

The Relationship Between the Competitive State Anxiety Inventory-2 and Sport Performance: A Meta-Analysis

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The multidimensional approach to the study of anxiety (Martens, Vealey, & Burton, 1990a) considers subcomponents of anxiety, specifically cognitive anxiety, somatic anxiety, and self-confidence. Much of the research based on this theory has utilized the Competitive State Anxiety Inventory (CSAI-2) (Martens, Burton, Vealey, Bump, & Smith, 1990b). Findings have been inconsistent, with some research suggesting that the three subcomponents have separate relationships with performance and other studies failing to find any relationship between the anxiety subcomponents and performance. This meta-analysis examined the effect of state anxiety as measured by the CSAI-2 (i.e., cognitive anxiety, somatic anxiety, and self-confidence) on athletic performance. Studies were coded for characteristics that could potentially moderate the effects of anxiety on performance (i.e., features of design, subjects, sport). Interdependency between the three subscales was examined using multivariate meta-analytic techniques (Becker & Schram, 1994). Relationships among cognitive anxiety, somatic anxiety, self-confidence, and performance appeared weak. Exploratory modeling showed that self-confidence displayed the strongest and most consistent relationship with performance.

Key Words: multidimensional theory, athlete, self-confidence, research synthesis

An inherent aspect of competitive athletics is the need for athletes to meet the demands of competition and to perform well under pressure. Depending on how the athlete perceives the demands of competition, he or she may interpret pressure situations in a variety of ways. For example, they may be perceived as a natural part of athletic competition, or they may invoke heightened levels of stress. "Stress is the process that involves the perception of a substantial imbalance between environmental demand and response capabilities under conditions in which a failure to meet demands is perceived as having important consequences and is responded to with increased levels of cognitive and somatic state anxiety" (Martens, Vealey, & Burton, 1990a, p. 10).

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When in stressful and anxiety-provoking circumstances, some athletes have been observed to experience deficits in performance, even to the point of "choking." Thus, the relationship between anxiety and athletic performance has received considerable attention from researchers in the field of sport psychology. In an attempt to develop effective interventions that will help ameliorate these negative and sometimes detrimental experiences for the athlete, sport psychologists began studying anxiety, first as an independent construct and more recently as a set of interdependent constructs (Jones, 1995; Krane, 1992; Scanlan & Passer, 1978; Simon & Martens, 1977).

Research on the sport anxiety/performance relationship was initially based on the inverted-U hypothesis (Yerkes & Dodson, 1908). This hypothesis posited a curvilinear relationship between physiological arousal and performance (Gould & Krane, 1992; Jones, 1995; Krane, 1992; Yerkes & Dodson, 1908). Moderate levels of arousal were generally associated with better performance, whereas arousal levels that were too high or too low led to poorer performance (Gould & Krane, 1992; Spielberger, 1989).

Other anxiety theorists have expanded the unidimensional approach of the inverted-U by examining other potential dimensions of anxiety. Martens et al. (1990a) made one such attempt to provide a multidimensional explanation of sport anxiety. Their multidimensional theory suggested that anxiety consisted of both cognitive and somatic subcomponents. Based on this theory, cognitive anxiety is defined as "the mental component of anxiety and is caused by negative expectations about success or by negative self-evaluation" (Martens et al., 1990a, p. 6). The authors posited a negative linear relationship between cognitive anxiety and performance.

On the other hand, somatic anxiety, as defined by Martens et al. (1990a), "refers to the physiological and affective elements of the anxiety experience that develop directly from autonomic arousal" (p. 6). Martens et al. (1990b) have suggested that somatic anxiety should affect performance in a curvilinear fashion, with both lower and higher levels of somatic anxiety being detrimental to performance. "It is likely to reach its peak at the onset of competition and dissipate once the contest begins" (p. 124). Therefore, somatic anxiety, due to its time course, is thought to have less of an influence on performance than does cognitive anxiety (Martens et al., 1990b).

A third subcomponent discussed by Martens et al. (1990b) is the individual difference factor of self-confidence. This encompasses the athlete's global perceptions of confidence. Although not originally proposed as a subcomponent of anxiety, Martens et al. have since included self-confidence in their study of the anxiety/performance relationship. They have proposed a positive linear relationship between self-confidence and performance.

The CSAI-2

Development and Use

In order to assess the multidimensional aspects of anxiety, Martens et al. (1990b) developed the Competitive State Anxiety Inventory-2 (CSAI-2). This 27-item measure has three subscales: cognitive anxiety, somatic anxiety, and self-confidence. Athletes are asked to indicate "how you feel right now" for each item on a 4-point Likert scale ranging from "not at all" to "very much so." Examples of

the cognitive anxiety items include "I am concerned about this competition," and "I am concerned about choking under pressure." These items differ from the somatic anxiety statements such as "I feel nervous" or "I feel tense in my stomach." The self-confidence subscale includes items such as "I feel at ease," and "I'm confident I can meet the challenge." Each of the three subscales has 9 items, which are summed to get a score representing the level of intensity the athlete is feeling for each component of anxiety, and for self-confidence about performing.

Following the development of the CSAI-2, over 40 studies have examined the relationship between the CSAI-2 subcomponents and sport performance. An initial series of studies examined how the subcomponents of anxiety would predict performance (Burton, 1988; Gould, Petlichkoff, Simons, & Vevera, 1987; McAuley, 1985).¹ Burton (1988) was one of the first to use the CSAI-2 on a sample of elite athletes. He asked two samples of elite level swimmers to complete the CSAI-2 just prior to competition. The performance outcome for this study was the swimmers' times, which were obtained from the swim-meet results. Correlational and multiple regression analyses showed that cognitive anxiety was more consistently and strongly related to performance than was somatic anxiety. Polynomial trend analysis confirmed that somatic anxiety showed an inverted-U relationship with performance, whereas self-confidence and performance had a positive linear relationship, and cognitive anxiety and performance had a negative relationship.

Burton's (1988) study is considered to be a landmark study, not only for its investigation of the reliability of the CSAI-2 (in terms of stability and consistency) but also for providing evidence for the theoretical underpinnings of the multidimensional theory. As noted by Smith (1989), however, Burton's findings should be interpreted with caution, as there may have been a different conclusion from the regression analyses if Burton had entered the variables differently into the stepwise regression analyses.

