Temporal Changes in Psychological and Physiological Components of State Anxiety

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Abstract:
This study examined the relationships of cognitive worry, somatic anxiety, and self-confidence—all components of the CSAI-2 (Competitive State Anxiety Inventory-2)—to each other, to physiological measures, and to motor performance prior to, during, and after competition. In addition, the prediction that only somatic anxiety increases prior to competition was examined. Forty-one undergraduate males competed in a motor task while the experimenter monitored heart rate and blood pressure responses. Each subject competed against a confederate for 10 experimental trials and completed the CSAI-2 prior to, during, and after the competition. The results confirmed the multidimensional nature of the state anxiety construct and provided evidence for the independence of cognitive worry and somatic anxiety. However, both dimensions followed similar temporal patterns prior to and during competition. Finally, the results confirmed the nonsignificant relationship between psychological and physiological measures of anxiety.

Article:
One of the issues that pervades anxiety research, as well as research of other global internal states such as fear and depression, is its measurement. Historically, two principal methods have been used to measure anxiety. The first method involves a number of paper-and-pencil, self-report measures that question respondents about such things as how they feel and their views on psychological constructs. The second method involves physiological assessment of an individual. Although a large number of investigators have used these two anxiety measures, either separately or in combination, gaps persist in our knowledge about the nature of anxiety. These gaps may exist because correlations between the two types of measurement are very weak (Bloom, Houston, & Burish, 1976; Bond, James, & Lader, 1974; Morrow & Labrum, 1978; Winter, Ferreira, & Ranson, 1963).

In an effort to develop more reliable and valid measurements of anxiety, some psychologists have come to view anxiety as a complex multidimensional construct that involves three separate but interacting response components (Borkovec, 1976; Borkovec, Weerts, & Bernstein, 1977; Lang & Lazovik, 1963). These investigators have commented that anxiety is not an undifferentiated internal state but rather a more complex multidimensional construct that involves a set of psychological (e.g., worry), physiological (e.g., rapid heart rate, clammy hands), and behavioral (e.g., restlessness, trembling, overt performance) response components. Although a number of researchers (Bellack & Hersen, 1977; Cone, 1979; Hugdahl, 1981) have questioned the validity of this multidimensional system by indicating the absence of synchrony among these three anxiety indices, a number of other researchers continue to propose that this assessment technique ensures more valid and accurate measures of anxiety (Baum, Grunberg, & Singer, 1982; Borkovec, 1976; Lang, 1968).

Proponents of the three-response system have suggested that this model allows for the categorization of individuals according to specific response patterns (Bellack & Lombardo, 1984). Furthermore, they have proposed that the discrepancies among measurement indices may be due to (a) "the individual differences in response patterns of anxiety that are functionally important to the maintenance and reduction of anxiety," and (b) "the effects of current environmental variables on a particular response component" (Borkovec et al., 1977, p. 369). Unfortunately, the absence of relationships among the anxiety indices of the three- response system, as well as the other factors such as time and technique limitations, have led a number of researchers to rely on

unidimensional measures of anxiety that often lack high reliability and validity (Baum et al., 1982; Lacey, 1967).

Although controversy and confusion about the unidimensional or multidimensional methods for assessing anxiety continue, the conceptualization and measurement of anxiety using Spielberger's (1966) trait-state anxiety theory is widely accepted by investigators. Furthermore, a number of these researchers (Davidson & Schwartz, 1976; Liebert & Morris, 1967; Sarason, Davidson, Light- hall, Waite, & Ruebush, 1960; Schwartz, Davidson, & Goleman, 1978) have suggested that state anxiety is an internal construct with complex components.

