experienced lower values of dedication at taper than reported at pre-season. Team averages in enthusiasm gradually decreased from baseline through max training and increased following the

taper to exceed the average found at baseline. A significant difference existed in dedication in a Time * Training Type Interaction. Mid-distance and distance groups had substantial decreases in feelings of dedication from baseline to mid-season and max training. Distance swimmers maintained low feelings of dedication at taper, while mid-distance swimmers resumed values near baseline. The sprint-trained swimmers experienced a gradual decrease in feelings of dedication from baseline to taper. These results suggest there are some differences in swimmer's mood states and feelings of engagement, but further research is needed. Overall it appears that sprint and mid-distance trained swimmers experience similar feelings in POMS subscales and distance swimmers reported the least disturbances in negative subscales. Sprint and distance groups were similar in reports of engagement and overall mid-distance swimmers were the least engaged group.

A Comparison in Mood States of Distance and Sprint Swimmers

A Thesis

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by

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CHAPTER 1: INTRODUCTION

Coaches spend months training their endurance athletes at high intensities in hopes of improving performance at the end of the season. Sports such as swimming have many phases of training throughout a season including: undertraining, overreaching, overtraining, and taper (Meeusen, Romain et al. 2006). Kreider et al. (1998) defines overreaching as the short-term effects of too much training compared to overtraining where long-term decreases in performance are noted. O'Connor described overtraining in 1997 as a systematic period of intensified, sport-specific training that is necessary to achieve the adaptations required for maximal performance (O'Connor 1997). Mackinnon (2000) described the symptoms of overtraining syndrome as being characterized by persistent fatigue, poor performance in sports, changes in mood states and neuroendocrine factors, and frequent illness. Swimmers typically train between 5,000- 14,000 yards a day in season. These intense and long practices are needed to excel in the sport and to increase performance, yet can have negative psychological impacts on the athlete such as short-term exhaustion and fatigue (Hooper, Mackinnon et al. 1998, Meeusen, Romain et al. 2006). Swimming is a sport where commitment and dedication play an incredibly important role. With a very high workload implemented there is very little time spent resting. Swimmers faces are spent mostly underwater staring at a black line while they swim back and forth. There is little socialization during practice, which can easily let the swimmer constantly think of the negative aspects of training.   Athletes who have greater mood state disturbances are less sucessful than their successful counterparts (Morgan, Brown et al. 1987). Therefore it is in the athlete and coaches best interest to increase positive moods as much as possible prior to competition.

Training for swimming is very event specific and swim teams are usually divided into practice groups based on events swum. Although training groups differ from college to college, most programs usually have two groups, a sprint group and a distance group. The distance swimmers practice longer and at a higher volume, but at a slower speed and the sprinters spend most days of training doing higher intensity swims but at a lower volume. Berger, Motl et al. (1999) support the idea that it is crucial for swimmers to train based on the idea of specificity, where training should be a reflection of the events swum. If distance swimmers practiced like their sprint teammates, they would not perform well at competition time and the same is true of sprinters practicing long races. Many times the distance swimmers show feelings of animosity towards the sprinters who have the ability to have shorter practices despite the higher intensity required. Arguments often arise on what practice group works harder. Do distance swimmers really perceive their practices as harder or do their practices create more negative psychological impact?   Do swimmers who report greater mood disturbances perform worse at in-season meets?

Swimmers look forward to the end of the season taper, when practice volume and/or intensity decreases. Performance gains found during a taper have been attributed to increases in muscular force and power and gains in neuromuscular adaptations as well as positive psychological components (Raglin, Koceja et al. 1996; Hooper, Mackinnon et al. 1998). Even after months or years of training and an appropriate taper, it is the psyche of the swimmer that is crucial to performance.

The purpose of this study was to determine whether distance swimmers have worse mood states and less feelings of engagement in their sport during the season than sprinters and how these moods change with taper and if they relate to performance. It was hypothesized that distance swimmers would report greater mood disturbances and less feelings of athletic engagement during the overtraining period of the season than the sprinters and those athletes who report more disturbances perform worse at dual meets. The Profile of Mood States (POMS) and the Athlete Engagement Questionnaire (AEQ) were used to determine mood disturbances in the swimmers.

Delimitations

1) East Carolina University swim team members were used in this study.
2) The subjects of this study were between the ages of 18-25 years.
3) The Profile of Mood States was used to examine the mood states of subjects.
4) The Athlete Engagement Questionnaire was used to examine how much the athletes are engaged in their sport.

Limitations

1) Participants were members of the East Carolina University Swim Team.
2) Conclusions were limited to the age group and level of training studied.
3) The POMS brief questionnaire was used to evaluate the mood profiles of the swimmers.
4) The POMS brief questionnaire can be affected by anxiety and must be answered honestly.
5) Questionnaires administered in-season was compared to a baseline questionnaire prior to the overtraining period.
6) The AEQ was used to examine athletic engagement.

Definitions

Overreaching- Negative short-term effects of too much training

Overtraining- Systematic period of intensified, sport-specific training necessary to achieve the adaptations required for maximal performance

Overtraining Syndrome- Syndrome characterized by persistent fatigue, poor performance in sports, changes in mood states and neruoendocrine factors, and frequent illness

Sprint Swimmers- Athletes who swim 100 yards or less per event

Mid-Distance Swimmers- Athletes who swim 200-400 yards per event

Distance Swimmers- Athletes who swim 500 yards or greater per event

Profile of Mood States (POMS)- self-report questionnaire comprised of six mood subscales including anger, confusion, depression, fatigue, tension and vigor

Iceberg Profile- Image graphically created when five negative mood subscales are lower than the average population and positive moods of vigor are higher than the average population

Burnout Syndrome- Psychological syndrome that often includes significant negative symptoms including illness, poor performance, and a discontinuation of the sport

Athletic Engagement- Conceptual opposite of burnout with a group of positive attributes including persistent, pervasive, positive, fulfilling and work-related feelings

Athlete Engagement Questionnaire (AEQ)- A self-report questionnaire aimed to assess feelings of engagement to one's sport

Effect Size (Cohen's *d*)- difference in means divided by average standard deviation where $|0.3|$ small effect, $|0.5|$ is moderate effect and $|0.8|$ is a large effect

Moderate Correlations- values between $|0.4 – 0.7|$

CHAPTER 2: REVIEW OF LITERATURE

The Hardships of Swimming

Throughout the sport of swimming it is widely accepted that success heavily relies on increases in the amount of training. This overload in training often manifests into staleness, which is the product of intense training that causes the athlete to experience decreases in performance and a lack in enthusiasm and motivation (Morgan, Costill et al. 1988), (Morgan, Brown et al. 1987). Morgan and colleagues previously found (1987) that staleness was reported in roughly 10% of collegiate swimmers who trained up to 14,000 meters per day.

Profile of Mood States- The Iceberg Profile

Emotions play a major role in sport performance. Mood states affect athletes' behavior and motivation during practice and competition (Arruza, Telletxea et al. 2009). The Profile of Mood States (POMS) is the most common way of determining mood states in athletes. The POMS is a self-report questionnaire comprised of six mood subscales including anger, confusion, depression, fatigue, tension, and vigor (https://ecom.mhs.com/TechBrochures/POMSTechBrochure). Of the six factors measured by the POMS, the vigor and fatigue scores show the greatest changes in responses to overtraining (O'Connor, Morgan et al. 1991). The POMS can be used in sports as a method to identify the negative aspects of overtraining during the early stages (Morgan, Brown et al. 1987).

Optimal mood states measured in athletes using the POMS should reflect an “Iceberg Profile” where five components of a poor attitude are lower than average and positive moods of vigor are higher when compared to the average population (Morgan, Brow, Raglin, O’Connor Ellickson 1987). During overtraining, athletes show negative changes in Total Mood Disturbance (TMD) and have a flattened or inverted “Iceberg Profile” on the POMS. Athletes experiencing an overload in training can see increased scores in anger and depression subscales (Morgan, Brown et al. 1987). This depression can be associated with a lack of energy, restlessness, physical complaints, mild sleep problems and irritability, all of which can affect an athlete’s performance (Arruza, Telletxea et al. 2009).

Athlete Engagement

The athletic community has discussed at length the negative attributes of burnout that elite endurance athletes often report. Maslach and Jackson (1984) defined burnout syndrome as a psychological syndrome that often includes significant negative symptoms including illness, poor performance, and a discontinuation of the sport. The concept of athletic engagement (AE) is the opposite of burnout. Engagement is a group of positive attributes that a person reports including persistent, pervasive, positive, fulfilling, and work-related feelings (Schaufeli et al. 2002). The core components of AE include confidence, dedication, and vigor (Lonsdale et al. 2007). In the Lonsdale et al. (2007) study of fifteen elite athletes from New Zealand, feelings of AE were obtained by open-ended and non-misleading questions. Ninety-three percent of the participants reported feelings of confidence in their ability to perform at high levels in their sport and to obtain their goals. One athlete described his confidence as "actually knowing that I could do it as opposed to just dreaming it and wondering… you just know that you are going to perform. I wouldn't say I was invincible, [but I was] quite hard to beat". A key component to obtaining high aspirations in a sport comes from believing in oneself. Dedication was another common theme in athletes when they felt engaged in their sport. Athletes described these feelings of dedication "all the sacrifices seemed worth it". Another athlete said, "I'd rather fail trying, than fail by not doing anything at all. I had set all these goals and even if I didn't quite achieve them, at least I had given 100% as opposed to copping out on myself". Vigor is the other core dimension of engagement. Feelings of vigor were often described as physical, mental and emotional energy that was related to the physical energy experienced by the athlete.

The Change Through a Swim Season

Swimmers maintain high workloads for many months in-season in hopes that their hard work pays off at taper time. Throughout the overtraining stage collegiate swimmers still must perform well at in-season dual meets in order to keep their spot on the traveling team and to qualify for the major competitions at the end of the season. In a series of investigations, Morgan et al. (1987) studied the mood states of approximately 200 men and 200 women who were members of the University of Wisconsin-Madison swim team between the years of 1975 to 1986. Morgan and colleagues (1987) administered the POMS at the beginning, middle, and end of their swim season and found that the highest mood disturbances were found to be mid-season when training was hardest and where most of the physiological gains would be obtained.

Morgan and associates (1987) found that 16 male swimmers reported that their significant ($P < 0.01$) mood disturbances were due to a significant increase in fatigue ($P < 0.01$) and a significant decrease in vigor ($P < 0.01$). In an additional study performed by Morgan et al. (1987), 22 male and 18 female swimmers were administered a monthly POMS throughout a swim season. A stepwise increase in total mood disturbances was noted as there were progressive increases in the training load. Mood disturbances for these 22 males and 18 females returned to baseline values during taper (Morgan, Brown et al. 1987).

In the second series of study, 15 female swimmers were tested in September and again in January and there was a significant increase in depression ($P < 0.01$) and anger ($P < 0.01$). These female swimmers in Study 2 experienced a decrease in vigor, which did not reach a significant value like their male teammates. Morgan et al. (1987) concluded that these differences in the observed changes in female reports of depression and anger may be due to gender, but that is unlikely since there have never been any observed differences in the sexes. In another investigation, the POMS in 14 female swimmers and 27 male swimmers were examined. A significant ($P < 0.01$) mood disturbance occurred during the overload portion of the swim season, but the disturbance values returned to baseline following the taper. There was no effect of gender, indicating that overtraining and tapering had the same effects on the moods of males and females. The fifth study performed by Morgan et al. used the same procedures and analyses as the previous study and found the same overall findings as Study 4 (Morgan, Brown et al. 1987).

Morgan et al. (1987) hypothesized that observed mood disturbances are dependent on training effects and are not the observed psychological stresses of general college students. A study of 44 swimmers and 86 controls were used to investigate this hypothesis during a 13-week school semester. There was an observed mood disturbance in swimmers from the fifth to the eleventh week of the semester and the controls experienced no significant changes. The swimmers scored significantly lower ($P < 0.05$) than the controls on the POMS at the beginning of the semester. The difference was eliminated during weeks five through seven. Weeks nine through thirteen swimmers scored significantly higher than the controls. These results support the hypothesis that greater mood disturbances with overtraining are associated with training effects rather than general academic, economic and social college stressors (Morgan, Brown et al. 1987).

Morgan, Costill et al. (1988) further studied mood disturbances in 12 male college swimmers across 12 consecutive days. On days 1 and 12 psychological questionnaires and psychological tests were completed. On days 2-11 the participants swam an average of 9,000 meters per day at about 94% of $VO2_{max.}$ The POMS was completed daily. The swimmers also completed a 7-point psychophysical scale to determine muscle soreness following a day of training.

Muscle soreness was computed for over-all feeling as well as for the calf, thigh, forearm, upper arm and shoulder muscles. These muscle soreness scales were completed with instructions to report on how the subjects muscles felt when they woke up after a nights rest prior to training that day (Morgan, Costill et al. 1988). Each swimmer completed a 24-hour history questionnaire daily. These questions included a section on general well being, exercise intensity of the previous days workout sleep pattern and health status (Morgan, Costill et al. 1988). Morgan and associates (1988) found that exercise intensity increased significantly ($P < 0.001$) and the general sense of well being decreased significantly ($P < 0.05$) throughout the 12 days. The POMS revealed significant increases ($P < 0.05$) in depression, anger and fatigue. An ANOVA test revealed that there was a significant increase ($P < 0.001$) in muscle soreness in each individual muscle group and for overall muscle soreness. No significant changes in sleep patterns were found. Morgan, Costill et al. (1988) noted that this finding did not agree with the common finding that overtraining leads to sleep disturbances including his previous study with Brown and associates in 1987. The authors proposed that this might be due to the brief training period studied (Morgan, Costill et al. 1988).