Gould et al. (1987), on the other hand, failed to find any identifiable relationship between cognitive anxiety and performance. Participants in this study were volunteer pistol shooters whose performance was based on the average of a series of five rounds. No relationship was found between cognitive anxiety and performance, and, unexpectedly, a negative relationship was noted between self-confidence and performance.

Research has continued to examine issues related to the theory of multidimensional anxiety. Specifically, some researchers have argued that cognitive and somatic anxiety may not be independent of one another, and that cognitive anxiety can have either a facilitative or a debilitating effect on performance, depending on the performer's level of physiological arousal (Edwards & Hardy, 1996; Hardy, 1997; Jones & Swain, 1992). These claims have involved the examination of potential interactive effects between cognitive anxiety and other components of competitive state anxiety (i.e., somatic anxiety and self-confidence) (Edwards & Hardy, 1996).

For example, Edwards and Hardy (1996) assessed the impact of anxiety on self-perceived netball performance among female netball teams over the course of

¹ These studies were published before the questionnaire was actually in print. The questionnaire first appeared as an unpublished manuscript in 1983 (Martens, Burton, Vealey, Bump, & Smith, 1983).

a competitive season. The authors found that as self-confidence increased, athletes perceived cognitive anxiety to be more facilitative and did not always perceive it as detrimental to performance. Specifically, compared to athletes with low physiological arousal and low cognitive anxiety, athletes with low physiological arousal and high cognitive anxiety perceived themselves as performing better. The Edwards and Hardy (1996) findings provide a distinct contrast from the findings in the 1980s through the 1990s because they suggest that anxiety could also be helpful to perceived performance.

Limitations of Primary Research and the CSAI-2

While the initial findings of research utilizing the CSAI-2 have been mixed, it continues to be used extensively in the field of sport psychology. For example, at the 2001 Association for the Advancement of Applied Sport Psychology conference, there were six published abstracts using the CSAI-2. A computer search of Sport Discus for the Year 2000–01 also revealed six citations of studies that have used the CSAI-2. Internationally, the CSAI-2 has also been very popular for assessing competitive anxiety (Papaioannou, Goudas, & Theodorakis, 2001). This is evidenced by the fact that at the 2001 Scientific Congress in Greece, over 20 published abstracts utilized the CSAI-2. In short, while the use of the CSAI-2 has not led to consistent results or the ability to consistently predict performance, researchers have continued to employ this inventory.

In an attempt to explain the discrepant findings, concerns with the primary research as well as potential psychometric shortcomings of the CSAI-2 have been identified (Jones, 1995; Krane, 1992; Lane, Sewell, Terry, Bartman, & Nesti, 1999; Vealey & Garner-Holman, 1988; Woodman & Hardy, 2001). Krane (1992) argued that the most prevalent methodological limitations have been problems with the operational definitions of performance. Athletic performance can be assessed in several ways. For example, it may be based on objective outcomes such as standard performance measures (e.g., finishing time, or place), on subjective outcomes such as evaluation by a coach or judge, or on self-perceptions of performance (e.g., Edwards & Hardy, 1996). These different categories of performance assessment may have different correlations with anxiety. Other study variations highlighted by the narrative reviews include the different subject and study characteristics such as the various types of sport, skill level of athletes, and time of test administration that are examined in the studies which report conflicting findings. Further examination of these variations in study design may help explain the inconsistent results reported.

Researchers have suggested there is a fundamental difference in performance and its relationship to anxiety for participants who play team sports versus individual sports (Martens et al., 1990b; Terry, Cox, Lane, & Karageorghis, 1996). The number of individuals participating together may moderate the effect of anxiety on performance. Specifically, some argue that participants in individual sports should be more adversely affected by anxiety than those in team sports (Martens et al., 1990b; Terry et al., 1996). Performance in which athletes work with others to try to obtain optimum sport performance may have a different relationship with anxiety than does performance undertaken by oneself. Researchers examining the relationships of other precompetitive mood states (e.g., depression, anger, tension, and fatigue) with performance have found that the variable of team or individual sport moderates the relationship (Beedie, Terry, & Lane, 2000).

While there is a scarcity of research on the relationships of open and closed skills with performance (Terry & Slade, 1995), these two types of skills may be influenced differently by anxiety. Performance based on open skills may be more influenced by anxiety and self-confidence than performance based on closed skills. An open skill can involve either an individual or team sport with the athlete performing in an interactive and ever-changing environment (i.e., basketball, tennis). A closed skill is performed in a more stable environment that is relatively predictable and often self-paced (i.e., golf, gymnastics, crew teams). Anxiety may have a different impact on performance on these two types of skills, based on how the influence of the environment and other competitors potentially moderate the anxiety/performance relationship.

Evidence from the literature on precompetitive mood and performance suggests that the more an athlete interacts with an opponent, the more likely the opponent's actions or performance will exert an influence on the relationship between mood and performance (Terry, 1995). For instance, in crew, a closed sport, teams have no physical contact with their opponents and their environment changes little during the race; this is in sharp contrast to basketball, where players are in contact with one another. Therefore, one could predict that anxiety would have a more detrimental effect on performance in open skill sports than in closed skill sports, due to the greater interaction with opponents and less control over the environment.

Terry and Youngs (1996) discuss how the predictive nature of competitive anxiety appears stronger for open skills such as basketball and netball than for closed skills such as weightlifting. They caution, however, that the athlete's skill level may moderate this relationship. We further caution that two other task features, complexity (the number of components in a task) and task organization (how the components are interrelated), may also moderate this relationship (Kahneman, 1973). The relationship between task complexity and sport performance has been examined; however, it is hard to determine task complexity. The interaction of task complexity with skill type and the potential influence of this interaction on performance have not been examined.

It is also important to examine the interactive effects of skill type and team vs. individual sports. As in the example above, many open skill sports are team sports whereas closed skill sports are often individual in nature. Examination of such task characteristics is warranted, as Kleine (1990) argues that performance may be affected differently by anxiety depending on these varied characteristics of team vs. individual sport and open vs. closed skills.

In addition to the different sports being assessed, the various levels of athletic ability among the participants in these studies have also raised some concern about making comparisons or generalizations across studies. For example, while elite athletes may face higher competitive demands than recreational athletes, they may also be more familiar with such demands and possibly more prepared to handle anxiety. Therefore, anxiety might be more detrimental to performance in athletes of lower skill levels. Yet this may not always be the case, and as such, the moderating effect of skill level on the anxiety/performance relationship remains unclear and should be studied further (Kleine, 1990). Initial research on the anxiety and sport relationship focused on high-level competitive elite athletes, but researchers more recently have focused on volunteers and students in physical education classes. While this may have increased the volume of studies employing the CSAI-2, it has

done little to advance the knowledge of the anxiety/performance relationship for competitive athletic populations.