Sarason and his colleagues (1960) labeled cognitive worry and emotional arousal as the two components of state anxiety. Liebert and Morris (1967) separated state anxiety into two major components, cognitive worry and somatic anxiety. According to their theory, cognitive worry and somatic anxiety are separate and elicited differently by various antecedent conditions. Furthermore, Liebert and Morris (1967) postulated that whereas somatic anxiety increases prior to evaluation or competition, cognitive worry does not change unless the individual's performance changes during this time. Finally, they found evidence that cognitive worry and somatic anxiety have different effects on intellectual and/or motor performance. Specifically, they suggested that cognitive worry consistently and strongly related (inversely) to performance (Deffenbacher, 1977; Liebert & Morris, 1967; Spiegler, Morris, & Liebert, 1968), whereas somatic anxiety related to performance only when cognitive worry was low (Doctor & Altman, 1969; Morris & Liebert, 1970).

On the basis of the conceptualization of state anxiety into at least two components, cognitive worry and somatic anxiety, Martens, Burton, Vealey, Bump, and Smith (1983) developed a sport-specific, multidimensional state anxiety inventory known as the Competitive State Anxiety Inventory-2 (CSAI-2). The CSAI-2 is a self-report questionnaire that includes 27 items. It has been found to assess accurately changes in cognitive worry, somatic anxiety, and self- confidence, all of which are separate components of competitive state anxiety.

Martens et al. (1983) conducted three studies with results indicating that the CSAI-2 measures the three separate components of state anxiety. Furthermore, the hypotheses that somatic anxiety increases prior to evaluation or competition and that cognitive worry is related to performance were confirmed. Recently Gould, Petlichkoff, and Weinberg (1984) conducted two field studies in an effort to provide additional evidence for the CSAI-2. The results from these two investigations supported the contention of Martens and his colleagues that the CSAI-2 measures three separate components of state anxiety. In addition, the hypothesis that somatic anxiety and cognitive worry would reveal different responses prior to and during competition was verified, but evidence for the relationships between performance and CSAI-2 subscale assessments was weak.

Although the results from the above studies suggest that the CSAI-2 is capable of assessing the cognitive worry, somatic anxiety, and self-confidence components of state anxiety independently, further studies are needed for a better understanding of the nature of each component of state anxiety. The somatic anxiety component, as measured by the CSAI-2, represents the perceived affective-autonomic responses of an individual rather than the actual physiological reactions per se. Thus, it seems reasonable to compare direct measures of physiological arousal (e.g., heart rate, blood pressure) to somatic anxiety scores on the CSAI-2. The work of Martens et al. (1983) and Gould et al. (1984) suggest that both CSAI-2 somatic anxiety and physiological measures should increase similarly immediately prior to competition and decrease during competition, but this has not been tested. Cognitive worry, in contrast, should show less relationship to physiological measures but a stronger relationship to performance and performance outcome during and after competition.

The purpose of the present study is to examine the nature of competitive state anxiety and its components. Specifically, this study uses the CSAI-2, a multidimensional sport-specific measure of A-state, to examine how the components of state anxiety are related to each other and to motor performance prior to, during, and after competition. In addition, the study incorporates the physiological measures of heart rate and blood pressure, and thus uses a multimethod approach to investigate anxiety and motor performance.

Three major hypotheses were examined. It was predicted that the components of the CSAI-2, cognitive worry, somatic anxiety, and self-confidence, are independent in that the three scores are moderately related to each other, but they relate differently to motor performance, and they show different temporal patterns prior to and during competition. First, an inverse relationship between cognitive worry and performance was expected, but somatic anxiety was not expected to relate to performance. Second, it was predicted that somatic anxiety increases prior to competition, whereas cognitive worry and self-confidence remain near baseline levels. Finally, physiological measures were expected to relate to somatic anxiety, but not to cognitive worry on the CSAI-2.

Method

Subjects and Design

A total of 41 male volunteers, ranging in age from 18 to 25 years, were recruited from physical education skills classes. All individuals who participated in the study were right-handed and had no history of cardiovascular diseases.

Trait and state anxiety, resting heart rate, and blood pressure were taken during a baseline session. State anxiety, heart rate, and blood pressure were also assessed at pre-, mid-, and postcompetition during a competitive session scheduled 1 week after the baseline session. Testing occurred mainly between 7 a.m. and 11 a.m., with the time of assessment approximately the same at baseline and at competition for each participant.