J.S. Raglin et al. (1991) examined the changes in mood states during training in female and male college swimmers. The POMS questionnaire was given to members of the swim team at the University of Madison-Wisconsin between 1982-1986. These swimmers completed these questionnaires at three to four week intervals during each training season. Males and females had similar training programs and began the season in August at 3,000 meters a day and progressed to 13,000 meters per day in late December and early January. Raglin and associates concluded that female and male collegiate swimmers show similar changes in mood during physical training. These disturbances and improvements throughout a season directly relate to training volume. Tension was found to be higher in female swimmers compared to their male teammates; however, this difference existed before increases in training. Tension does not decrease in response to reduced training in male or female swimmers like other measures of mood states (Raglin, Morgan et al. 1991). These conclusions formed by Raglin et al. lead us to believe that our male and female subjects will react similarly to training changes and values of tension may be higher in our female subjects than our male participants.

Hooper et al. (1997) stated that POMS scores are more closely related to training intensity verses volume. This would suggest that sprint swimmers would report greater mood disturbances since they are practicing at a faster paces and higher intensities. After months of heavy training swimmers and other endurance athletes will often reduce the workload of training prior to a major competition. This decrease in workload is often done by reducing the volume of training, but still maintaining high levels of intensity.

Berger et al. (1997) studied the relationship between distance swum and acute changes in moods in 48 Australian age-group swimmers who were between the ages of 12 and 20 years. Berger and associates hypothesized that acute changes in mood during the week of taper would be related to the performance in a competitive race. An additional hypothesis was made that performance during competition would be related to acute changes during the regular season.

Berger et al. examined the mood disturbances before and after a normal and taper practice. The analysis showed a significant interaction ($p< 0.001$). There appeared to be no significant mood disturbances ($p< 0.09$) from assessments done pre and post-practice during the taper period. Significant increases in TMD scores from pre to post-practice were observed during the normal duration practice ($p < 0.02$) (Berger, Grove et al. 1997). After the taper was completed prior to competition there was an acute decrease in Total Mood Disturbances (TMD) (Berger, Grove et al. 1997).

Practices that were shorter in duration were associated with short-term changes in relation to pre and post-practice scores with a decrease in depression ($p < 0.0007$), confusion ($p < 0.0007$), and tension ($p < 0.05$). Normal duration practices showed decreases in scores in vigor ($p < 0.003$) and increase in fatigue ($p < 0.0001$) (Berger, Grove et al. 1997). These data support the physiological and psychological need for a taper prior to competition to obtain peak performance at competition.

Berger et al. assessed performance by swimming times. “Successful” athletes were those swimmers who equaled or improved personal bests in their best event. Those swimmers who did not reach or surpass their previous best time were called “unsuccessful”. Based on these terms, 24 athletes were considered successful, 21 were not successful and 3 participants had missing data and were excluded (Berger, Grove et al. 1997).

Berger et al. also defined “success” by participant’s subjective rating of personal satisfaction. Thirty swimmers reported feelings of satisfaction with their performance, 17 were not satisfied, and 1 swimmers data was missing. The researchers concluded that the shortened POMS appeared to be valid and efficient method for monitoring moods in young athletes. In general the swimmers reported an acute decrease in TMD after the taper a week prior to competition. They reported short-term benefits including a decrease in scores in depression, confusion, and tension. The measured acute mood benefits during taper prior to the meet did not appear to be related to the athlete’s swimming performance (Berger, Grove et al. 1997). Based on these results, we expect that differences in moods between the sprint and distance groups will not play a role in performance of dual meets.

A significant relationship was found between the distances swum and the acute changes in moods of swimmers. Berger and associates (1997) believe that beyond a certain distance, which is dependent on fitness level, an increased duration of practice is associated with chronic decrements in mood scores.

Exercise has long been associated with positive mood changes; however a negative relationship has been established between swimming lasting longer than 30 minutes and chronic mood states (Morgan, Brown et al. 1987; Morgan, Costill et al. 1988). Morgan et al. (1988) found that collegiate swimmers who abruptly increased training from 4,000 to 9,000 meters a day at an intensity of approximately 94% of VO2max for 10 days reported significant increases in depression, anger, fatigue, and TMD scores. Although Morgan, Brown et al. 1987 and Morgan, Costill et al. 1988 saw these decrements in mood, coaches and swimmers must remember O'Connor's description and necessity of the overtraining stage in order to see improvements at the end of a swim season.

POMS Validation in Other Athletes

Information obtained from other studies using the POMS in different types of athletes were researched to see if there may be conclusions that can be applied to the sport of swimming. Seven male professional basketball players from the Israel Basketball league were studied to see if a relationship existed between the Profile of Mood States (POMS) and performance. Hoffman and associates (1999) found that throughout a basketball season when the team was performing poorly and winning fewer games, scores in vigor were decreased. As the team's winning percentage increased, the vigor subscale returned to normal values, which was about one standard deviation above the average population (Hoffman, Bar-Eli et al. 1999). This suggests that perhaps the swimmers who perform poorly at dual meets throughout the season will report lower scores of vigor during weekly POMS tests.

Arruza et al. (2009) studied mood states of 11 elite athletes who competed at the national or international levels in cycling, judo, surfing, mountain climbing, golf, snowboarding, and kayaking over a total of 104 competitions. Arruza and colleagues (2009) found that there was a strong relationship between the expected outcomes and the resultant performance. Therefore those who believed in their training program and who had better mood states performed better at competition. This suggests that swimmers who report significant mood disturbances prior to a meet are already at a disadvantage to their competitors before they ever walk onto the pool deck.

Berger, Motl et al. (1999) studied the effects of overtraining, mood and performance during a high-intensity, short-duration overtraining period in cycling performance. Berger and associates hypothesized that the 10 highly skilled pursuit cyclists would report a positive mood score prior to the overtraining since athletes usually have higher levels of mental health. The study also expected that the cyclists would not report major mood disturbances throughout the overtraining implemented during this study. It was also hypothesized that there would be gains in performance brought about by the taper that followed the intense training regimen (Berger, Motl et al. 1999).

The cyclists in this study were tested at the United States Olympic Training Center. The two highest rankings of amateur cyclists in road and track racing, Category I (N=3) and Category II racers (N=5), were used. The participants averaged between 3 and 7 years of competitive cycling experience (M = 4.5; SD =1.4). This study was not performed in the cyclists in-season, however the athletes were in shape, as determined by a mean VO_2max of 63.0 $ml \bullet kg^{-1} \bullet min^{-1}$ (SD = 5.7) and the average percent body fat was 7.6% (SD = 2.3) (Berger, Motl et al. 1999).

The subjects completed the POMS in the morning prior to training for 13 days throughout the study. Berger et al. (1999) reported that moods seemed to be responsive to the different training modalities. The average TMD scores for the three baseline questionnaires totaled 159.52 (SD = 34.27). On high-intensity days the average score was 172.83 (SD = 49.63) and on days of recovery following days of overtraining the cyclists reported an average of 158.77 (SD = 31.82). TMD scores declined to an average of 136.76 (SD = 17.11) during taper time. The high-intensity and short-duration overtraining implemented was not associated with chronic mood disturbances while it did promote gains in cycling performance (Berger, Motl et al. 1999).

POMS Validity

Although the Profile of Mood States has been a major instrument to assess moods within sports and exercise, there has been some doubt about its validity (Leunes and Burger, 1998). Meussen and associates described several potential problems with mood-state questionnaires. These potential sources of error included that other mood states including attention focusing and anxiety might influence the questionnaire, measures must be compared to an accurate baseline of the athlete, differences between self assessment and questionnaires may be evident, the timing of the questionnaire should be used under standardized conditions (same time and day) to prevent bias to pre and post exercise, morning and night variances and the honesty of answers is questionable.

A shortened version of the POMS questionnaire was created and now has 30 questions instead of 65. The Reliability program from the Statistical Package for Social Science (SPSS) assessed the contribution of items of the internal consistency of the scale. Items off the 65-question version were eliminated if they met two criterions: the contribution to internal consistency (coefficient alpha) of the scale, and the face validity of the items in relation to the scales. For each of the six subscales two to seven items could reduce the POMS measures without losing the internal consistency. Shacham found that internal consistency coefficients for Confusion and Tension scales improved. Therefore the shortened version of the POMS remains reliable and the time to administer the questionnaires was reduced to nearly half (Shacham, 1983).

Summary

Thus far no previous studies have examined the changes in mood states as they relate to the type of training volume performed. If significant mood disturbances occur in swimmers who train and compete in certain events, coaches and athletes can work together to promote positive moods to help the mental state of the swimmers and to improve athletic performance. It was hypothesized that swimmers who train and compete in distance events, any distance over 500 yards, will have greater mood disturbances and thus improve less during the dual-meet season compared to their sprint teammates.

CHAPTER 3: METHODS

Subject Recruitment

To examine the effects of training volume on mood states in endurance athletes, the East Carolina University Varsity Swim Team was sampled. All swimmers were explained the goals of the study. If swimmers wished to participate they completed informed consent. Initially 52 swimmers were recruited for this study. The swimmers were placed into groups depending on the types of training they practiced; sprint, mid-distance, or distance based.

Subjects were excluded if they sustained an injury prior or during the swim season that resulted in absence of practice and or meets. Participants were excluded from body composition assessment if they were uncomfortable having the assessment performed, or were unavailable at baseline or taper. Subjects were excluded from the analysis of the POMS and AEQ if they did not complete questionnaires at all four time-points. Swimmers were excluded from performance results if they did not attend the Conference Championship meet or they did not attend a meet that fell within two weeks of a completed questionnaire.

Training Volume

The coaching staff determined training intensity and volume. The total number of yards swam per week were obtained at the end of the season for each group. Monthly averages were then computed from these weekly values.

Performance

Performance was calculated for the 27 swimmers who competed in the Conference Championship meet and any meets that fell within two weeks after an administered questionnaire. If swimmers competed in two meets within two weeks following a questionnaire, an average percentage of performance was used. The swimmers best time during this season was calculated as 100% and less than best times were calculated as a percentage of their best time.

Questionnaires

The POMS brief and AEQ questionnaires were given to all swimmers interested in participation prior to practice. Similar to Morgan's 1987 study of overtraining and staleness, swimmers were asked to respond to the POMS in terms of "how you have been feeling during the past week including today", rather than the other possible response cues of the POMS, "generally", "today", or "right now" (McNair et al, 1971). The POMS included 30 items that assessed anger, confusion, depression, fatigue, tension and vigor subscales and were answered on a Likert scale.

To evaluate whether sprint, mid-distance, and distance swimmers' mood states changed across the season, a series of 3 (group) X four (time) repeated measures ANOVA's were conducted with POMS subscales serving as the dependent measure. Since sample sizes for each group were small (n= distance 4, mid-distance 23, sprint 11), resulting in low power, effect sizes (Cohen d) were determined to evaluate the magnitude of change in POMS subscale scores. Effect size was calculated by taking the difference in means and dividing it by the averaged standard deviation. An effect size of 0.2 was considered to be a small effect, 0.5 was considered a medium effect, and large effect was above 0.8. Since our primary focus was on differences between sprint and distance trained swimmers effect size was calculated between the two groups for all time points on POMS subscales.

The AEQ was comprised of 16 questions that addressed the three core components of AE: confidence, dedication and vigor and were answered from almost never to almost always. Swimmers were asked to answer the AEQ in terms of “How often have you felt this way in the past two months”. The questionnaire administered in September during the preseason period, was used to obtain baseline values for each swimmer. The swimmers were given the second questionnaire in October at mid-season, when practices became more intense and the dual meet season started. The third questionnaire was given at the beginning of January, following an intense training trip when training volumes were at the peak. Final questionnaires were given in the middle of January or in February. These dates were chosen to follow similarly along with the two to four week administrations of POMS by Morgan et al. (1987). Because there were no meets from the middle of November to the middle of January and performance could not be calculated, questionnaires were not administered in November and December. Dates for taper questionnaires were determined by the swimmers taper schedule since not all athletes were able to attend the Conference Championship meet. If swimmers missed an occasional question in a questionnaire, the average was computed for that subscale and the mean was used for that voided question. After all POMS questionnaires were scored, and averages for each group were calculated, POMS brief profiles were graphed.

Body Composition

Body composition was determined via 7-site skinfold assessment in September to obtain baseline data and again during the taper period in February. Changes in body composition throughout the swim season were assessed as they may alter swimmer's moods and affected performance.

Statistical Analysis

Each swimmer's POMS, AEQ and performance were measured across the four time points across the season. A 3 (training type) X 4 (time) factorial analysis of variance (ANOVA) was used with reported feelings being a repeated measure for the POMS and AEQ. To evaluate changes in performance a 3 (training type) X 4 (time) factorial analysis of variance (ANOVA) was used with performance being a repeated measure. Effect sizes (Cohen's *d*) for the POMS were calculated by taking the difference in means and dividing by the averaged standard deviation. Correlations were calculated to assessed if moods and feelings of engagement could predict performance.

CHAPTER 4: RESULTS

Subject Recruitment

Of the initial 52 possible participants, 9 were excluded from all analyses due to injury and being unable to swim (n= 4), quitting the team (n = 3), not completing the follow up questionnaire (n= 1), and discontinuing study participation (n=1). The final sample size of subjects who completed the questionnaires at all four assessments throughout the season was 38, which was comprised of 11 sprinters, 23 mid-distance swimmers, and 4 distance swimmers. Of the 38 swimmers who completed the season, performance scores were calculated for the 27 participants who swam their primary event at meets within two weeks of an administered questionnaire and at the Conference Championship meet. Performance was assessed in 9 sprinters, 14 mid-distance swimmers, and 4 distance swimmers. Preliminary analyses also revealed that the POMS and AEQ subscales were internally consistent.