The time when the CSAI-2 was administered relative to the competition, from 24 hours prior to just 15 minutes prior, may also affect how well it predicts performance. An assessment of anxiety 24 hours before a competition may not yield the same information about one's anxiety state as when administered just 15 minutes prior to competition. With different studies using different times of assessment, different correlations with performance might well emerge.

Recently critics have raised serious questions about the psychometric properties of the CSAI-2 and the manner in which it is used in primary research (Vealey & Garner-Holman, 1998). Specifically, the congruence between its conceptual and operational definitions of anxiety has been questioned. Different theories of anxiety such as the catastrophe theory (Hardy & Fazey, 1987) and the zone of optimal functioning (ZOF) model (Hanin, 1980) may provide alternatives to the multidimensional approach. However, researchers examining various alternative theories are currently using the CSAI-2 as the primary inventory to assess precompetitive anxiety. Thus they are using an instrument that was developed and founded on different theoretical principles than those of either the catastrophe theory or the ZOF model. Because of this, a conclusive statement as to the observed relationship between anxiety and performance under these alternative theories is debatable.

The factor structure of the CSAI-2 has also been called into question. Lane and colleagues (1999), utilizing 1,213 sport participants ages 15 to 39 years, conducted both single- and multi-sample confirmatory factor analyses (CFA) on the CSAI-2. The data failed to fit the hypothesized structure for both the single and multi-sample CFA. The authors highlighted three items in particular that failed to load on their hypothesized factors ("I am concerned about competition"; "I am concerned about reaching my goal"; and "My body feels relaxed") and provide a rationale for this limitation of the inventory.

Lane et al. argued that the factor structure of the CSAI-2 was flawed and that limitations may be related to the phrasing of items. For example, eight of the nine cognitive subscale items begin with "I am concerned" (e.g., I am concerned about this competition), and this use of the word "concerned" may not be appropriate for an athletic population. An athlete may respond as being concerned about the competition, but that concern may represent the athlete's acknowledgment of the competition as an important challenge rather than anxiety. Lane et al. argue that using a term such as "worried" would better assess anxiety, as this term is more reflective of the negative thoughts or expectations associated with anxiety. Likewise, Woodman and Hardy (2001) also argue that problems associated with the wording of the CSAI-2 subscales may contribute to the weak relationships between the subscales and performance. Martens et al. (1990b, p. 211) further describe problems in CSAI-2 research related to confusion among athletes as to the interpretation of the word "concern."

Furthermore, because the CSAI-2 was developed using exploratory factor analysis (EFA) techniques rather than CFA, Lane et al. (1999) have called for further validation studies and refinement of the inventory. Recent attempts to validate the CSAI-2 have been unsuccessful. Cox (2000) conducted a confirmatory factor analysis using 506 intramural athletes and failed to fit the hypothesized three-factor structure of the CSAI-2. Schutz (1994) called for CFA of the factor

structures of inventories in the field of sport psychology that are based on techniques such as EFA. These studies raise important questions about the psychometric properties of the CSAI-2 and point to the potential limitations of the CSAI-2 to adequately assess state anxiety as proposed by the multidimensional anxiety theory.

Finally, researchers have failed to consider the interdependency of the three CSAI-2 subscales. Smith (1989) argues that because the subscales are correlated, they share a common variance. If researchers fail to consider this shared variance in their analyses, the potential for Type I and Type II errors is increased. Furthermore, without considering this shared variance it becomes difficult to determine each subscale's unique relationship with performance. Use of the CSAI-2 results in multiple correlations from the same sample. As such, these correlations are related. Thus it is erroneous not to address this dependency in the statistical analyses of research utilizing this instrument.

In spite of the suggested weaknesses of the CSAI-2, if the multidimensional theory is correct and the CSAI-2 is in fact a valid instrument, then the following predictions could be made: (a) the hypothesized relationships between the three subscales and performance, based on the multidimensional theory, should hold under a variety of settings, sports, etc.; and (b) the three subscales of the CSAI-2 should predict performance. Therefore this study had three purposes: (a) to assess the ability of each CSAI-2 subscale to predict athletic performance; (b) to assess the interdependence of the three subscales and their subsequent relationship with performance; and (c) to explore the potential moderating effects of four variables (type of sport, skill type, athlete's skill level, and time of CSAI-2 administration).

With respect to the first purpose, we hypothesized that cognitive anxiety and performance would have a negative relationship; that due to the use of linear statistical analyses in the primary research, the relationship between somatic anxiety and performance would be close to zero; and that self-confidence and performance would have a positive relationship. Hypotheses related to the interdependency of the CSAI-2 subscales were that cognitive anxiety and somatic anxiety would have a positive relationship, but that each in turn would have a negative relationship with self-confidence. Finally, there were no specific hypotheses regarding potential moderator variables. Those analyses were exploratory in nature.

Method

Selection and Inclusion of Studies

All English-language studies available as of October 1999 which used the CSAI-2 to examine anxiety and sport performance were included. Computer-aided searches of PsychLit, Educational Resources Information Center (ERIC), Sport Discus, and Dissertation Abstracts were undertaken. We also conducted hand searches of relevant sport psychology journals and examined reference lists obtained from articles. We attempted to obtain unpublished masters' theses and doctoral dissertations, and contacted several authors in our search to locate any other published or unpublished data relevant to this topic. Finally, we placed a notice on the sport psychology listserv in order to solicit additional unpublished material. Studies ($N = 29$) were included in the analysis if they investigated the relationship between state anxiety as measured by the CSAI-2 (the independent variable) and athletic performance (the dependent variable).

Coding of Studies

Each study was coded for variables related to quality of the study, participant characteristics, performance characteristics, and CSAI-2 administration. Subject selection, study setting, power, and sample size were coded as indicators of study quality. Participant characteristics included gender, age, and level of athletic ability. The latter was coded as elite (national level or higher), European club (all studies involving club athletes used European samples and most likely represent professional athletes), college varsity, or college physical education students. Performance characteristics such as actual sport, sport type (team vs. individual sport), type of performance measure (objective, subjective rating by judge/official, subjective rating by athlete, subjective rating by coach), and skill type (open vs. closed skill) were coded. Also coded was the time of CSAI-2 administration (before or during competition) and the length of time prior to competition (15 min or less, 16–30 min prior, 31–59 min prior, or 1–4 hr prior) that the inventory was administered.