Task

The pegboard task consisted of a board (35.6 cm square) and three pegs (17.1 cm high and 1.27 cm in diameter) arranged in a triangular pattern with the base toward the performer. Seven rectangular blocks varying from 5 cm to 20 cm in length were stacked in pyramid fashion with the smallest block at the top and the largest block at the bottom. For the competitive session, two boards were set up on tables with a partition separating the two areas so that neither competitor could evaluate the other's performance.

The task required the individual to move the seven rectangular blocks one at a time from peg no. 1 to peg no. 2, stacking the blocks in reverse order. Then the individual moved the blocks from peg 2 to peg 3 and from peg 3 back to peg 1. Individuals were allowed to use only their right hand to move the rectangular blocks as quickly as possible. During the competition session, the subject tried to complete the task faster than the opponent, who was a confederate of the investigator. Two graduate and one undergraduate student who had trained for a week served as confederates in the competitive sessions. Three confederates were used because the experiment involved too many hours of work for one person, but all received similar training so that they could perform similarly in the experiment. To control possible effects from using more than one confederate, a partition was used to eliminate any interaction between the subject and the confederate. Also, the confederates and subjects were not acquainted prior to the study and were discouraged from interacting during the experiment.

Each trial during the baseline, pre-, mid-, and postcompetition sessions was timed with a Dekan Automatic Performance Analyzer (Dekan Timing Devices). The msec timer was wired with a start switch used by the investigator and one stop switch that was placed on the right side of the pegboard. During the baseline session the investigator began the timer by hitting the start switch, and the subject stopped the timer by hitting the stop switch upon completing the task.

Although two timers were used during the competition session, the time recorded for the confederate was not a true performance time. Bogus information was given to the competitors to manipulate the winning and losing ratio. The competitive session consisted of a total of 10 trials that were divided into two halves. The confederates had better scores than the subjects for the 1st, 3rd, 5th, 6th, 8th, and 10th trials. This sequence was selected in order to maintain a high level of uncertainty and competitive anxiety during all stages of competition.

Dependent Measures

Competitive State Anxiety Inventory-2. The CSAI-2 is a self-report measure designed by Martens and his colleagues (1983) to assess cognitive worry and somatic anxiety. However, development and psychometric testing of the CSAI-2 also yielded a third component, self-confidence, which is negatively correlated with cognitive worry and somatic anxiety. The CSAI-2 includes 27 items which are evaluated using a 4-point scale. Martens et al. (1983) have reported content, concurrent, and construct validity information by comparing the CSAI-2 with other validated anxiety inventories such as the Sport Competition Anxiety Test, the State-Trait Anxiety Inventory, and the Achievement Anxiety Test. In addition, they reported reliability coefficients for the CSAI-2 ranging from .79 to .90.

Sport Competition Anxiety Test. The Sport Competition Anxiety Test (SCAT; Martens, 1977) is a self-report inventory designed to assess competitive trait anxiety. It includes 10 competitive anxiety and 5 filler items that are evaluated using a 3-point scale. Martens reported strong reliability and validity for SCAT, and the measure has been used in considerable sport psychology research. The SCAT was given during the baseline session to assess competitive A-trait.

Heart Rate and Blood Pressure Assessment. In this study, blood pressure and heart rate recordings were obtained with an Infrasonde D4000 monitoring system. This recording device consists of a standard cuff containing a Korotkoff- sounds microphone and a microphone cable that is connected with the pump/recorder unit. Cuff inflation pressure is fixed to allow blood pressure readings to change automatically in relation to previous readings.

The validity of the Infrasonde D4000 recorder was examined by comparing its readings to those taken by a Hawksley blood pressure monitoring device (Zezulka, Sloan, Davies, & Beevers, 1986).

In the present investigation, both absolute and change scores were used. Blood pressure and heart rate change scores were calculated as change score = level during competition—baseline value. Readings were taken at 2-min intervals (at 1, 3, 5, 7, and 9 min) during a 10-min baseline period, and values of each physiological index were calculated as the mean of the last three readings. The first two readings were disregarded because early readings usually are less reliable.

