Psychological and Physiological Changes in Competitive State Anxiety During Noncompetition and Competitive Success and Failure[1]

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Abstract:

In this study we examined relationships among components of the Competitive State Anxiety Inventory-2 (cognitive worry, somatic anxiety, and self- confidence) to each other, to physiological measures, and to performance prior to, during, and after a bicycle competition. Undergraduate male students (N=24) participated in three counterbalanced conditions: (a) noncompetition, (b) success, and (c) failure. Participants completed the CSAI-2 at pre-, mid-, and postcompetition in each condition and frontalis muscle activity was recorded at those times. Results revealed that the cognitive and somatic components of state anxiety are moderately related to one another and change differently over time. Intraindividual regression analyses conducted to test relationships between anxiety and performance revealed no linear or curvilinear relationships between any of the CSAI-2 components and performance. The frontalis iEMG/performance relationship was best explained by a linear trend. The findings support the prediction that competitive state anxiety is a multidimensional construct with related components that are influenced differently by competitive conditions and task demands.

Article:

Although sport psychologists have devoted considerable attention to anxiety responses in reaction to threatening situations, such as sport competition, numerous questions remain concerning the dynamics of competitive anxiety and its relationship to performance. This lack of understanding may be due in part to the failure to employ multidimensional and sport-specific measures of anxiety (Burton, 1988; Martens, 1977).

Borkovec, Weerts, and Bernstein (1977) proposed anxiety as a multifaceted construct that involves three separate and interacting response components: psychological (e.g., cognitive worry, perceived somatic anxiety), physiological (e.g., rapid heartbeat, increased muscle tension), and behavioral (e.g., performance decrements, trembling). Adoption of a multifaceted conceptualization of anxiety requires the assessment of all three components (Baum, Greenberg, & Singer, 1982; Borkovec, 1976).

According to Liebert and Morris (1967), the psychological component of anxiety consists of cognitive worry and somatic anxiety subcomponents. They further postulated that cognitive worry and somatic anxiety change differently prior to and during performance evaluation. Specifically, somatic anxiety increases prior to evaluation but cognitive worry changes only when performance actually changes. Furthermore, cognitive worry was consistently inversely related to performance but somatic anxiety was related to performance only when cognitive worry was low (Morris & Liebert, 1970). These findings provide support for a multidimensional conceptualization of state anxiety.

In addition to conceptualizing state anxiety as a multidimensional construct, several researchers advocate using situation-specific assessments of anxiety (Martens, 1977; Sarason, 1978). Within sport, Martens, Burton, Vealey, Bump, and Smith (1983) developed a sport-specific, multidimensional measure of state anxiety, the

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Competitive State Anxiety Inventory-2 (CSAI-2). The CSAI-2 assesses cognitive worry and somatic anxiety, two components of competitive state anxiety, and self-confidence.

Researchers have continually supported the multidimensional nature of competitive state anxiety since the initial development of the CSAI-2. However, studies have contradicted each other when examining changes in competitive state anxiety prior to, during, and after competition. Gould, Petlichkoff, and Weinberg (1984), for example, found that somatic anxiety and cognitive worry changed differently prior to a wrestling competition and a volleyball tournament. Somatic anxiety increased prior to competition but cognitive worry and self-confidence remained stable. However, Karteroliotis and Gill (1987) found that cognitive worry and somatic anxiety followed similar temporal patterns prior to and during competition. Additionally, events associated with, competition (e.g., feedback, spectators) and knowledge of results, particularly snccess and failure feedback, may influence anxiety levels. That is, successful performers are likely to decrease in state anxiety and unsuccessful performers are likely to increase (Martens & Gill, 1976; Scanlan, 1977; Scanlan & Passer, 1979).

The current study examined changes in the components of state anxiety across conditions of competitive success, competitive failure, and noncompetition during a cycling task. We predicted that state anxiety reactions in the competitive failure condition would be greater than state anxiety reactions in the competitive success condition. Additionally, state anxiety reactions in the competitive conditions should be greater than state anxiety reactions in the noncompetitive condition.