The first two authors each coded all the studies included in this meta-analysis and, to assess potential coder drift (Orwin, 1994), compared codes for each study. Interrater coding reliabilities ranged from 0.80 (agreement on 8/10 studies) for variables such as outcome reliability and analysis to 1.0 (agreement on 10/10 studies) for variables such as year of publication and gender. Due to the high reliabilities, interrater agreement was deemed acceptable.

Correlations were used as the effect size (ES) estimates. Because the CSAI-2 has three subscales, each study had the potential to provide six correlations (the three correlations of subscales with performance and the three intercorrelations among subscales). Correlations were calculated using observed Pearson's r values when possible, or transformations of Cohen's d (Hedges & Olkin, 1985) if r was not reported.

Analyses

An alpha level of .05 was used for all statistical tests. Correlations were first transformed using Fisher's Z transformation. The transformed correlations were weighted by the inverse of their variances; specifically, by $n_i - 3$ where n_i equals the sample size for each correlation. Chi-square analyses for categorical variables and t -tests for continuous variables were conducted to examine potential differences between published and unpublished studies on variables related to study quality. Multivariate analyses, under a fixed-effects model, were conducted (Becker, 1992; Becker & Schram, 1994). These analyses explicitly account for dependence when a sample contributes more than one correlation. Average correlations and homogeneity tests of the correlation matrices, and of the correlations for each relationship, were computed.

To examine the magnitude of correlations, Q_B was used to test the hypothesis that all population correlations equal zero for all relationships. It is a chi-square test with df_B degrees of freedom, where df_B is the number of relationships. Here, $df_B = 6$. If the observed probability of Q_B was small, we rejected the hypothesis that all rho values in the population correlation matrix equal zero. Q_E tests the hypothesis that all of the variation in observed correlations is due to random sampling variation. It is a chi-square test with df_E degrees of freedom, where $df_E = M - df_B$, and where M is the total number of observed correlations. If the observed

probability of Q_E was small, we rejected the hypothesis that all variation for all relationships is sampling error and decided that between-studies differences exist for at least one relationship. More detailed univariate analyses can identify which relationships show significant between-studies variation, and which relationships have nonzero correlations.

Exploratory modeling was also used to further examine the interrelationships among the variables and to explore potential moderators of the anxiety/performance relationship. The partial relations of each aspect of anxiety with performance were examined using standardized regression equations estimated from the mean correlation matrix. This modeling procedure allowed us to examine the effect of each predictor (cognitive anxiety, somatic anxiety, and self-confidence) on performance while statistically controlling for the effects of the other two predictors. The modeling procedure uses the matrix of average correlations across samples, and its variance/covariance matrix, to estimate a series of standardized regression equations, or path models. These analyses were reported for several subgroups of studies, specifically for subsets based on type of sport, type of skill, level of athlete, and time of CSAI-2 administration.

Results

The search of the literature on anxiety as assessed by the CSAI-2 and performance produced 29 studies (69 independent samples², 246 correlations, and 2,905 participants) that met the inclusion criteria for this meta-analysis. It would be possible for each study to have contributed six correlations. However, due to differences in reporting, the average number of correlations reported from a single sample ranged from one to six with a mean of 3.6. Twenty of these were published studies and nine were unpublished. Chi-square and *t*-test analyses indicated no significant ($p > .05$) differences between published and unpublished studies on variables related to study quality. Eleven additional studies did not provide sufficient data to calculate any of the desired correlations.

Q_B tests the hypothesis that all population correlations equal zero for all relationships. In this study, $Q_B = 972.74$ ($df = 6$) and was significantly ($p < .05$) different from zero. Therefore we examined the individual correlations. Multivariate fixed-effects analyses resulted in a mean overall correlation for the cognitive anxiety/performance relationship of .01 ($SE = .02$), with a 95% confidence interval of $-.03$ to $.04$, indicating that this mean is not significantly different from zero. The overall mean correlation for somatic anxiety and performance was $-.03$ ($SE = .02$), with a 95% confidence interval of $-.08$ to $.01$, indicating that this value is also not significantly different from zero. Finally, the overall mean correlation for self-confidence and performance was $.25$ ($SE = .02$), with a 95% confidence interval of $.20$ to $.28$ which was significantly different from zero. Therefore the self-confidence/performance relationship was the only one of the three that was significantly different from zero, yet even this relationship was not large. Each of the three intercorrelations among the CSAI-2 subscales was significantly different from zero: cognitive anxiety and somatic anxiety, mean $r = 0.52$ ($SE = .02$); cognitive

² Multiple subgroups from within single studies are treated as independent in the same way as they would for within-studies statistical analyses.

anxiety and self-confidence, mean $r = -.47$ ($SE = .02$); somatic anxiety and self-confidence, mean $r = -.54$ ($SE = .02$).

The overall multivariate test of homogeneity for the entire matrix was significant ($Q_E = 1099.68$, $df = 240$). The univariate homogeneity test for the cognitive anxiety/performance relationship was significant ($Q_E = 333.42$, $df = 63$), indicating heterogeneity of the correlations. This test was also significant for the somatic anxiety/performance relationship ($Q_E = 276.91$, $df = 56$) and for the self-confidence and performance relationship ($Q_E = 224.97$, $df = 54$). Tests of homogeneity were also significant for each of the three intercorrelations. For the cognitive anxiety/somatic anxiety relationship, $Q_E = 115.69$ ($df = 24$); for the cognitive anxiety/self-confidence relationship, $Q_E = 39.38$ ($df = 21$); and for the somatic anxiety/self-confidence relationship, $Q_E = 57.17$ ($df = 22$).

Exploratory modeling was used to determine the overall slope coefficient (standardized Beta) for the relationship between each subscale and performance while controlling for the other subscales. The overall slope coefficients for each subscale and performance were significantly different from zero: for cognitive anxiety and performance, $\beta = .13$ ($CI = .08, .18$); for somatic anxiety and performance, $\beta = .09$ ($CI = .03, .14$); and for self-confidence and performance, $\beta = .36$ ($CI = .30, .41$). Therefore each of the three subscales predicts performance, with self-confidence showing the largest beta weight. Figure 1 presents the overall model and slope coefficients associated with the three subscales and performance. Due to the significance of the above relationships and the use of a fixed-effects model, we must caution the reader that since these are exploratory analyses, we are not being conservative in these tests.