Procedures

Upon entering the research site each participant was informed of the testing procedures, and informed consent was obtained for participation in this study. He was then fitted with the blood pressure and heart rate recording equipment. Prior to the experimental manipulation, the individual was requested to remain quietly seated for 10 minutes to allow him to become acclimated to the experimental environment and allow pretest assessment of physiological indices.

During the pretest assessment, blood pressure (systolic and diastolic) and heart rate readings were assessed during a 10-min resting period. Competitive trait anxiety and competitive state anxiety were then assessed by having each participant complete both the SCAT and the CSAI-2. After both questionnaires were filled out, the individual received instructions for performing the task and performed 5 baseline trials. Following this, blood pressure and heart rate readings were taken again to investigate possible physiological changes due to muscle tension that might have occurred from excessive movement. At the end of this session all individuals were asked to return to the laboratory 1 week later for the competitive portion of the study.

After arrival at the testing site on the day of competition, each subject was informed about the testing procedures. Following this he was asked to sit quietly for 10 minutes, after which readings of resting heart rate and blood pressure (systolic and diastolic) were taken for 10 minutes. Immediately following this, he completed the CSAI-2. Following these assessments each subject competed for 5 trials with a confederate. The experimenter signaled the competitors to begin by triggering a buzzer. Then the experimenter used a verbal signal to cue the confederate to terminate the competition at the appropriate time. The confederate won 3 out of

5 trials in the first half, to keep the score close. Both the confederate and the subject were told their performance scores after each trial.

After the first 5 trials, a 2-min resting interval was given in order to allow physiological reactivity to return to normal levels. Then heart rate and blood pressure readings were taken for 10 minutes. In addition, each individual was asked to fill out the CSAI-2 for a second time. After this the subjects were asked to concentrate more to perform better during the next 5 trials. After the second half, 5 trials were completed, with the confederate again winning 3 out of 5 trials, postcompetition measures were taken following the same procedures used at pre- and midcompetition.

Results

Correlations Among Measures

Table 1 gives the Pearson product-moment correlation coefficients between cognitive worry and somatic anxiety at each time of assessment. Results revealed moderate positive correlations (mean r = .50) between cognitive worry and somatic anxiety at baseline, precompetition, and midcompetition. Martens and his colleagues (1983) reported the same correlations (mean r = .50) in their field

Table 1

Correlations Between Cognitive Worry and Somatic Anxiety

	Cognitive worry			
	Baseline	Pre-	Mid-	Post
Somatic anxiety				
Baseline	.50*			
Pre-		.41*		
Mid-			.59*	
Post-				.03

*$P < .01$, no other correlations were significant at $p < .05$.

studies and Gould et al. (1984) also found similar correlation coefficients (mean r = .52) when they assessed competitive state anxiety the night before competition, before match 1, and before match 2 of a group of 37 intercollegiate wrestlers.

Correlations among the subcomponents of CSAI-2, cognitive worry, somatic anxiety, and self-confidence responses, and SCAT were not completely consistent with the previous findings in the field studies. As Table 2 indicates, significant correlations were found between cognitive worry and SCAT at baseline, midcompetition, and postcompetition, but somatic anxiety was significantly related to SCAT only at midcompetition. Martens et al. (1983) reported a high relationship between somatic anxiety and SCAT whereas Gould et al. (1984) found significant correlations only between cognitive worry and SCAT. Finally, SCAT was related negatively to self-confidence at mid- and postcompetition.