Reliability of POMS Questionnaire

As reported in Table 1, reliability (i.e. internal consistency) of the POMS questionnaires at each of the four time points was determined by Cronbach's alpha (**α**). Cronbach's alpha was determined for the 6 POMS subscales at each time point. The fatigue subscale had the highest reliability across all measures with values between 0.852 and 0.873. Confusion had the lowest reliability. Based on Cronbach's alpha, it appeared that swimmers might have been confused by the meaning the word "efficient", as the alpha coefficient was lower with the inclusion of this item and based on comments made by swimmers when completing the questionnaire. After removing the swimmer's answers for the term "efficient", reliability values were increased to 0.631 (from 0.495) at time 1, 0.529 (from 0.445) at time 2, 0.694 (from 0.629) at time 3, and 0.721 (from 0.536) at time 4.

Reliability of AEQ Questionnaire

The Athletic Engagement Questionnaire has four subscales including confidence, dedication, vigor, and enthusiasm. Reliability, as shown in Table 2, was also calculated for the AEQ questionnaire using Cronbach's alpha. Cronbach's alpha showed the questionnaire was highly reliable across all subscales of the AEQ, with the enthusiasm subscale having the highest values across all time points.

Training Volumes

Coaches provided the amount of yards swam and the number of practices that swimmers had each week. Weekly yardage averages were conducted for each training group by month (Table 3). A significant difference between groups was found (p =0.0096) but was not found by the month of training (p = 0.5517) (Table 4). Figure 1 shows that sprint and mid-distance groups had peak volume training loads in December that were similar to the yards swum by the distance group. Sprint and distance trained swimmers experienced more fluctuations in training volumes than the mid-distance trained group. Mid-distance and distance groups increased training volumes prior to taper, while the sprint group decreased training volume.

As seen by Table 3, sprint swimmers swam less average yards per week than the mid-distance trained group, with December being the exception. In December, sprint swimmers swam an average of 300 yards more a week than the mid-distance group. The sprint-trained swimmers swam less than the distance group every month, with December having the least difference of 79 yards per week and the greatest difference in February with 3,390 yards. Testing was performed at the times designated with arrows in Figure 1.

POMS

Initially, the POMS subscales scores were averaged for each group (Table 5) and standardized to population norms to evaluate whether swimmers reported feelings similar to the average population, which is indicated by a T-score of 50. POMS brief profiles were graphed for team averages at baseline, mid-season, post max training and taper (Appendix E, Appendix F). At baseline, mid-season, and post max training the team experienced averages higher than population norms in vigor and fatigue, and lower than population norms in the remaining negative subscales (Figure 2). At taper, team averages were higher than population averages for vigor and lower than the population average for all negative subscales (Figure 3).

A true “Iceberg Profile” as described by Morgan et al. (1987), is where all negative traits are below a T-score of 50, and the positive subscale (vigor) is above 50. The T-score of 50 represents the average population, thus an “Iceberg Profile” would show greater mental health and an inverted profile would show negative mental health. A true Iceberg Profile was observed for the team at taper, and the profiles never inverted suggesting there was not a substantial amount of negative mental health associated with training.

Changes in total mood disturbances were not significantly different between groups based on a non-significant Time * Training Type, $F(6,66) = 1.266$, $p = 0.29$. However, there was a significant time effect $F(3,33) = 8.5$, $p < 0.0001$ (Table 5). As shown in Figure 2 A, across groups, swimmers all experienced an increase in TMD from baseline to mid-season. Sprint and mid-distance groups continued to feel greater disturbances after max training. All groups reported TMD at taper that were lower than baseline values.

Based on inspection of mean scores, sprint swimmers average baseline TMD was 16.25, and increased to 19.16 and 18.30 at mid-season and post max training, respectively. As with all groups, sprint swimmers reported the least mood disturbance at taper with an average of 10.27. Mid-distance trained swimmers reported the highest feelings of mood disturbances amongst the groups and team average at baseline (16.54) mid-season (22.88) and post max training (24.37). Distance swimmers consistently reported the lowest amount of disturbance across all time points. The distance group reported a mood disturbance of 9.44 at baseline, and showed a substantial increased at mid-season to 18.56. Distance swimmers then decreased TMD at post max training to 5.06, and further decreased to 4.25 at taper. At post max training, mid-distance swimmers reported almost 5 times greater mood disturbances than distance-trained swimmers. Team averages for TMD started at 15.71 and increased to 21.35, then decreased after max training to 20.58 and lastly reported averages at 9.02 at taper (Table 6).

The team showed a moderate decrease in TMD from post max training to taper (.772). Based on evaluation of effect sizes the sprint trained swimmers experienced small changes in TMD throughout the season and the distance group experienced large increases in TMD from baseline to mid-season (-1.218) and a decrease in TMD from mid-season to post max training (1.669). Mid-distance trained swimmers experienced a moderate increase in TMD (-.509) from baseline to mid-season and large change in TMD from post max training to taper (.952), based on examination of effect size (Table 7). When comparing sprint and distance groups in TMD scores, moderate effect size changes were found at baseline (.566) and taper (.622) and large changes were observed at post max training (1.178) with sprinters have greater TMD values at all time points (Table 8).

As shown in Table 5, there was a significant time main effect for fatigue $F(3,33) = 2.602$, $p < 0.0001$, and there was a Training Type * Time interaction $F(6,66) = 2.429$, $p=0.03$. As shown in Figure 2 B, across the entire team, fatigue levels were the highest at mid-season and post maximum training and lower at baseline and taper. Distance swimmers experienced the most fatigue at mid-season and sprint, mid-distance, and team averages were greatest at post max training.

Team averages in fatigue started at 10.61 and progressed to 12.16, 11.55 and 5.13 throughout the season. Sprint swimmers reports of fatigue were consistent from baseline (10.09) to mid-season (10.82) and post max training (10.91). Similar to all groups, sprinters experienced the lowest report of fatigue at taper, with an average of 5.73. Of all groups, mid-distance swimmers reported the greatest fatigue from baseline through post max training. Mid-distance swimmers experienced an increase in fatigue from baseline values of 11.39 to a peak of 13.00 at mid-season. Mid-distance values had a slight decrease to 12.96 at post max training and a substantial decrease at taper, with an average of 5.00 (Table 6).

All group's experienced large decreases in reported feelings of fatigue from post max training to taper based on effect sizes. Distance swimmers had consistently large effect size changes in the fatigue subscale, with increases from baseline to mid-season (-1.542), and decreases at mid-season to post max training (3.365), as well as from post max training to taper (1.138) (Table 7). Changes in fatigue between sprint and distance trained swimmers were found to be moderate at baseline (.797) and taper (.612) and large at post max training (2.012), supporting the significant changes found by Wilk's Lambda (p = .032). As shown in Figure 2 B, sprinters experienced greater feelings of fatigue than the distance group at all time points, except at mid-season (Table 8).

Changes in vigor were not found to be significant across the swim season $F(3,33) = 2.186$, $p=0.11$ nor was there a Training Type * Time interaction $F(6,66) = 1.192$, $p= 0.32$ (Table 5).

Team averages in vigor were the highest at baseline (9.37) and reached their lowest at mid-season (8.29). Team values for vigor increased at post max training (8.53) and further increased to (8.84). Sprinters had a constant decrease in feelings of vigor from baseline (9.82), to mid-season (9.45), to post max training (8.36), and taper (8.18). Mid-distance swimmers also experienced their highest feelings of vigor at baseline (9.35). The mid-distance group felt the least vigorous at mid-season (8.22) and reported an increase at post max training (8.52) and taper (9.04). Distance swimmers began the season with an average of 8.25 for feelings of vigor. They experienced the lowest observed value across all groups at mid-season (5.50), and had an increase at post max training (9.00) and taper (9.50) (Table 6).

Sprint, mid-distance and team changes for vigor were all found to be small based on effect size examination. Distance swimmers had a large decrease from baseline to mid-season in vigor (.985) and an increase from mid-season to post max training (-1.136) (Table 7). In comparing sprint and distance-trained swimmers the only notable change in effect size for vigor was at mid-season where distance swimmers felt much less vigorous (1.823) (Table 8).

Changes in depression across the season approached significance $F(3, 33) = 2.644$, $p = 0.065$. However, training groups did not appear to show differential changes in depression based on a non-significant Training Type * Time interaction $F(6, 66) = 1.088$, $p = 0.38$ (Table 5). Sprint, mid-distance and team averages for depression peaked at post max training, while the distance group peaked at mid-season (Figure 3 A).

Sprint averages ranged for depression between 2.00 at taper, and 3.82 at post max training. Mid-distance swimmers reported the greatest observed average for depression, 5.04, which occurred after max training. Distance swimmers experienced the lowest values across all groups at baseline and taper with an average of 1.75 for the depression subscale. Distance swimmers experienced their peak feelings of depression at mid-season, which was 2.5 times greater than their lowest report (Table 6).

As presented in Table 7, sprint (.672), mid-distance (.576) and team (.557) reports of depression were found to have moderate increases from post max training to taper. The distance group had large effect size changes from baseline to mid-season (-1.287) and from mid-season to post max training (1.010). In comparison of the two main groups studied, sprint and distance swimmers, a moderate effect size change was found for the depression subscale at post max training (.692) (Table 8).

As reported in Table 5, changes in tension scores were not significant across time, $F(3, 33) = 0.417$, $p = 0.74$. The Training Type * Time interaction $F(6,66) = 0.411$, $p = 0.87$ was also non-significant. Based on Figure 3 B it appears that distance swimmers experienced the opposite feelings of tension compared to the sprint, mid-distance, and team averages until taper.

Overall as a team, swimmers felt the least amount of tension at baseline (4.68). Team values in tension were highest at mid-season (5.39) and then steadily decreased at post max training (5.11) and taper (5.00). Sprinters also experienced the least tension at baseline (4.82) and the greatest tension at mid-season (6.00). Sprinters experienced a decrease in tension at post max training (5.27) and an increase at taper (5.73). Mid-distance swimmers experienced a peak in tension at mid-season (5.57) and post max training (5.48), while values at baseline (4.87) and taper (4.74) remained lower. The distance group experienced the least amount of tension, compared to all groups at all time points. Values were lowest at mid-season (2.75) and post max training (2.50) and highest at baseline (3.25) and taper (4.50) (Table 6).

Only small changes as examined by effect size were seen across the swim season for the tension subscale, confirming the lack of significance found by Wilk's Lambda (Table 7). When comparing sprint and distance groups, moderate effect size changes were found in tension at baseline (.626) and large at mid-season (.985) and post max training (1.243), where sprinters reported highest feelings of tension (Table 8).

There was no significance in changes in anger across the swim season $F(3,33)= 0.687$, $p=0.57$; or within Training Type * Time interaction $F(6,66)$, $p= 0.87$ (Table 5). All groups except the distance group felt an increase in feelings of anger from baseline to mid-season while the distance group feelings did not change. Overall the mid-distance group reported the highest feelings of anger across the season and distance swimmers experienced the least feelings, with the sprint team averages falling between the two groups (Figure 3 C).

Team values in anger were highest at post max training (4.89) and lowest at taper (3.37), with baseline (4.24) and mid-season (4.82) falling in between. Sprinters had an average score of 4.27 at baseline and experienced an increase at mid-season (4.45). Sprinters average scores decreased at post max training (4.18) and taper (3.18). Mid-distance swimmers had feelings of anger increase from baseline (4.43) to mid-season (5.30) and to post max training (5.83). Mid-distance swimmers also experienced the lowest feelings of anger at taper (3.70). The distance group had the greatest amount of anger at baseline (3.00) and mid-season (3.00) and experienced no change between the two time points. Values for the distance group were lowest at post max training (1.50) and experienced an increase at taper (2.00) (Table 6).

A moderate decrease was found in the anger subscale for mid-distance swimmers from post max training to taper (.530). Large decreases, as examined by effect size, were seen in the distance group from mid-season to post max training (.991) (Table 7). In comparing sprint and distance groups, moderate differences in anger existed at baseline (-.666) and large differences were observed at max training (1.250), where sprint swimmers had the higher feelings of anger (Table 8).

As seen in Table 5, no significance between groups $F(6,66) = 1.557$, $p= 0.17$ but did approach significance in confusion subscales by time effect $F(3,33)= 2.602$, $p= 0.068$. As shown by Figure 3 D, the sprint group experienced a step-wise decrease in feelings of confusion and their average was considerably higher at taper than mid-distance and distance groups. Mid-distance and distance groups reported peaks at mid-season and post max training. All groups experienced a decrease in confusion from mid-season to taper.

Team averages in confusion increased from baseline (2.85) to mid-season (3.73) and then decreased at post max training (3.23) and taper (2.05). Sprinters experienced the greatest confusion between all groups. Sprinters began the season with confusion averages at 4.06 and slightly increased to 4.07 at mid-season. Sprint averages decreased at post max training (2.48) and taper (1.82). Mid-distance swimmers experienced lowest feelings of confusion at taper (2.29) and the highest at mid-season (3.74). Distance swimmers experienced an increase in feelings of confusion from baseline (2.19) to mid-season (2.81). The distance group experienced no change from mid-season to post max training (2.81) and had the least feelings of confusion at taper (1.25) (Table 6).

The only noted change in effect size scores for the confusion subscale across all groups and the team was a large decrease in the distance group from post max training to taper (1.304) (Table 7). Moderate differences were found between the sprint and distance group's feelings of confusion at baseline (.631) where sprinters were more confused and at post max training where distance swimmers had higher feelings of confusion (Table 8).