In addition to psychological assessments, physiological assessments provide further information about the nature of state anxiety. Physiological assessments of anxiety such as heart rate, respiration rate, muscle tension, palmar sweating, and blood pressure may permit the inference of psychological processes and emotional states (Fenz & Jones, 1972; Hatfield & Landers, 1983; Weinberg & Hunt, 1976). Additionally, Martens et al. (1983) and Gould et al. (1984) suggested that somatic anxiety as assessed by the CSAI-2 and physiological measures of anxiety should increase similarly prior to and during a competition. Thus, in this study we predicted a positive correlation between a physiological measure of anxiety and somatic anxiety.

In the present study the physiological measure examined was frontalis muscle activity. We chose this measure because the muscle was not directly involved in the task performed, thereby reducing artifacts produced by the physical activity. Additionally, Smith (1973) reported that frontalis muscle activity is correlated with psychological measures of anxiety and is less affected by posture and gravity than other muscles (Blais & Vallerand, 1986).

In addition to psychological and physiological components of anxiety, researchers are interested in the effects of anxiety on behavior and sport performance. Past research supports the inverted-U hypothesis, which predicts that athletes perform best when anxiety is moderate and that performance deteriorates when anxiety increases or decreases from this optimal level (Burton, 1988; Sonstroem & Bernardo, 1982; Weinberg & Genuchi, 1980). Furthermore, individuals may respond differently to anxiety-producing situations and have different optimal arousal levels. Thus, Sonstroem and Bernardo (1982) recommended that researchers use intraindividual analyses, which control between-subject variance, when examining the anxiety/performance relationship. Consistent relationships between anxiety and performance have been found when variations around each individual's own optimal level of state anxiety were examined (Sonstroem & Bernardo, 1982). Individuals performed best under moderate levels of arousal, and performance deteriorated when arousal levels were either too high or low.

Recently, studies of the inverted-U relationship between anxiety and performance have conceptualized anxiety as a multidimensional construct (Burton, 1988; Gould, Petlichkoff, Simons, & Vevera, 1987). Using an intraindividual analysis, Burton (1988) found that swimming performance decreased linearly with increases in cognitive worry, increased linearly with self-confidence, and demonstrated an inverted-U relationship with somatic anxiety. However, Gould et al. (1987) found no relationship between cognitive worry and pistol shooting performance, and a negative linear trend between self-confidence and performance. The differences in the results of these studies could be due to differences in cognitive and performance demands of the two tasks.

The purpose of the present study was to examine relationships of psychological and physiological components of state anxiety to one another and to performance prior to, during, and after competition. In general, it was predicted that anxiety is a multifaceted and multidimensional construct that consists of psychological and physiological components that are moderately related to each other and change differently over time. Furthermore, each component is influenced differently by competitive conditions and uniquely related to performance.

Four major hypotheses were examined. First, we hypothesized that cognitive worry, somatic anxiety, and self-confidence are moderately related to one another prior to, during, and after competition. Second, the psychological measure, somatic anxiety, relates to the physiological measure, frontalis iEMG. Third, cognitive worry and somatic anxiety are higher and self-confidence is lower in the failure condition than in the noncompetitive and competitive success conditions. Fourth, we hypothesized a negative linear relationship between cognitive worry and performance, a curvilinear relationship between somatic anxiety and frontalis iEMG with performance, and a positive linear relationship between self- confidence and performance.

Method

Subjects and Design

Twenty-four male undergraduates ranging from 18 to 25 years of age, who were enrolled in physical education classes and had had athletic experience in high school, volunteered to participate in the experiment. An institutional review board for the protection and welfare of human subjects approved the experimental protocol and participants were acquainted with all aspects of the study before consenting to participate. All participants performed a bicycle task across three conditions: noncompetition, competitive success, and competitive failure, with each condition performed on a separate day and the order of conditions counterbalanced across participants.