Table 2

Correlations of CSAI–2 Subcomponents and SCAT

Variables	Cognitive worry *r*	Cognitive worry *p*	Somatic anxiety *r*	Somatic anxiety *p*	Self-confidence *r*	Self-confidence *p*
SCAT						
Baseline	.40	.01	.18	ns	–.17	ns
Pre-	.20	ns	.24	ns	–.14	ns
Mid-	.37	.01	.35	.02	–.32	.02
Post-	.36	.01	.12	ns	–.28	.05

In contrast to the significant relationships found among the psychological measures, only 5 of the 21 correlations among the three physiological measures were found to be statistically significant. The Pearson product-moment correlations revealed that HR and DBP responses were significantly correlated at baseline (r = .40, $p < .01$), midcompetition (r = .45, $p < .01$), and postcompetition (r = .42, $p < .01$). Also, a low significant relationship between SBP and DBP was demonstrated (r = .28, $p < .05$) at postcompetition. Finally, the results indicated that only the HR and DBP change scores were correlated (r = -.29, $p < .05$) at postcompetition. In general, the results of the present study are consistent with the findings of other research studies that reported an absence of relationships among physiological measures (Bond et al., 1974; Lacey & Lacey, 1958; Morrow & Labrum, 1978; Tyrer & Lader, 1976).

Finally, correlations between psychological (somatic anxiety) and physiological measures (HR, HR change scores, SBP, SBP change scores, DBP, and DBP change scores) were not significant at any stage of assessment. Thus, while the psychological measures of competitive state anxiety were found to be moderately interrelated, the physiological measures were not significantly correlated with either psychological measures or each other.

Temporal Changes in Psychological and Physiological Measures

A one-way MANOVA was conducted to examine differences between the two baseline measures of HR, SBP, and DBP taken in this investigation. The overall MANOVA was not significant, indicating that there was no statistical difference between the two baseline measures. Thus the muscle activity involved in performing the task did not seem to influence physiological anxiety measures, and only the first baseline measures are used in the analysis reported here.

Martens et al. (1983) suggested that the components of state anxiety, cognitive worry, somatic anxiety, and self-confidence change separately as the time of competition approaches. Specifically, they proposed that cognitive worry and self-confidence show almost no changes prior to competition, whereas somatic anxiety increases prior to competition and peaks at the beginning of competition.

In the present study the temporal changes in the dimensions of state anxiety, illustrated in Figure 1, were examined by conducting a one-way repeated measures MANOVA with the three CSAI-2 scores as the dependent variables. The assessment times—baseline, pre-, mid-, and postcompetition—were used as levels of the independent variable. The overall MANOVA was significant, $F(9, 287) = 3.40$, $p < .001$. A follow-up analysis of univariate planned comparisons of each adjacent pair of measures revealed that cognitive worry significantly increased from precompetition ($M = 13.14$) to midcompetition ($M = 14.80$), F(1, 40) =

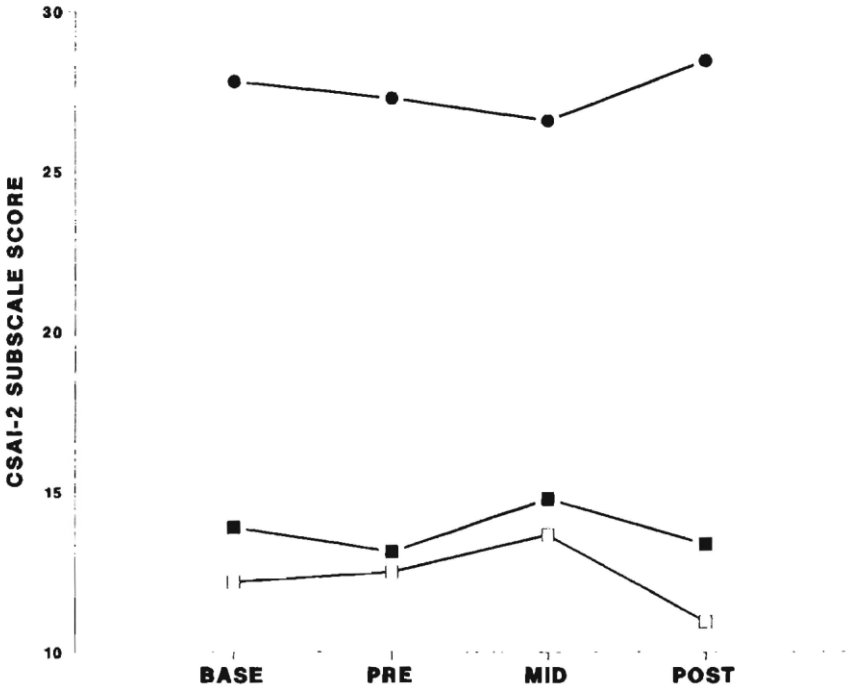

Figure 1 — Temporal changes in CSAI–2 subscale scores. ■ = cognitive worry; □ = somatic anxiety; ● = confidence.