Athletic Engagement Questionnaire

Significant changes were found in the dedication subscale in regards to time (p = .002) and in the Time * Training Type interaction (p= .057) (Table 9). As shown by Figure 4 A, all groups and the team experienced decreased feelings of dedication across the swim season, while the mid-distance and team averages returned to near baseline values at taper. Overall sprint swimmers experienced the greatest feelings of dedication across the swim season.

Sprint swimmers experienced a slight decrease in values of dedication across the season, with the averages starting at 17.90 at baseline and decreasing to 17.10 at taper. Mid-distance reported a decrease in feelings of dedication from baseline (17.41) to post max training (15.82), and returned to an average slightly lower than baseline at taper (17.32). Distance swimmers experienced the highest observed average for dedication amongst all groups (18.75), which occurred at baseline; however, they had the lowest average observed in all groups at taper (15.25) (Table 10).

As examined by effect size, a moderate decrease was found for dedication in mid-distance swimmers from baseline to mid-season (.542) and a moderate increase from post max training to taper (-.551). Distance swimmers had a large decrease from baseline to mid-season (1.078) (Table 11). Moderate effect size changes in dedication were found when comparing sprint and distance swimmers at baseline (-.632) and post max training (.747), where distance swimmers had the highest feelings of dedication at baseline and sprinters felt more dedicated after max training. A large effect size was found at taper (.867) where sprinters remained more dedicated than the distance group (Table 12).

Significant changes across time for were found for the entire team on the enthusiasm subscale (p = .026). However, one group did not appear to change more than the others based on a non-significant interaction effect (p =.294) (Table 9). As diagramed in Figure 4 B, all groups experienced a decrease in reported feelings of enthusiasm at either mid-season or post max training and averages at taper exceeded baseline values in sprint, mid-distance and team scores. Mid-distance swimmers reported the lowest feelings of enthusiasm across all groups throughout the whole swim season.

Sprint swimmers experienced their lowest feelings of enthusiasm at mid-season (13.70) and the highest average at taper (17.00). Distance swimmers reported the highest observed feelings of enthusiasm amongst all groups (16.00), which was observed at baseline (Table 10).

A moderate increase in enthusiasm, as assessed by effect size, was found from post max training to taper in sprint swimmers (-.625), mid-distance swimmers (-.593), and the team (-.510). Distance swimmers experienced a moderate decrease (.565) from baseline to mid-season and no change in feelings of enthusiasm from post max training to taper (Table 11). When comparing the sprint and distance swimmers, large effect sizes were observed at taper (1.239), with sprinters have the greater feelings of enthusiasm (Table 12).

No significant relationship was found for the confidence subscale across time (p= 0.754) or between groups across time (p= 0.33) (Table 9 Figure 4 C).

Team averages in confidence decreased from baseline (15.58) to mid-season (15.44) and post max training (15.17), before increasing to the highest average at taper (15.89). Sprinters began the season as the most confident group (16.90) and experienced decreases at mid-season (16.70) and post max training (16.10). Sprint averages for confidence at taper (16.80) resumed to values almost as high as baseline. Mid-distance swimmers experienced an increase in confidence from baseline (14.86) to mid-season (14.59). Mid-distance swimmers did not experience a change in confidence from mid-season to post max training and then experienced an increase at taper (15.68). Distance swimmers experienced the greatest amount of confidence at mid-season (17.00) and the least at taper (14.75) (Table 10).

The only notable change in confidence, as assessed by effect size, was a moderate decrease in confidence in distance swimmers from post max training to taper (.500). This is barely a moderate effect size change and confirms the non-significant values found by Wilk's Lambda (Table 11). In the comparison of the two main groups, sprint and distance swimmers, large differences were observed at taper (1.082) (Table 12).

As reported in Table 9 and Figure 4 D, changes in vigor were not significant across time ($p = 0.100$) or evident by a Training Type * Time interaction ($p = 0.915$).

Sprint values varied from the lowest at mid-season (14.60) to highest at taper (16.70). Mid-distance swimmers values varied the least with the greatest change of 1.0 between mid-season and post max training to taper (Table 10). No noteworthy changes, as examined by effect size, were found in the vigor subscale across time (Table 11). The only notable difference between sprint and distance swimmers was at taper (.794) where sprinters had higher feelings of vigor (Table 12).

Body Composition

Changes in percent fat across the season were found to be significant $F(2, 32) = 38.991$ $p < .0001$. One group did not appear to change more than another based on a non-significant Percent Fat * Training Type interaction $F(4,64) = 0.341$, $p = 0.849$ (Table 13).

As seen in Figure 5, all groups experienced a decrease in percent fat over the swim season and sprint, mid-distance and team averages were very similar. The distance group was noticeably leaner than their teammates.

The sprint group average at baseline was 15.33% and 13.21% at taper. The sprint group had the greatest change (2.12%) in percent fat amongst groups. The mid-distance group had the highest percent fat at baseline (15.41%) and taper (13.83%). The distance group had the least change (1.06%), but was the leanest group at baseline (11.30%) and taper (10.24%) (Table 14).

Performance

Repeated measures ANOVA was conducted to examine performance in distance (n=5), mid-distance (n=13), and sprint (n=9) swimmers at four time points. Meets 1, 4, 8 and 12 were chosen because a questionnaire was administered within two weeks prior to the meet and were called baseline meet, mid-season meet, post max training meet and taper meet, respectively.

There was a significant change in performance across time $F(3,22)= 39.51$, $p< 0.0001$ with all groups performing better after taper (Figure 6). The Training Type * Time interaction was not significant, $F(6,44)= 2.56$, $p= 0.33$ (Table 15) meaning that all three groups showed similar performance improvements.

The sprint group maintained the highest percentage of performance amongst all groups from baseline (96.78%) to mid-season (96.77%). The mid-distance group consistently had the lowest measured performance throughout the swim season. The mid-distance trained swimmers began the season at

94.90%, 95.15% at mid-season and 95.10% at post max training. Distance swimmers started out the season with performances that were at 95.51% of their best in season times. Distance swimmers had the highest observed percentage of performance at post max training (96.42%) and at taper (100%). The distance swimmers were the only group to have all group members perform best times at the taper meet. Sprint and mid-distance groups performed at 99.93% of their best times at taper (Table 16).

Relating Performance and Mood and Engagement

As shown in Table 17, correlations were calculated by the team's performance across the swim season and with the subscales of the POMS and AEQ. Correlation analysis found that only moderately strong relationships existed between performance and tension at mid-season (.435) and of confusion at max training (.414).

CHAPTER 5: DISCUSSION

Overview

The purpose of this study was to examine the effects of training in collegiate swimmers on mood states and how these moods relate to athletic performance. Previous research has shown that short-term overreaching found in sports such as swimming, can have a negative psychological impact (Hooper, Mackinnon et al. 1998, Meeusin, Romain et al. 2006). Morgan, Brown et al. (1987) reported that athletes who experience greater mood disturbances are less successful than their teammates. No previous research has examined the differences in sprint and distance trained swimmers to see if training types alter mood. It was proposed that due to the higher volume that distance swimmers train, worse mood states and less feelings of engagement would occur and thus result in poorer performances. To test this hypothesis, participants in this study completed POMS and AEQ questionnaires. Performance was assessed using athletes' times in their primary event across the swim season. The only significant differences in mood states and engagement found between training groups was in the POMS fatigue subscale (Table 5 and Figure 2 B) and the AEQ dedication subscale (Table 9 and Figure 4 A). We believe this lack of significance is due to the small sample size since calculated effect size indicated moderate and or large differences in all subscale of the POMS except tension and all subscales of the AEQ (Table 7). Significant changes in the POMS fatigue subscale and total mood disturbances (TMD) throughout the swim season were found (Table 5). Significant reduction in dedication across time was found by the AEQ (Table 9 and Figure 4 A).

Training Volumes

Our results may not have reached significance like previous research suggested (Morgan, Costill 1988, Raglin, Morgan et al. 1991) since training volumes were considerably less than the average 9,000 meters per day that swimmers trained in Morgan's study and the peak of 13,000 meters in the max training portion of the season that Raglin observed. Hooper et al. (1997) previously reported that POMS scores were more closely related to training intensity rather than volume. Since we saw significant changes in training volumes (p= 0.0096) (Table 4 and Figure 1) and only saw significant changes in TMD (p< 0.001) and fatigue (p< 0.001) (Table 5 and Figures 2 A and 2 B), we might conclude that there were no differences in intensity among groups and thus less observed changes in questionnaire scores (Table 6 and 10). Our results further support Berger and associates (1997) previous findings that beyond a certain yardage swum, that is dependent of fitness of the swimmer, an increase in volume of practice is associated with decrements in overall mood.

Profile of Mood States Questionnaire (POMS)

Team

Average scores for TMD, fatigue, tension, and confusion were greatest at mid-season, while depression and anger subscales were highest at after the maximum training load stage (Table 6, Figures 3 and 4). Our results partially support Morgan's et al. (1987) previous findings that greatest mood disturbances when training loads were greatest. As presented in Table 6 and Figure 2 C, the team reported the least feelings of the positive subscale, vigor, at the mid-season and highest feelings of vigor at baseline. Although values of vigor were not significantly higher at baseline than at taper, it was expected that athletes would report the highest feelings of vigor at taper prior to the championship meet as found by Morgan (1987) and Raglin (1991). Although the time effect of depression did not reach significant values (p= .065), it was approaching significance ($p \leq .05$) and we believe with a larger sample size, significance would be reached since effect size changes in depression were large (Table 5).

The team reported the lowest feelings of TMD, fatigue, depression, anger, and confusion at taper. Unlike Raglin's (1991) findings that significant changes were found in depression, anger, vigor, fatigue, confusion and TMD, we only found significant changes in fatigue and TMD. We found significant changes in TMD and fatigue (Table 5), which partially supports Morgan and Brown's (1987) results that significant changes in TMD were due to changes in vigor and fatigue. The only negative subscale that was not reported lowest at taper was tension, which was lowest at baseline. Our results for the tension subscale support previous research (Raglin, Morgan et al. 1991) that reported that tension does not decrease in response to reduced training loads. Higher tension scores at taper may have been due to the stress of performing well at the Conference Championship meet.

Although a significant by time effect was only found in TMD and fatigue, and only approached significance in depression (p = .065), effect size changes indicate moderate and or large changes in all subscales except tension (Tables 5 and 7). It appears that TMD returned to slightly lower than baseline values as previously found by Morgan, Brown (1987). However most athletes reported higher feelings of vigor at baseline, which was unexpected.

By generalizing the data obtained from the means of subscales and the calculated effect size of the POMS, it appears that regardless of training type, swimmers reported less negative moods at taper and or baseline verses higher training periods as predicted by previous research (Raglin et al. 1991 and Morgan (1987).

Distance Swimmers

The distance trained swimmers reported the highest feelings of depression, anger, fatigue, confusion and total mood disturbances, as assessed by the POMS, at mid-season (Table 6, Figures 2 and 3). It should be noted however that distance swimmers reported no change in anger subscales from taper to mid-season and no change in confusion from mid-season to post max training questionnaires. Distance swimmers reports of depression, which were the lowest observed in all groups, returned to baseline values at taper (Table 6 and Figure 3 A). Tension was the only negative subscale that was not reported highest at mid-season, but rather at taper. The highest value of tension (4.50) for the distance swimmers was still lower than the lowest value of tension by the two other groups (4.74) (Table 6, Figures 3 A). Once again this higher report in tension, may be due to anxiety about performance at the Conference Championship meet similar to what Raglin et al. (1991) proposed.

Distance swimmers reported the least feelings of vigor and greatest feelings of fatigue at mid-season and the most vigorous and least fatigued at taper, which is supportive of what previous research has found (Morgan 1987; Raglin 1991).

Sprint Swimmers

As shown in Table 8, sprint trained swimmers also reported greatest feelings of the negative subscales at mid-season and at post max training loads, partially supportive of previous research by Morgan and associates (1987) that found greatest disturbances at max training. Lowest values of negative mood disturbances were reported at taper, with tension being the exception and reported lowest at baseline (Figures 2 and 3).

Sprinters reported a stepwise decrease feeling of vigor from baseline to taper time (Figure 2 C). This is the opposite of what was expected since previous research by Morgan, Brown et al. (1987) showed that after periods of overtraining swimmer “negative iceberg profiles” shifted to positive profiles that were similar to baseline. Unlike Morgan and associates (1987) results, significant changes in total mood disturbances were primarily from an increase in fatigue since changes in vigor did not reach significance.

Sprint swimmers were similar to distance trained swimmers in their reports of greatest disturbances of anger, confusion and TMD at mid-season and least feelings of depression, fatigue, confusion and TMD at taper (Figures 2 and 3).

Mid-Distance Swimmers

Mid-distance swimmers also reported greatest mood disturbances at mid-season and post max training questionnaires (Table 6, Figures 2 and 3). Similar to distance swimmers, mid-distance trained swimmers experienced less feelings of vigor at mid-season (Figure 2 C).

Mid-distance trained swimmers reported the least feelings of anger, fatigue, confusion and TMD at taper. Tension and depression subscales were lowest at baseline. The mid-distance trained swimmers were more similar to sprinters in the reports of their feelings across all subscales (Table 6, Figures 2 and 3).

Differences in Sprint and Distance Trained Swimmers

As presented in Table 5, statistically significant changes in the Time * Training Type interaction were only found in the fatigue subscale ($p = .032$). Moderate differences between the groups were seen at baseline in TMD, fatigue, tension, anger and confusion. Moderate differences were observed at taper for TMD and fatigue. Large effect sizes were seen throughout mid-season and post max training for TMD, fatigue, vigor, tension and anger (Table 7). The highest tension scores for distance swimmers were lower than the lowest sprint tension score but moderate effect size at baseline and large differences at mid-season and post max training suggest that differences may exist between the two training groups.