Dependent Measures

Competitive State Anxiety. Competitive state anxiety was assessed with the Competitive State Anxiety Inventory-2 (CSAI-2; Martens et al., 1983). The 27-item inventory assesses two components of state anxiety, cognitive worry and somatic anxiety, and a related construct, self-confidence. Reliability coefficients for the CSAI-2 subscales range from .70 to .90 (Martens et al., 1983).

Electromyographic Assessment of the Frontalis Muscle. Muscle action potentials (MAP) represent the amount of electrical activity within a muscle. The integration of MAPS provide a measure of total electrical activity of the muscle as some function of time. In this study, integrated electromyograms (iEMG) were monitored using bipolar surface disc electrodes applied over the frontalis, in accordance with the procedures used by Waters, Williamson, Bernard, Blouin, and Faulstich (1987). After the skin surface was cleansed with alcohol, electrodes were attached 1 inch above each eyebrow, centered above the pupil of the eye while the subject gazed forward. Electrical resistance between a pair of electrodes was kept under 10,000 ohms.

Frontalis muscle activity was measured on a Coulbourn high gain bio- amplifier with the gain set at 10,000 x (x represents times) and the time constant at 10 volt seconds. The output was subsequently channeled through a digital converter and displayed on a readout meter providing iEMG values over 5-sec intervals. The iEMG (microvolts/sec) data analyzed in the present study were the averages of the 5-sec recordings across 2-min periods allotted for completion of the CSAI-2 at precompetition, midcompetition, and postcompetition during each of the three conditions.

Performance. Performance scores consisted of the number of revolutions completed during the cycling trials. One point was counted for every five revolutions. The total number of points accumulated over the trial was the participant's score.

Procedures

Task. Each individual bicycled as fast as possible for two 45-sec trials in each condition. Two Quinton Monarch bicycle ergometers with the tension set at 2 KP were placed side by side. The ergometers, separated by a partition, were wired to a portable scoreboard via a manipulation panel. The scoreboard, placed directly in front of the riders, allowed them to see their own and their opponent's score as well as the time elapsed in each trial. In the noncompetition condition the participant rode one of the bicycles alone, while in the competitive success and competitive failure conditions a confederate rode the other bicycle.

In the success and failure conditions the score of the losing rider was electronically manipulated to register only 80% of his score. After the first 45-sec trial, at midcompetition, to reinforce the success/failure feedback of the scoreboard, the experimenter told the participant that he was winning/losing the competition. At the end of the second 45-sec trial, the experimenter told the participant that he had won/lost the competition.

Testing Procedures. For each condition, after the individual entered the laboratory, surface electrodes were applied at the appropriate sites of the frontalis muscle. The confederate followed the same procedures and had a strap with electrodes secured around his chest so the subject would believe that multiple physiological measures were being assessed.

The experimenter informed participants that they were to complete two 45-sec trials on the bicycle and would be allowed a 2-min rest between trials. Participants were instructed to pedal as fast as possible in order to achieve a high score. They then warmed up with 2 minutes of light cycling. After the warm-up was completed, the CSAI-2 was administered (precompetition). Participants also completed the CSAI-2 after the first 45-sec trial (midcompetition) and after the second 45-sec trial (postcompetition). During the success and failure conditions, participants completed the CSAI-2 at midcompetition and postcompetition after the experimenter verbally provided win/loss feedback. Following completion of the first condition, participants returned the following 2 days to complete the remaining conditions.

Results

Correlations Among Measures

Correlations among the CSAI-2 subcomponents were calculated to test the hypothesis that the CSAI-2 subcomponents are moderately related to one another. The results, presented in Table 1, indicated that cognitive worry, somatic anxiety, and self-confidence were moderately related. This supports the multidimensional nature of competitive state anxiety and corroborates previous research (Gould et al., 1984; Martens et al., 1983).

Correlations between frontalis iEMG values and somatic anxiety scores were calculated to test the hypothesis that the physiological and psychological measures of anxiety are related. The results, presented in Table 1, revealed significant correlations between somatic anxiety and frontalis iEMGs only at midcompetition and postcompetition in the noncompetition condition. The results supported the hypothesis only for noncompetition and not in the competition conditions. This finding may be due to low levels of anxiety at noncompetition and reporting physiological arousal from the task as somatic anxiety.