7.15, $p < .01$, and significantly decreased from midcompetition to postcompetition ($M = 13.39$), $F(1, 40) = 5.20$, $p < .05$. Furthermore, somatic anxiety increased from precompetition ($M = 12.51$) to midcompetition ($M = 13.68$), $F(1, 40) = 4.60$, $p < .05$, and significantly decreased from mid- to postcompetition ($M = 10.97$), $F(1, 40) = 24.60$, $p < .001$. Finally, it was found that self- confidence significantly increased from midcompetition ($M = 26.65$) to post- competition ($M = 28.53$), $F(1, 40) = 7.46$, $p < .01$.

A one-way MANOVA with repeated measures was also condncted on the dependent variables of HR, SBP, and DBP. The overall MANOVA was significant, $F(9, 287) = 5.94$, $p < .001$. A follow-up analysis of univariate planned comparisons of each adjacent pair of physiological measures revealed that HR significantly increased from baseline ($M = 68.19$) to precompetition ($M = 70.48$), $F(1, 40) = 4.98$, $p < .03$. HR also significantly increased from pre- to midcompetition ($M = 73.03$), $F(1, 40) = 6.17$, $p < .02$. Furthermore, results revealed that SBP significantly increased from baseline ($M = 114.9$) to precompetition ($M = 116.9$), $F(1, 40) = 4.56$, $p < .05$. Finally, DBP significantly increased from precompetition ($M = 62.14$) to midcompetition ($M = 64.74$), $F(1,40) = 9.97$, $p < .002$. Thus, as Figure 2 illustrates, physiological indices generally increased from baseline to precompetition, and from precompetition to midcompetition, and did not change from mid- to postcompetition.

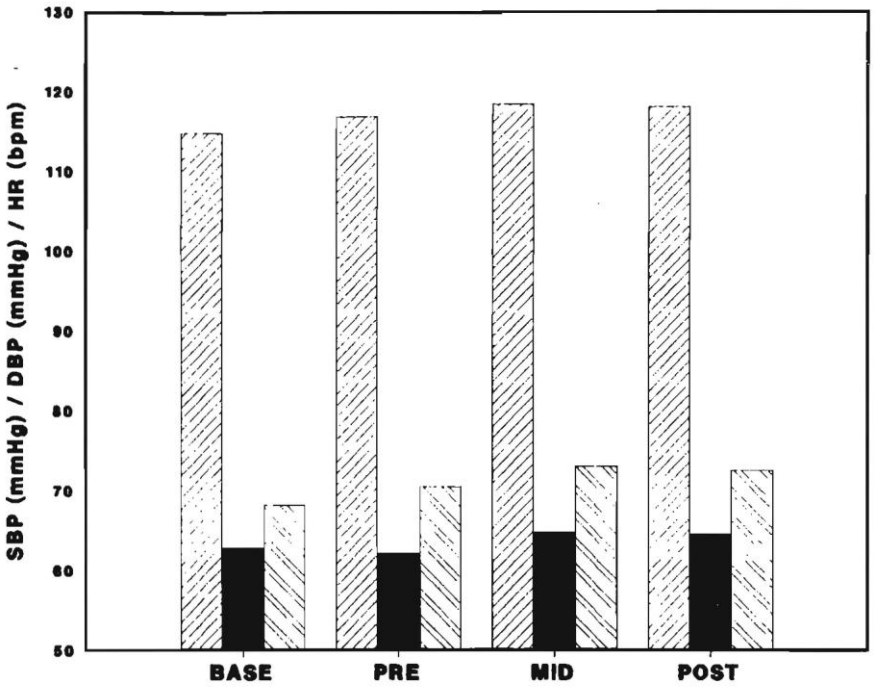

Figure 2 — Temporal changes in physiological measures. ▨ = SBP; ■ = DBP; ▧ = HR.