Athlete Engagement Questionnaire (AEQ)

Team

As expected the team reported greatest feelings of confidence, vigor and enthusiasm at taper and lowest feelings of these subscales at mid-season or after max training (Table 10, Figure 4). Unexpectedly dedication, the fourth subscale examined, had greatest reports at baseline and the lowest reports at post max training. It appears that as the season progressed, swimmers felt less dedicated and ready for the season to be over (Table 10, Figure 4 A). High reports of these four subscales were expected at taper due to the decrease in training load and the excitement of the upcoming Conference Championship meet.

Moderate and/or large effect sizes found across the season support the significance (p = .002) found in swimmers reports of dedication and in enthusiasm (p = .026) (Table 9). Only barely moderate effects were found from max training to taper in confidence in distance swimmers and reports of vigor (Table 11). Since these effects were barely moderate, significance may not have resulted even with a larger sample size.

Distance Swimmers

Distance trained swimmers reported the greatest feelings of dedication, vigor and enthusiasm at baseline and the most confidence at mid-season (Table 10 and Figure 4). After a decrease in feelings of vigor across the mid-season and post max training periods, levels returned to baseline values. The least feelings of vigor and enthusiasm were found to be at mid-season. Unexpectedly they reported the least feelings of confidence and dedication at taper (Table 10 and Figure 4).

Sprint Swimmers

Sprinters reported the greatest feelings of vigor on this questionnaire at taper, which differs greatly in their stepwise decrease in vigor on the POMS (Table 10 and Table 6, Figures 4 D and Figure 2 C). They also reported feeling the most enthusiastic at taper. The sprint group reported the greatest feelings of confidence and dedication at baseline, with the lowest feelings at post max training and taper, respectively (Table 10, Figure 4).

Mid-Distance Swimmers

As shown in Table 10 and Figure 4, mid-distance swimmers reported the highest feelings of confidence, vigor, and enthusiasm at taper. Like the other two groups, they reported the highest feelings of dedication at baseline. They reported the least feelings of all four subscales at post max training.

Differences in Sprint and Distance Trained Swimmers

Effect size indicates there were moderate differences in sprint and distance swimmers reports of vigor at taper and of dedication at baseline and post max training. These effect size changes indicate sprinters were more vigorous than the distance group at taper. The differences in effect size in feelings of dedication show that distance swimmers had much greater feelings of dedication at baseline than the sprinters and less at post max training. With the large effect sizes that were found between the two groups at taper in dedication, enthusiasm, and confidence suggest that significant differences may be found in the Time * Training Type interaction in enthusiasm and confidence if the sample size were greater (Table 9 and 10).

Body Composition

Seven-site skinfold measurements were taken on 36 swimmers (distance n= 3, mid-distance n=22, sprint n=11) at baseline in September and again in February at taper.

Significant differences of percent fat were observed by time across the season ($p < .0001$) but not in a Time * Training Type ($p = .849$) (Table 13). As shown in Table 14, mid-distance swimmers had the highest body fat at baseline (15.41 ± 7.14% fat) and taper (13.83 ± 5.81%) and distance swimmers had the lowest at both times, 11.30 ± 4.73% and 10.24 ± 4.38% respectively. Sprint swimmers showed the greatest change from baseline to taper (2.12 ± 1.84%), while distance swimmers showed the least change (1.06 ± 1.23%). Distance swimmers may have seen the least change since there was a low sample size (n=3), they were the leanest group at baseline and consisted of 2 males and 1 lean female. On average the whole team decreased body fat percentage from 15.04% to 13.34% (Figure 7).

Performance

Means for the whole teams calculated performance started at 95.64 ± 1.98% the baseline meet. As shown by table 16, performance remained similar for the mid-season and post max training meets, 95.95% and 95.72% respectively. As expected the largest change occurred following a taper meet when performance increased to 99.94% for the team mean (Figure 6).

Changes in performance by time effect were significant (*p* <.0001) but a non-significant (*p*= 0.33) relationship was found in the Time * Training Type interaction (Table 15). Distance swimmers began the swim season at baseline performing at 95.5% of their best. They improved performance to 96.5% at mid-season and 96.4% at post max training. Distance swimmers had all swimmers compete at 100% of their best time at the Conference Championship meet. The distance group was the only group to reach 100% of best performance at the taper meet; part of this may be due to the low sample size (n=5). Sprint trained swimmers began the season with the highest performance at 96.8%. They maintained this 96% throughout the season and ended the year with a group average of performance of 99.9%. The mid-distance group started at the lowest in terms of performance, 94.9%, and remained they lowest performing group throughout the season until the Conference Championship meet where they performed at 99.9% of their best (Table 16).

Relating Performance and Mood and Engagement

It appears through correlation that mood states and feelings of engagement as found by the POMS and AEQ respectively do not strongly predict performance in collegiate swimmers (Table 17). Our research, although small in sample size, does not fully show that improvements in mood states are the cause or necessary for improvements in performance that Hooper et al. (1998) found. Perhaps greater improvement would have been seen if significance was reached in all subscales of the POMS and in the AEQ.

Summary

Significant changes in mood states as assessed by the POMS were found in TMD in regards to time and feelings of fatigue in regards to time and training groups. TMD values were greatest, indicating the most negative moods, at mid-season and post max training. TMD values in all groups at taper were between half and a quarter of what they were at mid-season and max training. (Table 8). Feelings of fatigue were highest at mid-season and post max training and lowest in all groups at taper. Distance swimmers were less fatigued the sprinters at all time points except at mid-season. Despite only finding significant changes in TMD and fatigue subscales, large effect sizes with respect to time were found in all subscales of the POMS and TMD except the tension subscale, indicating large changes in feelings throughout the season were present (Table 7). When comparing figures for the POMS subscales it is apparent that sprint and mid-distance trained swimmers reported similar feelings in all subscales, while distance swimmers seemed to experience different feelings. Large effect sizes between sprint and distance swimmers support these observed differences in TMD, fatigue, and anger subscales at post max training, with sprinters having the higher values. Large effect size changes were also seen in vigor and tension at mid-season, where sprinters felt more vigorous and more tension (Tables 6 and 8).

Similarly, only a few significant changes were found in assessment of the engagement. Significant changes were found in feelings of dedication with respect to time and training group and in enthusiasm in regards to time. The only large effect size for time effect was found in reported feelings of dedication from baseline to mid-season, thus suggesting that feelings of engagement do not drastically change for feelings of confidence and vigor across time. Large effect sizes were found between sprint and distance group averages for dedication, enthusiasm, and confidence at taper. Sprinters showed much higher feelings than the distance group in dedication, enthusiasm, and confidence. By examining Figure 4, it appears that sprint and distance groups were similar in reports of engagement and overall mid-distance swimmers were the least engaged group.

Training methods determined by the coaching staff provided significant changes in percent fat and performance by time effects. We conclude in our study that changes in mood and engagement does not strongly predict the success swimmers will exhibit in a swim season.

Future Studies

This current study suggests that there may be observed differences in mood states and engagement between sprint and distance trained swimmers. Further research is needed to determine if larger sample sizes may produce more significant results in this area of research.

Table 1 Reliability (α) for POMS				
Factor	Baseline	Mid-Season	Post Max Training	Taper
Tension	.754	.726	.841	.783
Depression	.809	.656	.810	.783
Anger	.810	.868	.871	.877
Vigor	.732	.622	.774	.712
Fatigue	.873	.853	.852	.863
Confusion	.631ψ	.529ψ	.694ψ	.721ψ

ψ Indicates α with 1 item deleted

Table 2 Reliability (α) for AEQ				
Factor	Baseline	Mid-Season	Post Max Training	Taper
Confidence	.877	.913	.902	.887
Dedication	.825	.884	.878	.909
Vigor	.889	.927	.938	.899
Enthusiasm	.921	.923	.950	.924

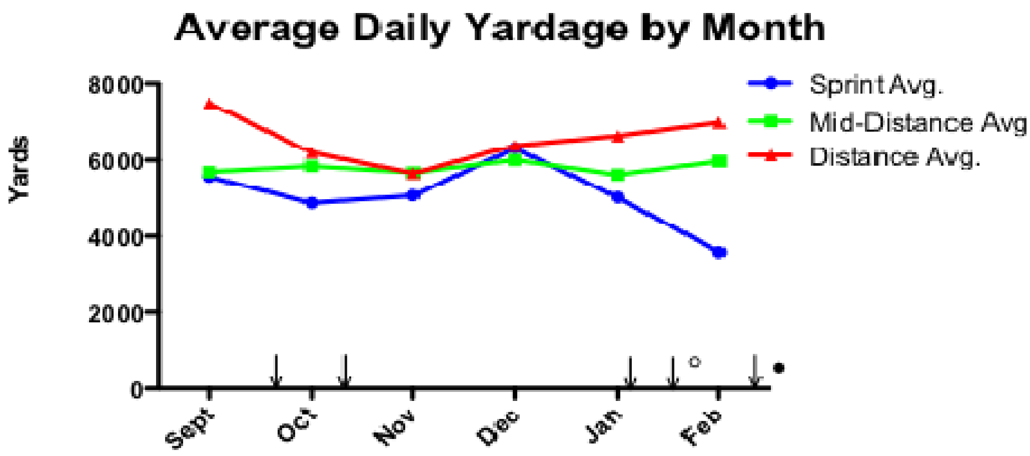
Table 3 Average Daily Yardage By Month			
Month	Sprint	Mid-Distance	Distance
September	5,560	5,689	7,496
October	4,876	5,841	6,202
November	5,070	5,677	5,657
December	6,307	6,002	6,386
January	5,020	5,617	6,635
February ψ	3,592	5,967	6,982

ψ denotes only two weeks observed in the month of February prior to taper

Table 4 Weekly Yardage by Month by Time Comparison		
Factor	F	P
Average Month	7.662	.0096*
Month of Training	.8384	.5517

*Significant difference ($P \leq 0.05$)

Figure 1



↓ Indicates when questionnaires were administered
↓° Indicates the final questionnaire administered to those swimmers not attending the Conference Championship meet
↓• Indicates the final questionnaire administered to those swimmers attending the Conference Championship meet

Table 5
POMS Subscale by Time Comparison

Factor	F	P
TMD		
Time Effect	8.511	<.0001*
Time X Training Type Interaction	1.266	.285
Fatigue		
Time Effect	13.426	<.0001*
Time X Training Type Interaction	2.479	.032*
Vigor		
Time Effect	2.186	.108
Time X Training Type Interaction	1.192	.322
Tension		
Time Effect	.417	.742
Time X Training Type Interaction	.411	.869
Depression		
Time Effect	2.644	.065
Time X Training Type Interaction	1.088	.379
Anger		
Time Effect	.687	.567
Time X Training Type Interaction	.411	.869
Confusion		
Time Effect	2.602	.068
Time X Training Type Interaction	1.557	.173

* Significant difference ($P \leq 0.05$)

Table 6
POMS Subscale Means ± SE
N= Sprint 11, Mid-Distance 23, Distance 4, Team 38

Factor	Baseline	Mid-Season	Post Max Training	Taper
TMD				
Sprint	16.25 ± 19.27	19.16 ± 15.70	18.30 ± 16.50	10.27 ± 11.07
Mid-Distance	16.54 ± 11.04	22.88 ± 13.85	24.37 ± 17.17	9.25 ± 14.59
Distance	9.44 ± 4.78	18.56 ± 10.20	5.06 ± 5.98	4.25 ± 8.29
Team	15.71 ± 13.40	21.35 ± 13.89	20.58 ± 16.98	9.02 ± 12.97
Fatigue				
Sprint	10.09 ± 4.12	10.82 ± 3.87	10.91 ± 4.37	5.73 ± 4.34
Mid-Distance	11.39 ± 4.27	13.00 ± 4.15	12.96 ± 3.32	5.00 ± 4.16
Distance	7.50 ± 2.38	11.00 ± 2.16	5.25 ± 1.26	4.25 ± .50
Team	10.61 ± 4.12	12.16 ± 3.97	11.55 ± 4.18	5.13 ± 3.95
Vigor				
Sprint	9.82 ± 2.93	9.45 ± 2.25	8.36 ± 4.41	8.18 ± 3.66
Mid-Distance	9.35 ± 3.02	8.22 ± 2.89	8.52 ± 3.19	9.04 ± 2.87
Distance	8.25 ± 3.50	5.50 ± 2.08	9.00 ± 4.08	9.50 ± 3.70
Team	9.37 ± 2.99	8.29 ± 2.82	8.53 ± 3.56	8.84 ± 3.13
Tension				
Sprint	4.82 ± 3.34	6.00 ± 2.41	5.27 ± 3.17	5.73 ± 2.36
Mid-Distance	4.87 ± 2.75	5.57 ± 3.59	5.48 ± 1.29	4.74 ± 3.09
Distance	3.25 ± 1.71	2.75 ± 4.19	2.50 ± 1.29	4.50 ± 2.89
Team	4.68 ± 2.83	5.39 ± 3.40	5.11 ± 3.85	5.00 ± 3.08
Depression				
Sprint	2.82 ± 3.66	3.27 ± 3.00	3.82 ± 3.63	2.00 ± 1.79
Mid-Distance	2.70 ± 2.10	3.65 ± 3.01	5.04 ± 4.21	2.74 ± 3.78
Distance	1.75 ± 0.96	4.50 ± 3.32	2.00 ± 1.63	1.75 ± 0.96
Team	2.63 ± 2.53	3.63 ± 2.97	4.37 ± 3.91	2.42 ± 3.10
Anger				
Sprint	4.27 ± 4.74	4.45 ± 4.03	4.18 ± 3.71	3.18 ± 3.19
Mid-Distance	4.43 ± 2.92	5.30 ± 4.18	5.83 ± 4.33	3.70 ± 3.71
Distance	3.00 ± 3.46	3.00 ± 2.45	1.50 ± 0.58	2.00 ± 1.83
Team	4.24 ± 3.51	4.82 ± 3.98	4.89 ± 4.11	3.37 ± 3.39
Confusion				
Sprint	4.06 ± 4.05	4.07 ± 3.54	2.48 ± 3.44	1.82 ± 1.17
Mid-Distance	2.40 ± 2.30	3.74 ± 3.24	3.65 ± 3.21	2.29 ± 2.38
Distance	2.19 ± 1.88	2.81 ± 2.14	2.81 ± 0.63	1.25 ± 1.77
Team	2.85 ± 2.90	3.73 ± 3.18	3.23 ± 3.11	2.05 ± 2.04