Exploratory modeling using a multivariate approach was also conducted to examine potential moderator variables. This allowed us to examine whether and how those variables influence the anxiety/performance relationship after the common variance shared by the three subscales had been taken into account. Four moderator variables were examined: type of sport (team, individual), type of skill (open, closed), type of athlete (elite, European, college athlete, college PE student), and time of CSAI-2 administration (15 min or less prior to competition, 16–30 min prior, 31–59 min prior, and 1–4 hr prior). Figures 2 and 3 present the

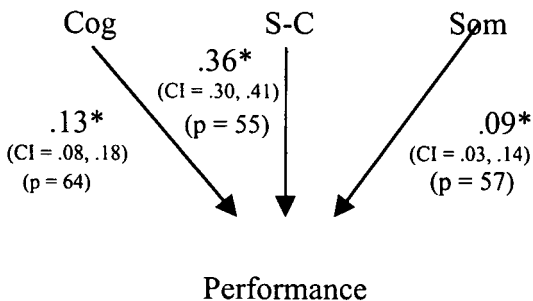


Figure 1 — Overall model and slope coefficients associated with the CSAI-2 and performance relationship. Note: p = no. of correlations for each relationship; CI = confidence interval. *Beta coefficient is significant at $p < .05$

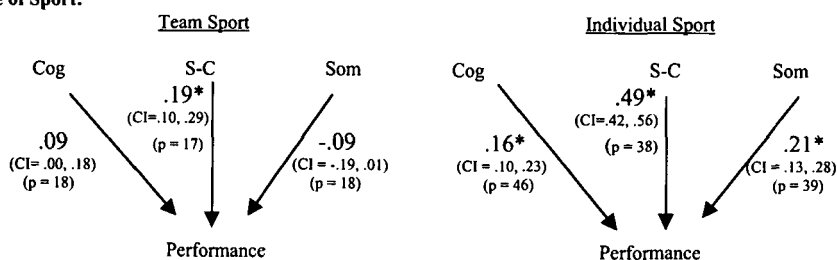
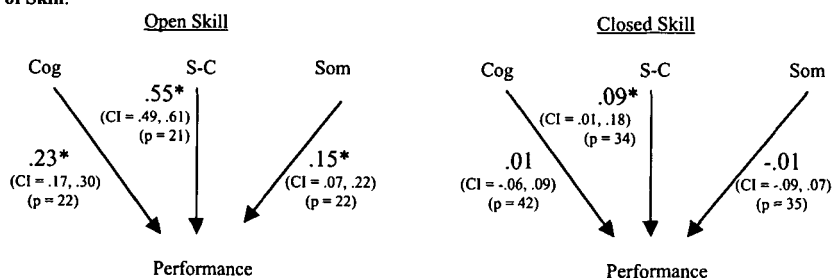
Type of Sport:**Type of Skill:**

Figure 2 — Models and slope coefficients associated with moderator variables of the CSAI-2 and performance relationship. Note: p = no. of correlations for each relationship; CI = confidence interval. *Beta coefficient is significant at $p < .05$

exploratory models and slope coefficients for each moderator variable. The tests of comparison among levels of moderator variables are shown in Table 1.

Moderator Variables

Type of Sport. For team sports, only the self-confidence and performance slope was nonzero. For participants of individual sports, however, each of the three relationships (cognitive anxiety/performance, somatic anxiety/performance, and self-confidence/performance) was nonzero. All three individual-sport slopes also differed significantly from the team-sport slopes.

Type of Skill. For open skills, all three slopes were significantly different from zero. For closed skills, only the self-confidence coefficient was significantly different from zero. Each of the three slope coefficients for the open skills was significantly different from the corresponding slope coefficient for the closed skills.

Type of Athlete. For elite athletes, only the somatic anxiety and self-confidence coefficients were significantly different from zero. All three slopes were significant for the European club athletes. For the college athletes, only the cognitive anxiety and self-confidence coefficients were significantly different from zero, and for the college physical education students only self-confidence was significant. For the cognitive anxiety/performance relationship, all pairwise comparisons among athlete groups were significant except for the comparison between elite athletes and PE students. All comparisons between levels were significant for the somatic anxiety/performance relationship. For the self-confidence and performance