Table 1

Intercorrelations Among CSAI–2 Subcomponent Scores and Somatic Anxiety With Frontalis iEMGS

	Intercorrelations			
	Cognitive worry and somatic anxiety *r*	Cognitive worry and self-confidence *r*	Somatic anxiety and self-confidence *r*	Somatic anxiety and frontalis iEMG *r*
Noncompetition				
Pre	.24	–.40*	–.34	–.03
Mid	.64**	–.31	–.39	.45*
Post	.46*	–.50**	–.34	.46*
Success				
Pre	.42*	–.42*	–.48*	–.23
Mid	.69**	–.50**	–.36	.10
Post	.28	–.38	–.18	.33
Failure				
Pre	.33	–.19	–.59**	–.28
Mid	.58**	–.40*	–.35	.14
Post	.54**	–.57**	–.32	.09

Note. *$p<.05$; **$p<.01$.

Changes in Psychological and Physiological Measures

A Time x Condition x Order (3 x3 x 6) repeated-measures MANOVA was conducted to examine whether the order of conditions affected CSAI-2 subscale scores. The overall MANOVA revealed no significant order main effect or interactions of order with time or condition. The same analysis was conducted with iEMG values and revealed no significant order main effect or interactions. Thus, changes in anxiety were not influenced by the order of conditions, and order will not be considered in subsequent analyses.

A Time x Condition (3 x 3) repeated-measures MANOVA on the three CSAI-2 subscale scores was conducted to examine changes over time and conditions. This overall MANOVA revealed a significant time effect, $F(6,88)=5.68$, $p<.001$, a significant condition effect, $F(6,88)=6.36$, $p<.001$, and an interaction, $F(12,238)=4.01$, $p<.001$.

Table 2 presents means and univariate results from CSAI-2 changes over time. Single-degree-of-freedom univariate contrasts revealed that somatic anxiety significantly increased from precompetition (M=12.60) to midcompetition (M=15.17) and from precompetition to postcompetition (M=15.88). Self- confidence significantly decreased from precompetition (M=28.57) to midcompetition (M=26.83) and from precompetition to postcompetition (M=26.95).

Table 3 presents means and univariate results for CSAI-2 changes over conditions. Univariate contrasts revealed that cognitive worry was significantly

Table 2

CSAI–2 and Frontalis iEMGs Means and Univariate Results for Time

Dependent measure	Precompetition *M*	*SD*	Midcompetition *M*	*SD*	Postcompetition *M*	*SD*	*F*	*p*
Cognitive worry	11.83	3.44	12.42	4.36	12.17	4.13	1.74	n.s.
Somatic anxiety	12.60	3.48	15.17	3.86	15.82	3.74	15.88	.001
Self-confidence	28.57	4.98	26.83	5.52	26.95	5.66	10.88	.001
Frontalis iEMG (microvolts/sec)	22.75	27.61	21.93	25.20	24.52	31.57	.60	n.s.

Table 3

CSAI–2 and Frontalis iEMGs Means and Univariate Results for Condition

Dependent measure	Noncompetition *M*	*SD*	Success *M*	*SD*	Failure *M*	*SD*	*F*	*p*
Cognitive worry	11.18	3.15	11.85	3.70	13.39	5.06	6.58	.001
Somatic anxiety	13.72	3.36	14.97	3.72	14.49	3.99	3.04	n.s.
Self-confidence	28.39	5.02	28.32	5.63	25.64	5.52	11.98	.001
Frontalis iEMG (microvolts/sec)	21.42	35.01	25.88	26.67	21.88	22.70	.32	n.s.

higher in the competitive failure condition (M=13.39) than the noncompetition condition (M=11.18). Self-confidence in the noncompetition condition (M=28.39) was significantly greater than in the competitive failure condition (M=25.64).