Relationship Between Performance and CSAI-2 Subcomponents

According to many psychologists (Doctor & Altman, 1969; Morris & Liebert, 1970) and sport psychologists (Martens et al., 1983), cognitive worry, especially prior to and during competition, should be negatively related to performance. Pearson product-moment correlation results indicated that the relationship between cognitive worry and performance was nonsignificant. In addition, in contrast to previous studies this nonsignificant relationship was positive. Actually, a negative correlation was found (mean r = —.18), but because lower performance times indicated better performance, this relationship was positive.

Discussion

The results of this investigation support the notion that anxiety is a multidimensional construct that involves a set of psychological and physiological components, with each of them influenced differently by the environmental conditions and the nature of the task.

The work of researchers in both psychology (Deffenbacher, 1977, 1980; Liebert & Morris, 1967; Schwartz, Davidson, & Goleman, 1978) and sport psychology (Gould et al., 1984; Martens et al., 1983) revealed that the components of state anxiety, cognitive worry, and somatic anxiety are independent and are related to each other only in highly competitive situations. Table 1 shows that cognitive worry and somatic anxiety were mostly correlated at midcompetition, the most intense stage of the competition. However, no significant relationship was found between cognitive worry and somatic anxiety at the end of the competition, probably due to the generally low state anxiety levels at this time. The results of the present study indicated a moderate relationship between cognitive worry and somatic anxiety, confirming that these are separate but related components of A-state. However, both dimensions followed similar patterns as competition progressed. In contrast to previous findings, somatic anxiety did not increase significantly from baseline to precompetition, as expected. Instead, somatic anxiety, as measured by the CSAI-2, significantly increased from pre- to midcompetition and then decreased at postcompetition.

One explanation for the nonsignificant increase in somatic anxiety prior to competition is related to the nature of the task. Specifically, individuals had little interest in the outcome of the competition because the task was a contrived competitive situation and the setting did not create tension levels similar to those that athletes

experience prior to a usual sport situation. Furthermore, it is possible that the simplicity of the task allowed individuals to focus more on their upcoming performance rather than on the cues involved in the evaluative setting prior to competition. According to previous findings, somatic anxiety is affected by various environmental stimuli (e.g., difficult task conditions, importance of competition, and uncertain outcome).

A possible explanation for the increase of somatic anxiety from pre- to midcompetition is that this competitive session took place within a very short period of time. Perhaps the setting did not allow enough time for the somatic anxiety to increase at precompetition as in typical sport competitive settings. Somatic anxiety did increase slightly (although nonsignificantly) from baseline to precompetition, and apparently continued to increase up to midcompetition. As expected, somatic anxiety did decrease dramatically at postcompetition to approximately baseline levels.

The patterns of cognitive worry and self-confidence were similar to previous research findings. Cognitive worry increased from pre- to midcompetition when individuals had performed 5 trials and were losing in a close competition. Cognitive worry then decreased and self-confidence increased from mid- to post- competition, although they did not return to baseline levels as somatic anxiety did.

In contrast to somatic anxiety on the CSAI-2, the physiological measures, HR and SBP, significantly increased from baseline to precompetition while DBP did not. From pre- to midcompetition, both HR and DBP significantly increased whereas SBP did not increase. Finally, none of the three measures decreased from mid- to postcompetition. Therefore somatic anxiety, as measured with the CSAI-2 and physiological arousal, should not be interpreted as the same response. In addition, the fact that the psychological and physiological measures were not related at any stage of assessment brings further evidence for the need to distinguish these components. In the present investigation the relationships between somatic anxiety, HR, SBP, and DBP were nonexistent. Apparently perceived physiological arousal (somatic anxiety) and actual physiological arousal are separate variables that may not be related in competitive settings.