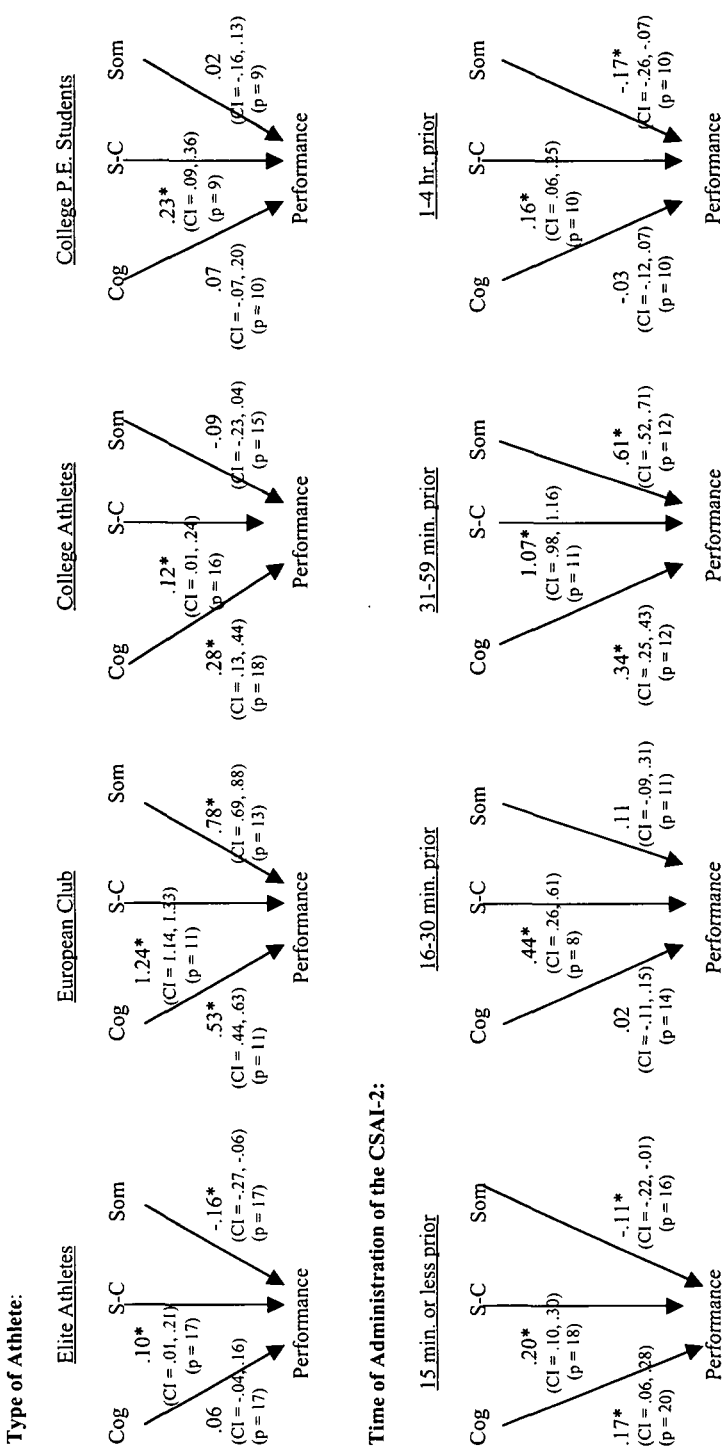


Figure 3 — Models and slope coefficients associated with moderator variables of the CSAI-2 and performance relationship. Note: p = no. of correlations in the relationship; CI = confidence interval. *Beta coefficient is significant at $p < .05$

Table 1 Slopes and Z-test Comparison for Moderator Variables
(95% CI in parens)

	Cognitive Anxiety and Performance	Somatic Anxiety and Performance	Self-Confidence and Performance
Type of Sport			
Team	.09 (.00, .18)	-.09 (-.19, .01)	.19 (.10, .29)
Individual	.16 (.10, .23)	.21 (.13, .28)	.49 (.42, .56)
Test of difference	2.26*	7.69*	5.84*
Type of Skill			
Open	.23 (.17, .30)	.15 (.07, .22)	.55 (.49, .61)
Closed	.01 (-.06, .09)	-.01 (-.09, .07)	.09 (.01, .18)
Test of difference	7.97*	4.33*	8.57*
Type of Athlete			
Elite	.06 (-.04, .16)	-.16 (-.27, -.06)	.10 (.01, .21)
European club	.53 (.44, .63)	.78 (.69, .88)	1.24 (1.14, 1.33)
Test of difference	13.06*	20.00*	16.10*
Elite	.06 (-.04, .16)	-.16 (-.27, -.06)	.10 (.01, .21)
College varsity	.28 (.13, .44)	-.09 (-.23, .04)	.12 (.01, .24)
Test of difference	3.92*	1.89*	0.25
Elite	.06 (-.04, .16)	-.16 (-.27, -.06)	.10 (.01, .21)
PE students	.07 (-.07, .20)	.02 (-.16, .13)	.23 (.09, .36)
Test of difference	0.24	3.15*	1.53
European club	.53 (.44, .63)	.78 (.69, .88)	1.24 (1.14, 1.33)
College varsity	.28 (.13, .44)	-.09 (-.23, .04)	.12 (.01, .24)
Test of difference	4.17*	28.06*	14.36*
European club	.53 (.44, .63)	.78 (.69, .88)	1.24 (1.14, 1.33)
PE students	.07 (-.07, .20)	.02 (-.16, .13)	.23 (.09, .36)
Test of difference	9.78*	14.34*	12.02*
College varsity	.28 (.13, .44)	-.09 (-.23, .04)	.12 (.01, .24)
PE students	.07 (-.07, .20)	.02 (-.16, .13)	.23 (.09, .36)
Test of difference	3.30*	2.50*	1.20
Time of CSAI-2 Administration			
15 min or less	.17 (.06, .28)	-.11 (-.22, .00)	.20 (.10, .30)
16-30 min prior	.02 (-.11, .15)	.11 (-.09, .31)	.44 (.26, .61)
Test of difference	4.50*	2.82*	2.34*
15 min or less	.17 (.06, .28)	-.11 (-.22, .00)	.20 (.10, .30)
31-59 min prior	.34 (.25, .43)	.61 (.52, .71)	1.07 (.98, 1.16)
Test of difference	3.78*	16.00*	12.79*
15 min or less	.17 (.06, .28)	-.11 (-.22, .00)	.20 (.10, .30)
1-4 hours prior	-.03 (-.12, .07)	-.17 (-.26, -.07)	.16 (.06, .25)
Test of difference	5.00*	1.62	0.58

(continued)

Table 1 (Cont.)

	Cognitive Anxiety and Performance	Somatic Anxiety and Performance	Self-Confidence and Performance
Time of CSAI-2 Administration (cont.)			
16–30 min prior	.02 (–.11, .15)	.11 (–.09, .31)	.44 (.26, .61)
31–59 min prior	.34 (.25, .43)	.61 (.52, .71)	1.07 (.98, 1.16)
Test of difference	10.67*	6.17*	6.20*
16–30 min prior	.02 (–.11, .15)	.11 (–.09, .31)	.44 (.26, .61)
1–4 hours prior	–.03 (–.12, .07)	–.17 (–.26, –.07)	.16 (.06, .25)
Test of difference	2.27*	3.83*	2.73*
31–59 min prior	.34 (.25, .43)	.61 (.52, .71)	1.07 (.98, 1.16)
1–4 hours prior	–.03 (–.12, .07)	–.17 (–.26, –.07)	.16 (.06, .25)
Test of difference	10.00*	18.57*	13.38*

*Z-test significant at $p < .05$

relationship, all comparisons of the European athletes to others were significant, but the slopes for elite athletes, college athletes, and PE students did not differ.

Time of CSAI-2 Administration. For the time periods of 15 min or less and 31–59 min prior to competition, all three slope coefficients were significantly different from zero. At 16–30 min prior to competition, only the self-confidence slope was significant, and at 1–4 hr prior, both self-confidence and somatic-anxiety coefficients were significantly different from zero. Comparisons of slope coefficients between levels showed that for the cognitive anxiety/performance relationship all slopes differed significantly. For the somatic anxiety/performance relationship, all comparisons were significant except for the comparison between 15 min or less and 1–4 hr prior. Finally, for the self-confidence/performance relationship, all slopes were significantly different except for the comparison between 15 min or less and 1–4 hr prior.