Time-by-condition interactions are illustrated in Figures 1, 2, and 3, which show the changes in CSAI-2 scores over time separately for each condition. Univariate analyses revealed a significant time-by-condition interaction for cognitive worry, $F(4,92)=9.93$, $p<.001$. Tukey's post hoc test revealed that cognitive worry significantly increased from precompetition (M=11.33) to postcompetition (M=14.54) in the competitive failure condition. This increase in cognitive worry may result from the negative visual and verbal feedback provided when losing the competition. In the competitive success condition, cognitive worry significantly decreased from precompetition to postcompetition, possibly because of the positive visual and verbal feedback associated with winning.

The time-by-condition interaction for self-confidence was also significant, $F(4,92)=7.91$, $p<.001$. Self-confidence significantly decreased from precompetition (M=28.46) to postcompetition (M=23.67) in the competitive failure con-

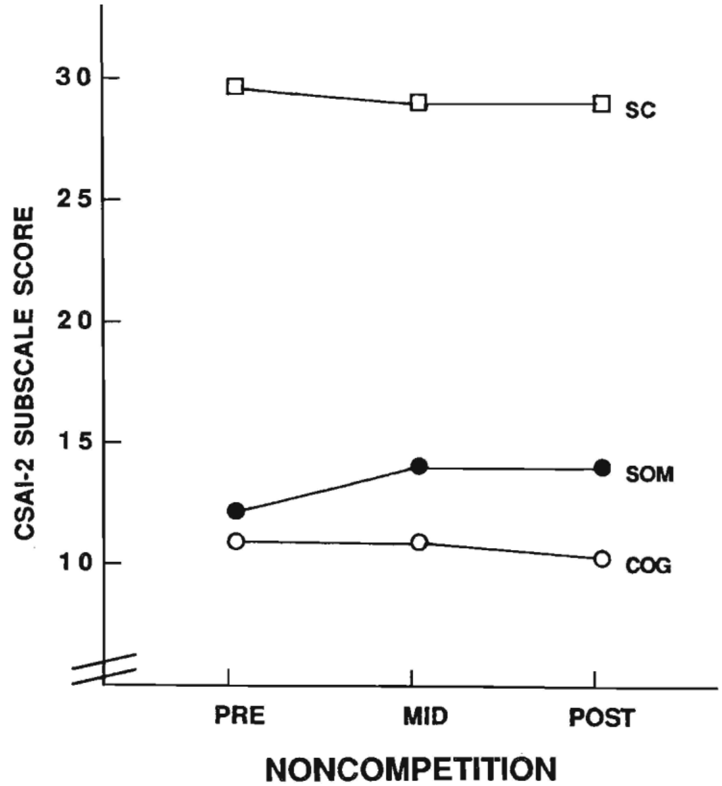

Figure 1 — Temporal changes in competitive state anxiety during noncompetition.

dition, possibly as a result of the negative evaluation associated with losing the competition. In the noncompetition condition, self-confidence significantly decreased from precompetition (M=29.00) to midcompetition (M=27.67), possibly due to the absence of feedback and uncertainty about the criterion for good performance.

A Time x Condition (3 x 3) repeated-measures MANOVA conducted to examine the temporal changes in frontalis iEMG values revealed no significant changes across conditions, $F(2,46) = .32$, $p = .73$, or time, $F(2,46) = .60$, $p = .55$. The nonsignificant results may be explained by large amounts of variance observed in iEMG values, which may reflect individual response differences (Lacey, Bateman, & Van Lehn, 1953).

For performance scores, a Time x Condition x Order (2 x 3 x 6) repeated- measures ANOVA conducted to consider possible sequence effects revealed a significant order-by-condition effect, $F(10,34)=2.61$, $p<.05$. However, a Time x Condition (2 x 3) repeated-measures ANOVA on performance scores indicated no significant condition, time, or interaction effect. Thus, the order-by-condition effect reflects a change over sessions but has no bearing on the time and condition