Table 7
POMS Effect Size by Time

Factor	Baseline → Mid-Season	Mid-Season → Post Max Training	Post Max Training → Taper
TMD			
Sprint	-0.166	0.053	0.582
Mid-Distance	-0.509*	-0.096	.952**
Distance	-1.218**	1.669**	.113
Team	-0.413	0.050	0.772*
Fatigue			
Sprint	-0.183	-0.022	1.190**
Mid-Distance	-0.383	0.011	2.129**
Distance	-1.542**	3.365**	1.138**
Team	-0.383	0.150	1.579**
Vigor			
Sprint	0.143	0.327	0.045
Mid-Distance	0.382	-0.099	-0.172
Distance	0.985**	-1.136**	-0.129
Team	0.372	-0.075	-0.093
Depression			
Sprint	-0.135	-0.166	0.672*
Mid-Distance	-0.372	-0.385	0.576*
Distance	-1.287**	1.010**	0.193
Team	-0.364	-0.215	0.557*
Tension			
Sprint	-0.411	0.262	-0.167
Mid-Distance	-0.221	0.023	0.199
Distance	0.169	0.091	0.032
Team	-0.228	0.077	0.032
Anger			
Sprint	-0.041	0.070	0.290
Mid-Distance	-0.245	-0.124	0.530*
Distance	0	0.991**	-0.416
Team	-0.155	0.017	0.406
Confusion			
Sprint	-0.003	0.456	0.287
Mid-Distance	-0.484	0.028	0.487
Distance	-0.309	0	1.304**
Team	-0.383	0.150	1.579**

*Moderate Effect Size **Large Effect Size
Negative score indicates an increase in mood subscale score
Positive score indicates a decrease in mood subscale score

Table 8
Effect Size of POMS between Sprint and Distance Groups

Factor	Baseline	Mid-Season	Post Max Training	Taper
TMD	.566* S	.046 S	1.178** S	.622* S
Fatigue	.797* S	-.060 D	2.012** S	.612* S
Vigor	.489 S	1.823** S	-.151 D	-.359 D
Depression	.464 S	-.389 D	.692* S	.182 S
Tension	.626* S	.985** S	1.243** S	.469 S
Anger	-.666* S	.447 S	1.250** S	.471 S
Confusion	.631* S	.444 S	-.162 D	.388 S

*Moderate Effect Size ** Large Effect Size
S denotes greater value for Sprinters
D denotes greater value for Distance

Figure 2: POMS- TMD, Fatigue, Vigor Over a Swim Season

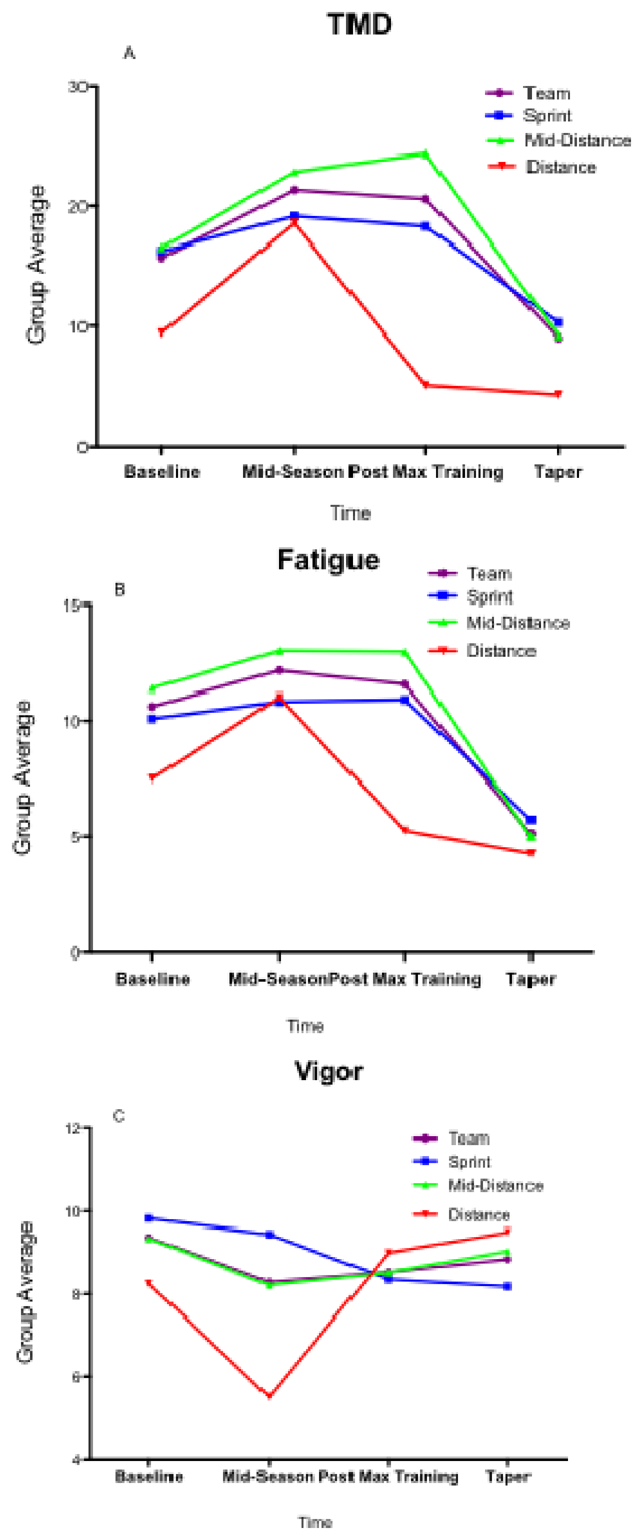


Figure 3: POMS- Depression, Tension, Anger, Confusion Over a Swim Season

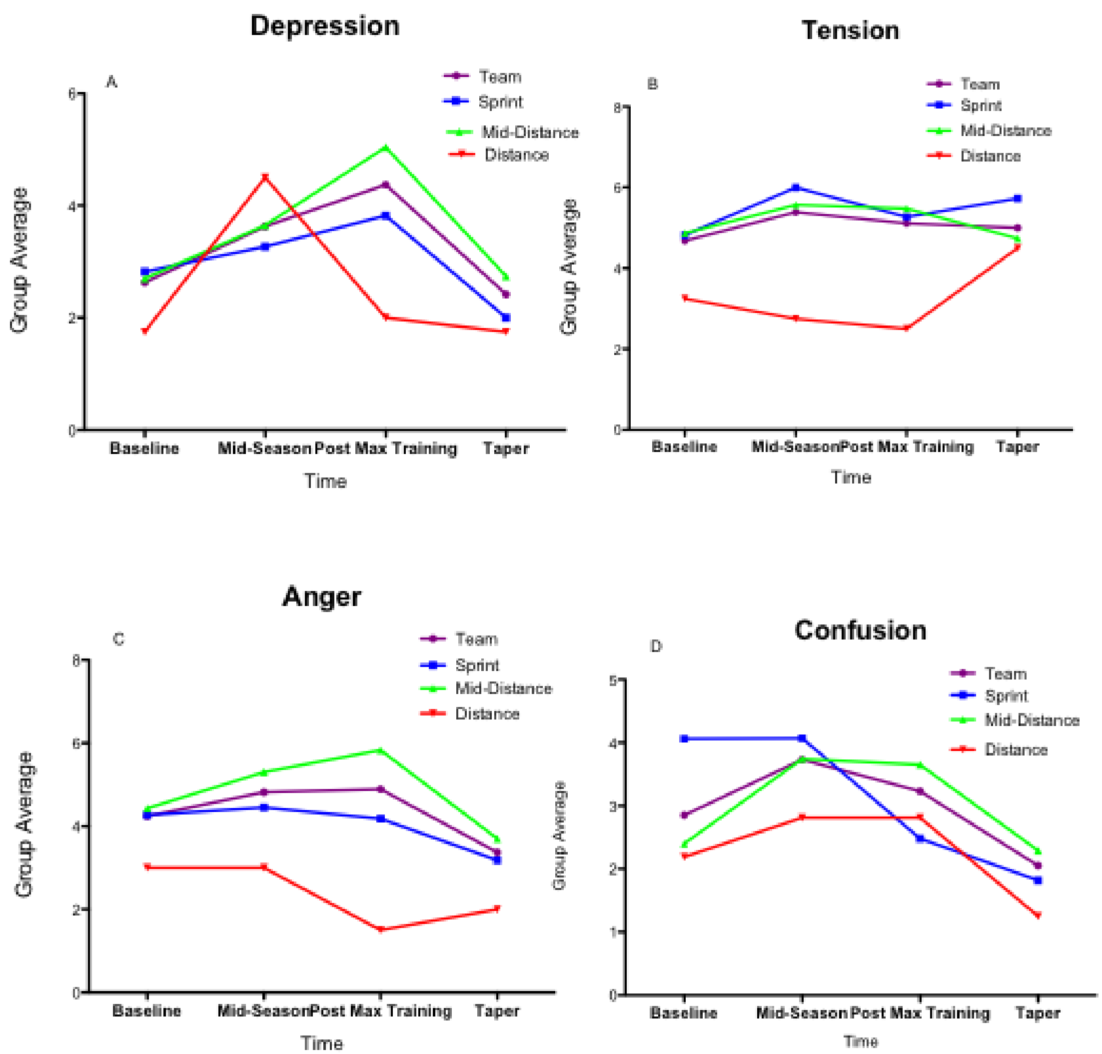


Table 9 AEQ Subscale by Time Comparisons		
Factor	F	P
Dedication		
Time Effect	6.506	.002*
Time X Training Type Interaction	2.182	.057*
Enthusiasm		
Time Effect	3.519	.026*
Time X Training Interaction	1.248	.294
Confidence		
Time Effect	.400	.754
Time X Training Type Interaction	1.194	.321
Vigor		
Time Effect	2.268	.100
Time X Training Type Interaction	.336	.915

*Significant Differences ($P \leq 0.05$)

Table 10 AEQ Means ± SE N= Sprint 10, Mid-Distance 22, Distance 4, Team = 36				
Factor	Baseline	Mid-Season	Post Max Training	Taper
Dedication				
Sprint	17.90 ± 1.73	17.60 ± 1.90	17.40 ± 2.46	17.10 ± 2.77
Mid-Distance	17.41 ± 1.89	16.18 ± 2.65	15.82 ± 3.08	17.32 ± 2.36
Distance	18.75 ± 0.96	16.75 ± 2.75	15.25 ± 3.30	15.25 ± 1.50
Team	17.69 ± 1.79	16.64 ± 2.49	16.19 ± 2.97	17.03 ± 2.43
Enthusiasm				
Sprint	15.30 ± 3.34	13.70 ± 3.56	14.90 ± 3.78	17.00 ± 2.94
Mid-Distance	12.18 ± 3.97	12.27 ± 3.51	11.14 ± 4.34	13.45 ± 3.45
Distance	16.00 ± 3.16	14.00 ± 3.92	14.25 ± 4.19	14.25 ± 1.50
Team	13.47 ± 3.99	12.86 ± 3.54	12.53 ± 4.43	14.53 ± 3.41
Confidence				
Sprint	16.90 ± 2.38	16.70 ± 2.45	16.10 ± 3.07	16.80 ± 2.53
Mid-Distance	14.86 ± 2.55	14.59 ± 2.30	14.59 ± 2.61	15.68 ± 2.66
Distance	16.25 ± 3.30	17.00 ± 2.16	16.00 ± 3.74	14.75 ± 1.26
Team	15.58 ± 2.68	15.44 ± 2.51	15.17 ± 2.87	15.89 ± 2.54
Vigor				
Sprint	15.40 ± 2.99	14.60 ± 3.06	15.50 ± 3.03	16.70 ± 2.16
Mid-Distance	12.59 ± 3.07	12.09 ± 3.18	12.09 ± 3.89	13.09 ± 3.13
Distance	14.75 ± 2.50	12.75 ± 5.32	14.50 ± 3.11	14.75 ± 2.75
Team	13.61 ± 3.19	12.86 ± 3.48	13.31 ± 3.84	14.28 ± 3.21

Table 11
AEQ Effect Size by Time

Factor	Baseline → Mid-Season	Mid-Season → Post Max Training	Post Max Training → Taper
Dedication			
Sprint	.165	.092	.115
Mid-Distance	.542*	.126	-.551*
Distance	1.078**	.496	0
Team	.491	.165	-.311
Enthusiasm			
Sprint	.464	-.327	-.625*
Mid-Distance	-.024	.288	-.593*
Distance	.565*	-.062	0
Team	.162	.083	-.510*
Confidence			
Sprint	.083	.217	-.250
Mid-Distance	.111	0	-.414
Distance	-.275	.339	.500*
Team	.054	.100	-.266
Vigor			
Sprint	.264	-.296	-.462
Mid-Distance	.160	0	-.285
Distance	.512*	-.415	-.085
Team	.225	-.123	-.275