Discussion

A Priori Hypotheses

Our first hypothesis predicted a negative linear relationship between cognitive anxiety and performance. The data did not provide support for this hypothesis. The overall correlation between cognitive anxiety and performance was .01 and did not differ significantly from zero. Furthermore, across all moderator variables examined, cognitive anxiety consistently displayed a positive rather than a negative relationship with performance.

This finding could be interpreted several ways. First, perhaps the multidimensional theory is incorrect and cognitive anxiety does not have a negative relationship with performance. Second, perhaps the true nature of this relationship is negative but the CSAI-2 inventory is not doing an adequate job of assessing cognitive anxiety because of how items are phrased (Lane et al., 1999; Woodman &

Hardy, 2001). Jones and Hanton (2001) also suggest that the CSAI-2 does not measure anxiety directly, but rather the symptoms associated with anxiety, and that due to the wording of the inventory, it may actually be measuring other "mislabelled" affective states. Another possibility may be that this inventory does assess cognitive anxiety, but that the way it has been utilized in the primary research has been inappropriate and the relationship has thus been masked (e.g., administered too long prior to competition, administered to small samples, used to gather information on group rather than individual means, focus on overall score rather than specific items). Finally, still another possibility may be that researchers cannot adequately understand the anxiety/performance relationship by measuring only cognitive anxiety. Cognitive anxiety, considered in isolation, may not be a good predictor of performance. Its influence on performance may be dependent on various other factors such as coping strategies, confidence in one's ability to handle anxiety (as opposed to confidence about competition), and athletes' overall perceptions of performance outcomes, which would take into account their perceptions of the situational demands such as weather, team interaction, etc. Until researchers are confident they are measuring cognitive anxiety accurately with a valid and reliable instrument, the relationship between cognitive anxiety and performance will remain unclear.

The second hypothesis predicted a very small (close to zero) relationship between somatic anxiety and performance. The data provided were consistent with this hypothesis. The overall mean correlation was $-.03$ and was not significantly different from zero. Historically, researchers have thought (cf. Landers, 1980) that the relationship between autonomic arousal and performance is curvilinear. Low and high levels of autonomic arousal are believed to be associated with low levels of performance, whereas moderate levels may be associated with higher levels of performance. Therefore somatic anxiety, which was defined as stemming directly from autonomic arousal, would not be expected to show a linear relationship with performance, and the resulting correlation should be near zero.

Primary researchers have persisted in analyzing the information gleaned from the CSAI-2 with linear multiple regression techniques, and thus have not truly examined this potentially curvilinear relationship. Researchers need to incorporate quadratic or trend analyses of somatic anxiety and performance scores to test for the proposed curvilinear relationship. The few researchers who have examined this relationship using a quadratic term in their regression analyses have reported support for a curvilinear relationship between somatic anxiety and performance (Burton, 1988; Gould et al., 1987; Randle & Weinberg, 1997; Woodman, Albinson, & Hardy, 1997). Our findings only show that clearly there is no support for a linear relationship between somatic anxiety and performance. At this time it remains possible that (a) either there is no relationship at all between somatic anxiety and performance, or (b) there is a curvilinear or quadratic relationship as suggested by the multidimensional theory. Therefore, the proposed curvilinear relationship remains a viable possibility that merits further examination.

Finally, researchers must continue to examine whether the CSAI-2 is actually assessing somatic anxiety. Due to a lack of content validity studies, the question remains as to whether the CSAI-2 is doing an adequate job of assessing this construct. Furthermore, because the proposed three-factor structure of the CSAI-2 was not supported with confirmatory factor analysis (Lane et al., 1999), this inventory needs to be examined further.

The third hypothesis predicted a positive relationship between self-confidence and performance. The data provided only moderate support for this hypothesis. While a positive relationship was found, the correlation was not strong (mean $r = 0.25$, $SE = 0.02$). This finding is similar to that of Moritz, Feltz, Fahrback, and Mack (2000), who reported an overall mean correlation between self-confidence and performance of mean $r = 0.38$ and, for studies using the CSAI-2, a mean correlation of $r = 0.24$. This suggests several possible conclusions. Again, only partial support is provided for the predicted relationship based on the multidimensional theory, and thus the theory itself is called into question. Alternatively, maybe this inventory does not accurately measure self-confidence. The CSAI-2 measures a generalized belief about self-confidence in sport competition (i.e., "I feel self-confident"). In order to have a more specific understanding of how self-confidence influences performance, researchers could assess athletes' perceptions of their confidence in their own ability to handle negative thoughts and apprehension that are specific to performance. This situation-specific self-confidence, or self-efficacy as outlined by Bandura (1997), may prove to be more predictive than the generalized notion of confidence that is currently being measured with the CSAI-2. And finally, it may also be an issue of poorly defined performance measures in many of the studies which is causing the relationship to appear weaker than expected.

Exploratory Modeling

Type of Sport. Regardless of type of sport, self-confidence seems to be positively related to enhanced performance. Furthermore, the self-confidence/performance relationship is strongest for individual sports. Although cognitive and somatic anxiety also seem more influential in individual rather than team sports, the coefficients for the relationships of cognitive and somatic anxiety with performance are both positive and rather weak ($\beta = .16$ and $.21$, respectively). One possible explanation may be that when an athlete participates alone, the pressure is greater than when competing along with others on a team. When teammates are present, anxiety and self-confidence may not predict performance as well because other players influence the outcome. This result parallels the findings of other researchers who have reported that the predictive ability of precompetitive anxiety and confidence differs between team and individual sport athletes (Kleine, 1990; Martens et al., 1990b; Terry et al., 1996).

Type of Skill. This variable was grouped into open and closed skills. Once again, the findings support what was expected and are consistent with those of earlier research (Kleine, 1990; Terry & Slade, 1996). The relationship between anxiety and performance is stronger for open skills (i.e., skills performed in environments that are constantly changing) than for closed skills.