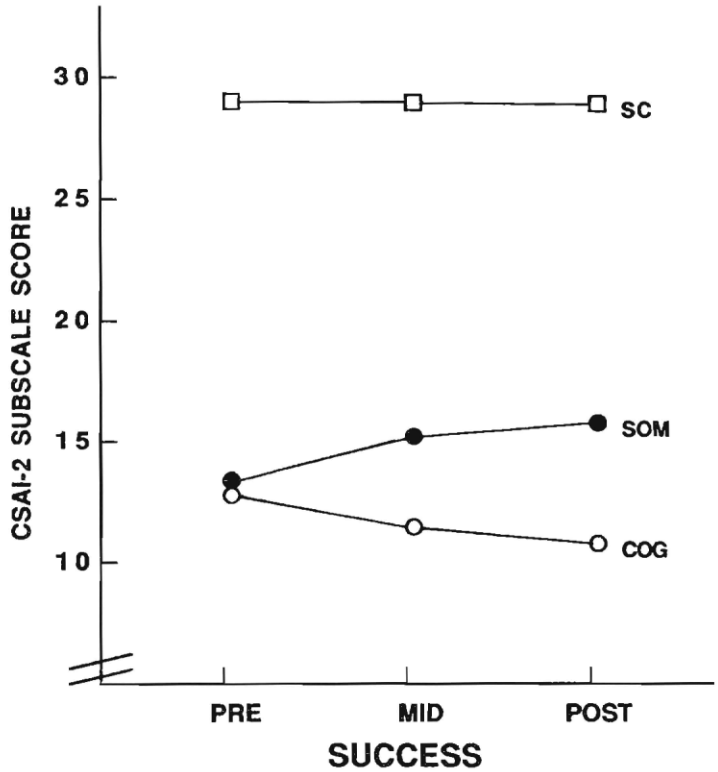

Figure 2 — Temporal changes in competitive state anxiety during competitive success.

effects that are the focus of this investigation. A possible explanation for the lack of effects is the nature of the task. The short duration, low complexity task may not have been influenced by changes in state anxiety levels (Landers & Boutcher, 1986).

Psychological and Physiological Measures and Performance

Pearson product-moment correlations were conducted to examine the relationships of performance to cognitive worry, somatic anxiety, self-confidence, and frontalis iEMGs. Results revealed only a significant negative correlation between self-confidence and performance at midcompetition in the failure condition (see Table 4).

The results are inconsistent with Burton (1988), who reported significant correlations for cognitive worry and self-confidence with performance. The lack of correlations in the present study may be due to the task or factors other than performance scores influencing competitive state anxiety (e.g., social and self- evaluation, negative feedback).

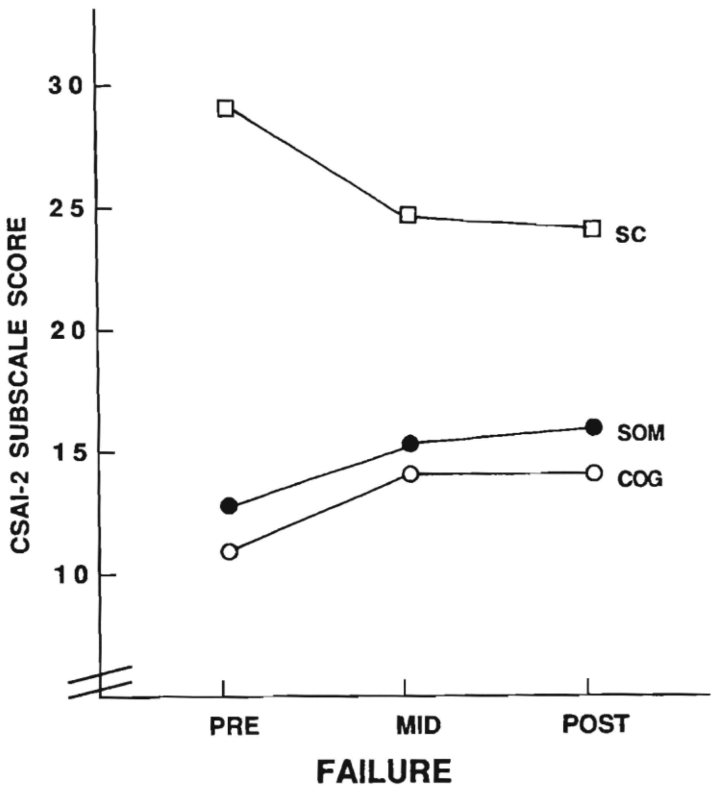

Figure 3 — Temporal changes in competitive state anxiety during competitive failure.