Deffenbacher (1980) suggested that perceived physiological responses (e.g. , emotionality, somatic anxiety) and actual physiological responses (e.g., heart rate, blood pressure) should not be taken as the same thing because they have been found to affect performance independently. According to him, perceived physiological arousal, which is related to the attention paid to affective-autonomic arousal, may interfere with performance when attention is directed to arousal and not to the task. This attentional interpretation suggests that performance deteriorates as highly stressful conditions cause the individual to attend to his or her own bodily processes. On the other hand, physiological arousal may interfere with performance only at levels at which reactivity is extremely distracting. For example, heightened physiological reactivity may negatively affect performance of a complex motor task due to trembling hands and/or to decreases in muscular coordination. Because each of these indexes is independent and affects performance differently, they must be examined simultaneously in order to understand the nature and effects of state anxiety.

As predicted, cognitive worry remained stable from baseline to precompetition, then significantly increased from pre- to midcompetition and finally decreased at postcompetition. These results are probably due to the negative feedback that all subjects received about their performance during the first five trials. These findings are consistent with the hypotheses of Morris, Harris, and Robins (1981) and Martens et al. (1983) that cognitive worry does not change unless failure and internal or external variables related to the performance occur. Therefore the negative performance information increased the individual's level of cognitive worry. The decrease in cognitive worry at postcompetition may be due to the fact that all subjects' actual performance times improved during the second- half trials.

The findings on the relationship of cognitive worry and somatic anxiety to performance did not reveal any evidence for their independence. Data from previous studies have revealed that cognitive worry is more consistently and inversely related to performance than is somatic anxiety. Results from this study revealed little support for the predicted relationship between cognitive worry and performance. One possible explanation for

this finding is the simplicity of the task; it did not include complex motor skills that might be impaired by anxiety.

An alternative explanation for the nonsignificant relationship between cognitive worry and performance is that all subjects failed regardless of their actual performance times. Therefore failure might have increased cognitive worry for everyone, but actual performance times were not related to cognitive worry. It should be noted that neither Martens et al. (1983) nor Gould et al. (1984) found strong support for the hypothesized relationship between cognitive worry and performance. Neither found that precompetitive cognitive worry related to performance, and both reported that relationships between midcompetitive cognitive worry and performance were not very strong. It may well be that A-state has little influence on performance and, at least in this study, factors other than actual performance times may have had stronger influences on reported cognitive worry.

Somatic anxiety also did not influence performance at any stage of assessment. Although somatic anxiety increased during the competition, as indicated by both psychological and physiological responses, it did not significantly affect performance. A possible explanation for this finding relates to Doctor and Alt- man's (1969) contention that somatic anxiety or emotionality interferes with performance only at low levels of cognitive worry. In this study the level of cognitive worry did not remain at a low level but instead increased, and this may account for the lack of a relationship between somatic anxiety and perfomance.

Another explanation for the obscure relationships between state anxiety components and performance in this study involves the design and analyses. Specifically, in this study the relationships between state anxiety and performance were examined using between-subject scores. Sonstroem and Bernardo (1982) found consistent relationships between state anxiety and performance with the use of an intraindividual approach. This approach controls for the interpersonal variation in anxiety responses by analyzing the variation around the individual's own optimal level of state anxiety. Thus, more consistent results may be found in future anxiety/performance research with the use of intraindividual analysis techniques.

It is important to remember that the increases in physiological state anxiety in this experimental study were clinically unremarkable and may not represent true anxiety. Perhaps competitive settings with clearer real threats might have induced stronger anxiety responses and different relationships than the ones observed in the laboratory setting. Thus, caution must be exercised in interpreting "anxiety" in this investigation.

The results of the present investigation provide evidence for the multidimensional nature of state anxiety. Also, results provide partial support for the utility of the CSAI-2 as a valuable tool for examining the temporal changes of the components of state anxiety and their relationships to performance. More research is needed in order to understand better how the subcomponents of CSAI-2 change with respect to competition, and how they relate to performance. Further investigations using the CSAI-2 should consider task characteristics such as complexity and attentional demands, as well as the environmental conditions of the competition including time constraints, attentional demands, and the degree of real or perceived threat.

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