Martens et al. (1990a) argue that uncertainty and importance of the outcome explain how a competitive situation may influence a person's state anxiety. Specifically, when an athlete is unsure about his or her ability to obtain the desired outcome, and the outcome is important to the athlete, his or her level of state anxiety can increase. Martens et al. believe that lack of certainty about the outcome may include not only uncertainty about winning and losing but also such things as uncertainty about ability to endure or to avoid injury. We would argue that the lack of control over the environment in sports based on open skills may

also increase the athlete's uncertainty about the outcome. This uncertainty could result in both increased levels of anxiety and increased variability of anxiety responses among athletes (i.e., because higher levels of anxiety are possible, a greater range results, and stronger relationships emerge). This might explain why the relationships of anxiety and self-confidence to performance for open skill sports are stronger than those for closed skill sports.

Type of Athlete. We found studies for four types of athletes: elite athletes (U.S. national level or higher), European club athletes, college varsity athletes, and college physical education students. Our most interesting finding here is that the European club athletes had the strongest relationships between anxiety, self-confidence, and performance. Perhaps this is because in Europe the club athlete truly represents the professional athlete, whereas in the U.S. the elite athlete group (defined as national level or higher) may include many who are just a step above the college level (Edwards & Hardy, 1996).

When comparing this high level group (European club) to players of a lesser skill level, not only is the relationship between cognitive anxiety and performance stronger but it is also a positive relationship, whereas for lower skill athletes this relationship is small or nonsignificant. In higher-level athletes, the presence of cognitive anxiety seems to enhance performance. The finding was similar for somatic anxiety, which also showed a positive relationship. Perhaps feelings of arousal prior to competition are optimal for athletes of this level and indicate a feeling of readiness. This finding should be interpreted with caution, however, based on the limitations in data analyses of the somatic anxiety/performance relationship in the primary research (i.e., use of linear regression techniques). Finally, as predicted, the self-confidence/performance relationship was strongest for this high ability group. For the lower ability groups, the relationships were either small or nonsignificant.

These findings need further exploration, as the relationships involving anxiety and self-confidence did not follow a predictable pattern based on skill level (i.e., reductions in anxiety and increases in self-confidence as skill level increases). The results of research with respect to skill level have been mixed. Martens et al. (1990b) reported an increase in cognitive anxiety for elite athletes as compared to college athletes. Kleine (1990), however, reported that athletes of higher skill levels were not as adversely affected by anxiety as were athletes of lower skill levels.

Time of CSAI-2 Administration. Cognitive anxiety, somatic anxiety, and self-confidence all showed the strongest relationships with performance at 31–59 min prior to competition, and the relationships weakened as time of competition drew near. This finding would suggest that the CSAI-2 might have the most predictive power when administered approximately 31 to 59 minutes prior to competition. It remains unclear why the CSAI-2 would not be most predictive just prior to competition.

Primary research indicates that anxiety may have a delayed influence on performance. For example, Gould, Petlichkoff, and Weinberg (1984) administered the CSAI-2 just 5 min prior to competition and found no relationship between scores on the subscales and wrestling performance in the first period of a wrestling match. Martens et al. (1990a) also found no relationship between CSAI-2 subscales and performance on the first 9 holes of golf, but they did find significant relationships between the CSAI-2 and scores for the last 9 holes of golf. Gould et al.

(1984) suggest that this delayed influence of anxiety on performance is a fairly consistent finding and should be examined further.

Perhaps, in the time just before competition, athletes are not focused on answering the questionnaire or are already cognitively immersed in game preparation, game strategy, etc. Krane (1992) suggested that athletes may be reluctant to report feelings of anxiety just prior to competition when they are planning for the performance at hand or trying to reach some favorable preperformance state. In addition, for practical purposes the CSAI-2 could be distracting to the athlete if administered too close to competition. Therefore, our findings provide some support for Martens et al.'s (1990b) recommendation that administering the inventory approximately 30 to 60 minutes prior to competition is optimal.

Summary

In conclusion, bivariate relationships show that only self-confidence predicts performance well, and even its relationship with performance is not strong. Also, the bivariate relations among cognitive anxiety, somatic anxiety, and self-confidence show that these three scales are quite intercorrelated on average. None of the subscales is an independent or separate measure of that component of anxiety. All mean intercorrelations among these subscales are stronger than the mean correlation of any subscale with performance. This underscores the importance of controlling for each subscale via the regression modeling approach. This finding supports those of other researchers who have argued that cognitive and somatic anxiety may not be independent of one another (Edwards & Hardy, 1996; Hardy, 1997; Jones & Swain, 1992).

Furthermore, partial relations from the regression-modeling analyses show that self-confidence continues to be the strongest predictor, and while cognitive and somatic anxiety each show slightly stronger predictive power after controlling for other subscales, their relationship to performance is still quite weak. Many moderator variables seem to affect the strength and even the direction of all three partial relations. Results of the moderator variable analyses also indicate that self-confidence consistently continues to be the strongest predictor of performance. However, cognitive and somatic anxiety do show significant or even large relationships to performance for some subsets of studies.

Given the strength of the intercorrelations among the three predictor variables and the stronger relationships between self-confidence and performance, it is possible that the best fitting pattern among the network of variables is hierarchical or one in which self-confidence mediates the relationships between cognitive and somatic anxiety and performance (Hardy, 1990; Jones & Hanton, 2001). This is in line with Bandura's (1997) self-efficacy theory. Future research should focus on this potential mediating role of self-confidence. We would, however, suggest using a more situation-specific measure of self-confidence rather than the CSAI-2, due to its measurement of a more global self-confidence and questionable psychometric properties.

Based on the results of this meta-analysis, we would caution researchers against using the CSAI-2 to examine the anxiety/performance relationship. While the results of this study have not disconfirmed the multidimensional theory, our findings do call into question the ability of the CSAI-2 to adequately predict performance as outlined by the theory. Future researchers should further examine the

psychometric properties of both the CSAI-2 and dependent variables used in this line of research. Currently the psychometric properties of the CSAI-2 remain disputable. Further, when results of studies utilizing the CSAI-2 are combined statistically, the results indicate that the relationships between its subscales and performance are weak. Until researchers can be certain that the CSAI-2 is actually assessing what it purports to in a reliable and valid manner, they should discontinue its use in studying the relationship between state anxiety and athletic performance. Finally, until the psychometric properties of the CSAI-2 are confirmed, the interpretation of the results of this meta-analysis and any further research utilizing the CSAI-2 cannot be interpreted relative to multidimensional anxiety theory.

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