Intraindividual Polynomial Trend Analyses

Using intraindividual multiple regression analyses (Sonstroem & Bernardo, 1982), the relationships of CSAI-2 subscale scores and frontalis iEMGs with performance were examined to determine possible linear or curvilinear trends between anxiety and performance. Means and standard deviations were calculated for each individual's CSAI-2 and frontalis iEMG scores for each condition (non- competition, competitive success, competitive failure) and at each time of assessment (pre, mid, post), and for first and second half performance for each condition. Intraindividual standard scores were then computed for each CSAI-2 subscale, frontalis iEMGs, and performance scores to negate between-subject response variation. Separate polynomial trend analyses were then used to test for linear or curvilinear relationships between precompetition and midcompetition standardized subscale scores and iEMG values with the first half and second half intraindividual performance scores.

Results revealed no interpretable linear or curvilinear trends between cognitive worry, somatic anxiety, or self-confidence and performance. At midcompe-

Table 4

Correlations of CSAI–2 Subscale Scores and Frontalis iEMGs With Performance

Performance	Cognitive worry *r*	Somatic anxiety *r*	Self-confidence *r*	iEMG *r*
Noncompetition				
PERF 1	−.17	.08	.21	.17
PERF 2	.19	.29	−.12	.16
Success				
PERF 1	−.08	.17	−.12	.34
PERF 2	−.15	−.11	−.25	.33
Failure				
PERF 1	−.14	−.11	.09	.15
PERF 2	.17	.28	−.39*	.13

Note. PERF 1 scores are correlated with precompetition state anxiety scores and PERF 2 scores are correlated with midcompetition state anxiety scores.
*$p<.05$.

tition, frontalis iEMG was significantly related to second half performance and was best explained as a positive linear trend, $F(1,23)=8.77$, $p<.01$, $R^2=.29$. Thus the hypothesized linear and curvilinear trends between anxiety and performance were not supported except for a linear trend between frontalis iEMGs and performance at one time.

Although the correlation results discussed earlier revealed no significant correlations between frontalis iEMGs and performance, the intraindividual trend analysis, which negates the wide individual response variance present in the iEMG raw scores, did reveal a linear trend. The linear trend between frontalis iEMGs and performance may be accounted for by the nature of the task. Specifically, the task required an all-out effort for 45 seconds, therefore high levels of physiological arousal were probably necessary and a result of performing the task.

Discussion

The results of this investigation confirmed that state anxiety is a multidimensional construct consisting of psychological and physiological components that are moderately related to one another and change differently over time. Furthermore, subcomponents are influenced differently by competitive conditions and task demands.

Correlations Among Measures

Researchers (Gould et al., 1984; Karteroliotis & Gill, 1987; Martens et al., 1983) have found that cognitive worry and somatic anxiety are separate but related to one another in highly competitive situations. The moderate relationships found among anxiety subcomponents in the present study were consistent with this previous research.

The moderate positive correlations between cognitive worry and somatic anxiety, as well as the moderate negative correlations between cognitive worry and self-confidence, and somatic anxiety and self-confidence support the concept of the CSAI-2 as a multidimensional anxiety measure with separate subscales.

Physiological measures may allow for the inference of psychological processes and emotional states (Hatfield & Landers, 1983). In this study, the influences of psychological variables (e.g., state anxiety, feedback) upon physiological responses (i.e., frontalis muscle tension) were examined but few relationships were found. Somatic anxiety and frontalis iEMGs were related only in the noncompetition condition. Several explanations may be offered to account for the lack of significant correlations between psychological and physiological measures during the success and failure conditions.