* Moderate Effect Size ** Large Effect Size
Negative score indicates an increase in mood subscale score
Positive score indicates a decrease in mood subscale score

Figure 4: AEQ- Dedication, Enthusiasm, Confidence, Vigor Over a Swim Season

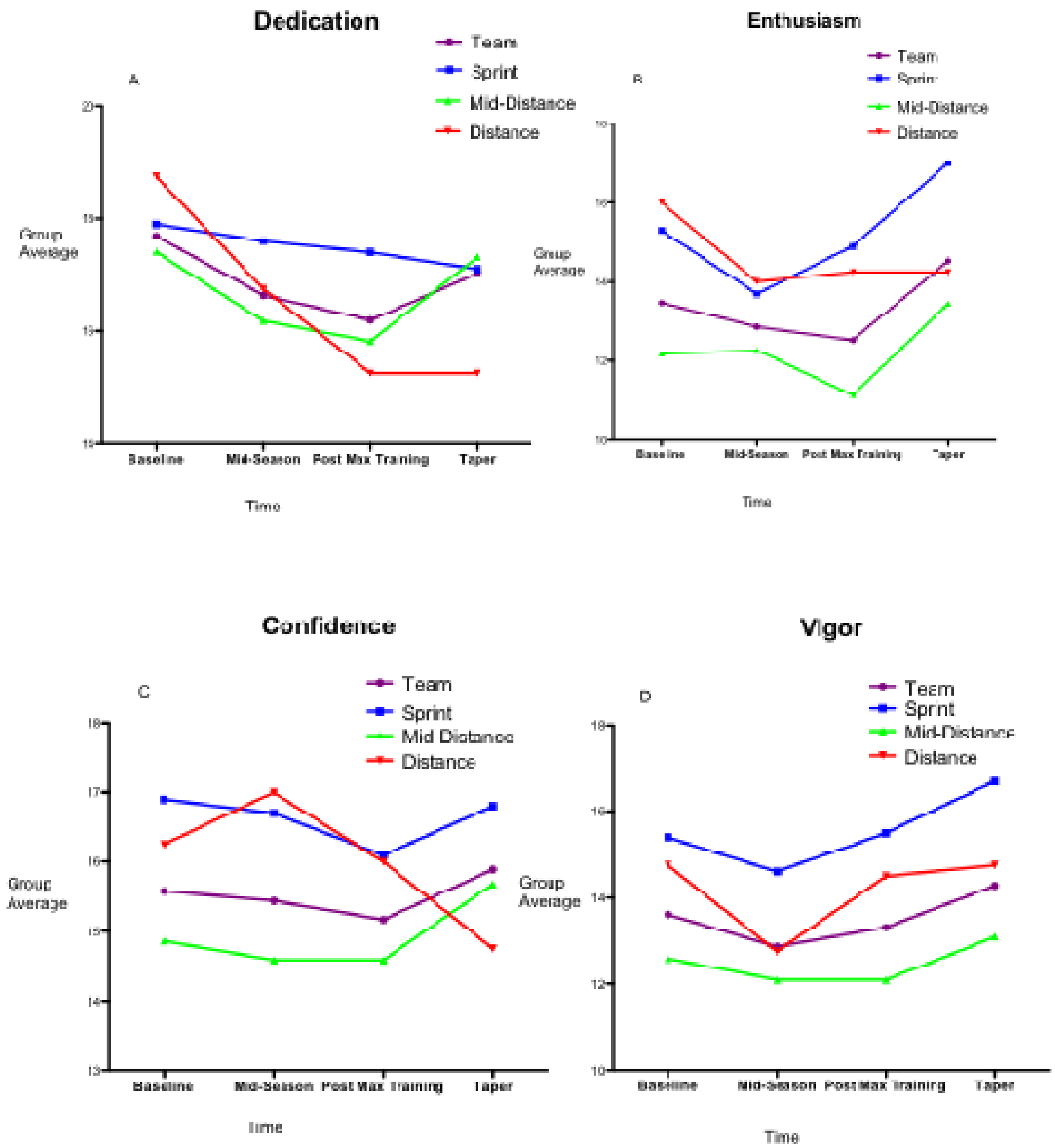


Table 12
AEQ Effect Size Between Sprint and Distance Groups

Factor	Baseline	Mid-Season	Post Max Training	Taper
Dedication	-.632* D	.366 S	.747* S	.867** S
Enthusiasm	-.215 D	-.080 D	.163 S	1.239** S
Confidence	.229 S	-.130 D	.029 S	1.082** S
Vigor	.412 S	.442 S	.326 S	.794* S

*Moderate Effect Size **Large Effect Size
S denotes greater value for Sprinters
D denotes greater value for Distance

Table 13
Percent Fat Comparisons

Percent Fat	F	P
Time Effect	38.991	<.0001*
Time * Training Type Interaction	.341	.849

* Significant Differences ($P \leq 0.05$)

Table 14
Percent Fat * Training Type
N= Sprint 11, Mid-Distance 22, Distance 3, Team 36

Training Type	Baseline % Fat	Taper % Fat	Change in % Fat
Sprint	15.33 ± 7.26	13.21 ± 6.94	2.12 ± 1.84
Mid-Distance	15.41 ± 7.14	13.83 ± 5.81	1.58 ± 5.81
Distance	11.30 ± 4.73	10.24 ± 4.38	1.06 ± 1.23
Team	15.04 ± 6.95	13.34 ± 6.01	1.70 ± 2.48

Figure 5: Average % Fat by Groups

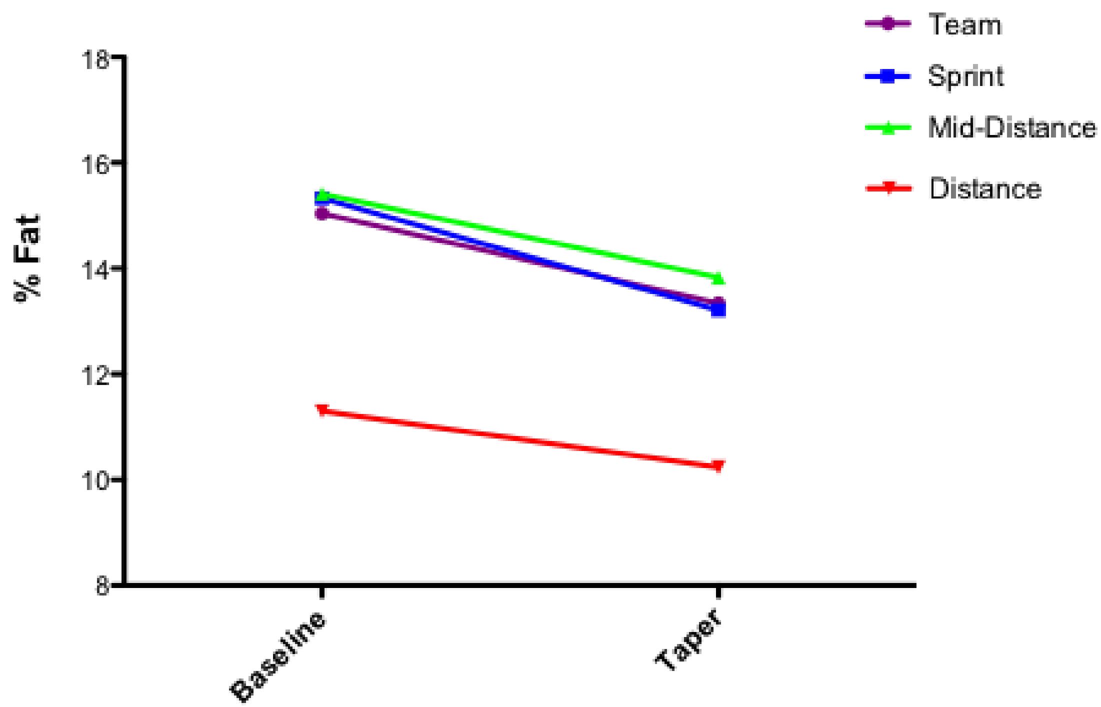


Table 15 Performance Comparisons		
Performance	F	P
Time Effect	39.505	<.0001*
Time X Training Type Interaction	2.559	.33
*Significant Differences ($P \leq 0.05$)		

Table 16 Performance Mean ± SE N= Sprint 9, Mid-Distance 13, Distance 5, Team 27				
Training Type	Baseline	Mid-Season	Post Max Training	Taper
Sprint	96.78 ± 1.00	96.77 ± 1.03	96.21 ± 1.50	99.93 ± 0.21
Mid-Distance	94.90 ± 2.36	95.15 ± 2.42	95.10 ± 2.01	99.93 ± 0.26
Distance	95.51 ± 1.39	96.54 ± 0.89	96.42 ± 1.89	100.0 ± 0.00
Team	95.64 ± 1.98	95.95 ± 1.94	95.72 ± 1.87	99.94 ± 0.21

Table 17
Correlation (*r*) Performance X Questionnaire Subscale

Factor	Baseline Performance	Mid-Season Performance	Post Max Training Performance	Taper Performance
POMS				
TMD	.092	.220	-.279	-.089
Fatigue	.257	.212	-.252	-.111
Vigor	.296	-.092	.236	-.275
Tension	.180	.435*	-.122	-.055
Depression	.071	.071	-.112	.017
Anger	.055	.250	-.177	-.256
Confusion	.022	-.139	-.414*	-.229
AEQ				
Confidence	.013	.001	-.234	.115
Dedication	.083	.298	.379	.271
Vigor	.230	.061	.387	.193
Enthusiasm	.253	.113	.307	.256

* Moderate Correlation

REFERENCES

Arruza, J. A., S. Telletxea, et al. (2009). "Understanding the relationship between perceived development of the competition plan and sport performance: mediating effects of self-efficacy and state depression." Percept Mot Skills **109**(1): 304-14.

Berger, B. G., J. R. Grove, et al. (1997). "Relationship of swimming distance, expectancy, and performance to mood states of competitive athletes." Percept Mot Skills **84**(3 Pt 2): 1199-210.

Coutts, A. J., L. K. Wallace, et al. (2007). "Monitoring changes in performance, physiology, biochemistry, and psychology during overreaching and recovery in triathletes." Int J Sports Med **28**(2): 125-34.

Hoffman, J. R., M. Bar-Eli, et al. (1999). "An examination of mood changes and performance in a professional basketball team." J Sports Med Phys Fitness **39**(1): 74-9.

Hooper, S. L., L. T. Mackinnon, et al. (1998). "Effects of three tapering techniques on the performance, forces and psychometric measures of competitive swimmers." Eur J Appl Physiol Occup Physiol **78**(3): 258-63.

Kellmann, M. and K. D. Gunther (2000). "Changes in stress and recovery in elite rowers during preparation for the Olympic Games." Med Sci Sports Exerc **32**(3): 676-83.

Lehmann, M., U. Gastmann, et al. (1992). "Training-overtraining: performance, and hormone levels, after a defined increase in training volume versus intensity in experienced middle- and long-distance runners." Br J Sports Med **26**(4): 233-42.

Lonsdale, Chris, Ken Hodge, and Thomas Raedeke. "Athlete Engagement: I. A Qualitative Investigation of Relevance and Dimensions." *Int. J. Sport Psychology* 38 (2007): 451-70.

Maslach, C., and S.E. Jackson. "Burnout in Organizational Settings." *Applied Social Psychology Annual* 5 (1984): 133-53.

Morgan, W. P., D. R. Brown, et al. (1987). "Psychological monitoring of overtraining and staleness." Br J Sports Med **21**(3): 107-14.

Morgan, W. P., D. L. Costill, et al. (1988). "Mood disturbance following increased training in swimmers." Med Sci Sports Exerc **20**(4): 408-14.

O'Connor, P. J., W. P. Morgan, et al. (1991). "Psychobiologic effects of 3 d of increased training in female and male swimmers." Med Sci Sports Exerc **23**(9): 1055-61.

Raglin, J. S., D. M. Koceja, et al. (1996). "Mood, neuromuscular function, and performance during training in female swimmers." Med Sci Sports Exerc **28**(3): 372-7.

Raglin, J. S., W. P. Morgan, et al. (1991). "Changes in mood states during training in female and male college swimmers." Int J Sports Med **12**(6): 585-9.

Schaufeli, W.B., M. Salanova, V. Gonzalex-Roma, and A.B. Bakker. "The Measurement of Engagement and Burnout: A Two Sample Confirmatory Factor Analytic Approach." *Journal of Happiness Studies* 3 (2002): 71-92

Shacham, Saya. "A Shortened Version of the Profile of Mood States." *Journal of Personality Assessment* 47.3 (1983): 305-06

Appendix A: UMCIRB APPROVAL

EAST CAROLINA UNIVERSITY
University & Medical Center Institutional Review Board Office
1L-09 Brody Medical Sciences Building• 600 Moye Boulevard • Greenville, NC 27834
Office 252-744-2914 • Fax 252-744-2284 • www.ecu.edu/irb

TO: Joseph Houmard, PhD; Dept. of Exercise and Sports Science; 363 Ward Sports Medicine; ECU

FROM: UMCIRB KWB

DATE: September 16, 2010

RE: Expedited Category Research Study

TITLE: "Comparison of mood states of distance and sprint swimmers"

UMCIRB #10-0464

This research study has undergone review and approval using expedited review on 09/16/2010. This research study is eligible for review under an expedited category number seven(7) which includes research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices, and social behavior), or research employing survey, interview, oral history, focus groups, program evaluation, human factors evaluation, or quality assurance methodologies. (NOTE: some research in this category may be exempt from the HHS regulations for the protection of human subjects 45 CFR 46.101(b)(2) and (b)(3). This listing refers only to research that is not exempt. The Chairperson (or designee) deemed this **unfunded** study **no more than minimal risk** requiring a continuing review in **12 months**. Changes to this approved research may not be initiated without UMCIRB review except when necessary to eliminate an apparent immediate hazard to the participant. All unanticipated problems involving risks to participants and others must be promptly reported to the UMCIRB. The investigator must submit a continuing review/closure application to the UMCIRB prior to the date of study expiration. The investigator must adhere to all reporting requirements for this study.

The above referenced research study has been given approval for the period of **09/16/2010** to **09/15/2011**. The approval includes the following items:

- Internal Processing Form (dated 08/23/2010)
- Protocol (UMCIRB rec'd date 09/01/2010)
- Informed consent (UMCIRB rec'd date 09/01/2010)
- Profile of Mood State Questionnaire (UMCIRB rec'd date 09/01/2010)
- Athlete Engagement Questionnaire (UMCIRB rec'd date 09/01/2010)

The Chairperson (or designee) does not have a potential for conflict of interest on this study.

The UMCIRB applies 45 CFR 46, Subparts A-D, to all research reviewed by the UMCIRB regardless of the funding source. 21 CFR 50 and 21 CFR 56 are applied to all research studies under the Food and Drug Administration regulation. The UMCIRB follows applicable International Conference on Harmonisation Good Clinical Practice guidelines.

IRB00000705 East Carolina U IRB #1 (Biomedical) IORG0000418
IRB00003781 East Carolina U IRB #2 (Behavioral/SS) IORG0000418
IRB00004973 East Carolina U IRB #4 (Behavioral/SS Summer) IORG0000418
Version 3-5-07

UMCIRB #10-0464
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APPENDIX B: INFORMED CONSENT

Title of Study: Comparison in Mood States of Distance and Sprint Swimmers

1907-2007
CENTENNIAL
East Carolina University

UNIVERSITY HEALTH SYSTEMS
of Eastern Carolina.

Informed Consent to Participate in Research

Information to consider before taking part in research that has no more than minimal risk.

Title of Research Study: Comparison of mood states of distance and sprint swimmers

Principal Investigator: Joseph Houmard, Ph.D.
Institution/Department or Division: Human Performance Lab, Department of Exercise & Sport Science
Address: 363 Ward Sports Medicine, Greenville 27858-4353
Telephone #: 737-4617

Researchers at East Carolina University (ECU) study problems in society, health problems, environmental problems, behavior problems and the human condition. Our goal is to try to find ways to improve the lives of you and others. To do this, we need the help of volunteers who are willing to take part in research.

Why is this research being done?
The purpose of this research is to observe the effects of different training types on mood states in college swimmers. The decision to take part in this research is yours to make. By doing this research, we hope to learn of changes in mood states that may occur due to the type (distance or sprint) of training and how this relates to performance

Why am I being invited to take part in this research?
You are being invited to take part in this research because you are a member of the 2010-2011 ECU swim team. If you volunteer to take part in this research, you will be one of about sixty people to do so.

Are there reasons I should not take part in this research?
I understand that I should not volunteer for this study if I am under 18 years of age or are not eligible to compete in the 2010-2011 swim season.

What other choices do I have if I do not take part in this research?
You can choose not to participate.

Where is the research going to take place and how long will it last?
The research procedures will be conducted at Minges. You will need to come to the pool 4 times during the study. The total amount of time you will be asked to volunteer for this study is 60 minutes over the next 5 months.

What will I be asked to do?
You are being asked to do the following: Fill out two questionnaires about how you have been feeling the previous two months at each of the four times. You will also have your skinfolds taken to measure body composition at baseline (September) and at the taper portion (January/February) of the swim season. Skinfolds will be taken using a caliper that lightly pinches the skin and subcutaneous (superficial layer of) fat.

UMCIRB Number: 10-0464

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UMCIRB Version 2010.05.01

UMCIRB
APPROVED
FROM 09/16/2010
TO 09/15/2011

______
Participant's Initials

What possible harms or discomforts might I experience if I take part in the research?
It has been determined that the risks associated with this research are no more than what you would experience in everyday life.

What are the possible benefits I may experience from taking part in this research?
We do not know if you will get any benefits by taking part in this study. This research might help us learn more about the effects of training programs on swimmers and their performance. There may be no personal benefit from your participation but the information gained by doing this research may help others in the future.

Will I be paid for taking part in this research?
We will not be able to pay you for the time you volunteer while being in this study.

What will it cost me to take part in this research?
It will not cost you any money to be part of the research. The sponsor of this research will pay the costs of: supplies needed for the questionnaires and skinfold assessments.

Who will know that I took part in this research and learn personal information about me?
To do this research, ECU and the people and organizations listed below may know that you took part in this research and may see information about you that is normally kept private. With your permission, these people may use your private information to do this research:

- The University & Medical Center Institutional Review Board (UMCIRB) and its staff, who have responsibility for overseeing your welfare during this research, and other ECU staff who oversee this research.
- The principal investigator and co-investigators

How will you keep the information you collect about me secure? How long will you keep it?
Each person will receive a number to identify the individual. The research team will have a record of all participants and their assigned number on a secured (password protected) file on a computer.

What if I decide I do not want to continue in this research?
If you decide you no longer want to be in this research after it has already started, you may stop at any time. You will not be penalized or criticized for stopping. You will not lose any benefits that you should normally receive.

Who should I contact if I have questions?
The people conducting this study will be available to answer any questions concerning this research, now or in the future. You may contact the Principal Investigator at (252) 737-4617 (days, between 8am and 5pm).

If you have questions about your rights as someone taking part in research, you may call the UMCIRB Office at phone number 252-744-2914 (days, 8:00 am-5:00 pm). If you would like to report a complaint or concern about this research study, you may call the Director of UMCIRB Office, at 252-744-1971.

I have decided I want to take part in this research. What should I do now?
The person obtaining informed consent will ask you to read the following and if you agree, you should sign this form:

- I have read (or had read to me) all of the above information.
- I have had an opportunity to ask questions about things in this research I did not understand and have received satisfactory answers.
- I know that I can stop taking part in this study at any time.
- By signing this informed consent form, I am not giving up any of my rights.

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FROM 09/10/2010
TO 09/15/2011

______ ***Participant's Initials***

- I have been given a copy of this consent document, and it is mine to keep.

Participant's Name (PRINT) **Signature** **Date**

Person Obtaining Informed Consent: I have conducted the initial informed consent process. I have orally reviewed the contents of the consent document with the person who has signed above, and answered all of the person's questions about the research.

Person Obtaining Consent (PRINT) **Signature** **Date**

APPENDIX C: POMS QUESTIONNAIRE

NAME ______________________________ DATE ______________________

SEX: Male Ⓜ Female Ⓕ Identification No. ______________________

Below is a list of words that describe feelings people have. Please read each one carefully. Then fill in ONE circle under the answer to the right which best describes HOW YOU HAVE BEEN FEELING DURING THE PAST WEEK INCLUDING TODAY.

The numbers refer to these phrases.

⓪ = Not at all
① = A little
② = Moderately
③ = Quite a bit
④ = Extremely

	Not at all	A little	Moderately	Quite a bit	Extremely
1. Tense	⓪	①	②	③	④
2. Angry	⓪	①	②	③	④
3. Worn out	⓪	①	②	③	④
4. Lively	⓪	①	②	③	④
5. Confused	⓪	①	②	③	④
6. Shaky	⓪	①	②	③	④
7. Sad	⓪	①	②	③	④
8. Active	⓪	①	②	③	④
9. Grouchy	⓪	①	②	③	④
10. Energetic	⓪	①	②	③	④
11. Unworthy	⓪	①	②	③	④
12. Uneasy	⓪	①	②	③	④
13. Fatigued	⓪	①	②	③	④
14. Annoyed	⓪	①	②	③	④
15. Discouraged	⓪	①	②	③	④
16. Nervous	⓪	①	②	③	④
17. Lonely	⓪	①	②	③	④
18. Muddled	⓪	①	②	③	④
19. Exhausted	⓪	①	②	③	④
20. Anxious	⓪	①	②	③	④
21. Gloomy	⓪	①	②	③	④
22. Sluggish	⓪	①	②	③	④
23. Weary	⓪	①	②	③	④
24. Bewildered	⓪	①	②	③	④
25. Furious	⓪	①	②	③	④
26. Efficient	⓪	①	②	③	④
27. Full of pep	⓪	①	②	③	④
28. Bad-tempered	⓪	①	②	③	④
29. Forgetful	⓪	①	②	③	④
30. Vigorous	⓪	①	②	③	④

MAKE SURE YOU HAVE ANSWERED EVERY ITEM.

SHORT FORM

A C D F T V

APPENDIX D: AEQ QUESTIONNAIRE

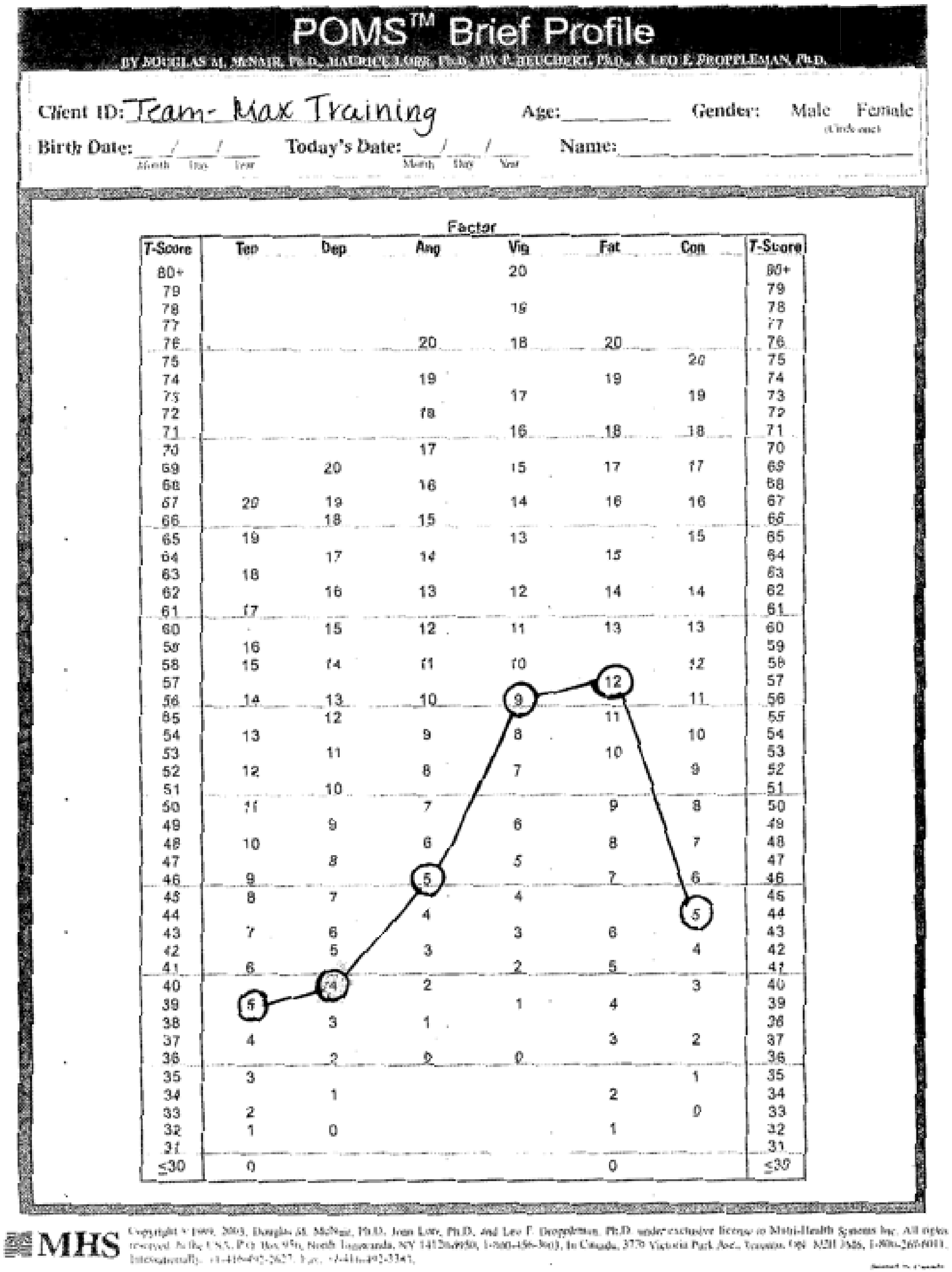
Athlete Engagement Questionnaire

How often have you felt this way in the past two months?

1= Almost Never 2= Rarely 3= Sometimes 4= Frequently 5= Almost Always

I believe I am capable of accomplishing my goals in swimming.	1 2 3 4 5
I feel capable of success in swimming.	1 2 3 4 5
I believe I have the skills/technique to be successful in swimming.	1 2 3 4 5
I am confident in my abilities.	1 2 3 4 5
I am dedicated to achieving my goals in swimming.	1 2 3 4 5
I am determined to achieve my goals in swimming.	1 2 3 4 5
I am devoted to swimming.	1 2 3 4 5
I want to work hard to achieve my goals in swimming.	1 2 3 4 5
I feel energized when I participate in swimming.	1 2 3 4 5
I feel energetic when I participate in swimming.	1 2 3 4 5
I feel really alive when I participate in swimming.	1 2 3 4 5
I feel mentally alert when I participate in swimming.	1 2 3 4 5
I feel excited about swimming.	1 2 3 4 5
I am enthusiastic about swimming.	1 2 3 4 5
I enjoy swimming.	1 2 3 4 5
I have fun swimming.	1 2 3 4 5

APPENDIX E: TEAM POMS PROFILE AT POST MAX TRAINING



APPENDIX F: TEAM POMS PROFILE AT TAPER