Deffenbacher (1980) stated that perceived physiological responses (e.g., somatic anxiety) and physiological responses (e.g., heart rate, muscle tension) should not be considered synonymous because they affect performance differently. Perceived physiological arousal and actual physiological arousal may be separate components that are affected differently within competitive situations. The results of the present study support Deffenbacher's contention.

Another difficulty is that electromyography records muscle activity, or arousal, which may not reflect anxiety. In the present study, task demands may have created high levels of physiological arousal (e.g., increased heart rate, increased muscle tension) that may have been interpreted as perceived physiological arousal (e.g., somatic anxiety). Thus, while assessment of physiological indices is important for further understanding competitive state anxiety, perhaps multiple physiological measures in addition to psychological and behavioral measures during competition will provide greater information.

Daily variations in emotional states and individual response stereotypy (Lacey et al., 1953) may also have contributed to the low correlations. Individuals tend to respond differently to stress; some may be heart rate responders while others are muscle tension responders. In the present study, the frontalis may have been a good indicator of muscle tension for some individuals but not for others.

Finally, several researchers have questioned the validity of the frontalis muscle as an indicator of general muscular tension (Alexander, 1975; McGowan, Haynes, & Wilson, 1979; Nidever, 1959). Graham et al. (1986) provided evidence that frontalis muscle EMG activity is responsive only to changes in head and neck muscles and does not correlate with exercise-induced changes in muscular tension in the rest of the body. Therefore the frontalis muscle may not be a valid indicator of general body tension, resulting in low correlations with psychological measures of anxiety.

Changes in Psychological and Physiological Measures

The present study revealed that competitive state anxiety changes across time and different competitive conditions. Cognitive worry decreased from precompetition to postcompetition in the success condition, possibly as a result of positive feedback. In the failure condition, cognitive worry increased from precompetition to postcompetition, possibly as a result of the negative feedback about performance. These findings support the hypothesis of Martens et al. (1983) that cognitive worry changes when failure occurs or performance expectations change.

In each condition, somatic anxiety increased from precompetition to mid- competition and from precompetition to postcompetition. These results contrast with those of Karteroliotis and Gill (1987), who found that somatic anxiety decreased at postcompetition. An explanation for the increase in somatic anxiety may lie in the demands of the task. Specifically, the 45-sec trial may have produced increased levels of physiological arousal and the somatic anxiety scores may reflect physiological arousal rather than perceived somatic anxiety.

The decrease in self-confidence from precompetition to postcompetition in the failure condition is consistent with Martens et al.'s (1983) predictions. Self- confidence decreased as a result of negative feedback provided during the failure condition. The negative feedback may be perceived as threatening information, indicating negative evaluation by others, resulting in a lack of confidence in ability to perform successfully in later situations (Scanlan, 1977).

The temporal changes in cognitive worry, somatic anxiety, and self- confidence supported the prediction that state anxiety is a multidimensional construct that changes over time and conditions. If state anxiety were unidimensional, each subcomponent would have shown similar fluctuations during the competition; rather, each displayed different changes over time. Success and failure experiences and feedback are powerful influences on state anxiety that serve to alter anxiety levels.

Psychological and Physiological Measures and Performance

The results of this investigation did not support the predicted linear or curvilinear relationships between anxiety and performance. The frontalis iEMG/ performance relationship was best explained by a positive linear trend.

Other studies have supported relationships among anxiety measures and performance. For example, Burton (1988) reported significant correlations between performance and both cognitive worry and self-confidence. The task in the present study was not cognitively demanding nor did it require complex motor skills that would lead to performance impairment as a result of anxiety. Additionally, the contrived competition did not induce high levels of anxiety. Anxiety levels in the present study were lower than state anxiety levels reported by Gould et al. (1987), Karteroliotis and Gill (1987), and Martens et al. (1983).

Thus the relationship between anxiety and performance remains elusive. Because competitive state anxiety changes differently over time and conditions, future research should attempt to discern the influences of success and failure on performances within actual competitive settings. More important, despite some limitations, the use of multimethod experimental designs is also encouraged and may further elucidate the nature of competitive state anxiety.

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