Measuring Anxiety in Athletics: The Revised Competitive State Anxiety Inventory–2

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The purpose of this study was to use confirmatory factor analysis (CFA) to revise the factor structure of the CSAI-2 using one data set, and then to use CFA to validate the revised structure using a second data set. The first data set (calibration sample) consisted of 503 college-age intramural athletes, and the second (validation sample) consisted of 331 intercollegiate (Division I) and interscholastic athletes. The results of the initial CFA on the calibration sample resulted in a poor fit to the data. Using the Lagrange Multiplier Test (Gamma) as a guide, CSAI-2 items that loaded on more than one factor were sequentially deleted. The resulting 17-item revised CSAI-2 was then subjected to a CFA using the validation data sample. The results of this CFA revealed a good fit of the data to the model (CFI = .95, NNFI = .94, RMSEA = .054). It is suggested that the CSAI-2R instead of the CSAI-2 be used by researchers and practitioners for measuring competitive state anxiety in athletes.

Key Words: athlete, cognitive anxiety, competition, confirmatory factor analysis, self-confidence, somatic anxiety

Anxiety is one of the most commonly measured constructs in sport psychology, with at least 22 published scales devoted to its measurement (Ostrow, 1996). One of the most widely used scales for measuring anxiety is the Competitive State Anxiety Inventory-2 (CSAI-2) (Martens, Burton, Vealey, Bump, & Smith, 1990). The CSAI-2 has been used in research published in over 35 articles on anxiety in sport (Ostrow, 1996) and is perhaps the most well-known anxiety instrument used in sport psychology research.

Martens, Burton, Rivkin, and Simon (1980) originally modified the State-Trait Anxiety Inventory (Spielberger, Gorsuch, & Lushene, 1970) in creating the original CSAI. A major limitation of the original CSAI was that, although it represented a sport-specific measure of state anxiety, the construct was conceptualized as unidimensional in nature. Thus the CSAI-2 was developed in order to create a sport-specific instrument that measured both cognitive and somatic anxiety (Mar-
tens et al., 1990). In addition to cognitive and somatic anxiety, the CSAI-2 was also supposed to measure the constructs of fear of physical harm and generalized anxiety. These constructs failed to emerge during validation studies. A third construct did emerge during validation studies, however, namely state self-confidence. Thus the final version of the CSAI-2 contained three subscales: cognitive anxiety, somatic anxiety, and self-confidence, each of which consisted of nine items (Martens et al., 1990).

Determining the Factor Structure of the CSAI–2

Problems

In developing the CSAI-2, Martens et al. (1990) conducted numerous analyses to assess the reliability and validity of the instrument. These included various factor analyses, item analyses, internal consistency analyses, concurrent validity analyses, and construct validation studies involving Martens’ (1977) model of competitive state anxiety. While the authors of the CSAI-2 were thorough in developing the instrument, methodological limitations raise questions about the factor structure of the CSAI-2. These limitations include problems related to statistical methods used to determine the factor structure of the inventory, arbitrary decisions regarding inclusions of items, and failure to confirm the factor structure of the CSAI-2 with a follow-up confirmatory factor analysis (CFA).

Exploratory Factor Analyses and Principal Components Analyses

There are three concerns regarding Martens et al.’s (1990) use of exploratory factor analysis (EFA) and principal components analysis (PCA) in developing the CSAI-2, namely the appropriateness of EFA vs. PCA, choice of rotation methods, and sample size issues. First, EFA and PCA are two different approaches to determining the factor structure of an instrument. In EFA only the common variance among observed variables is available for analysis, while in PCA both common and unique variance (including error variance) are available (Fabringer, Wegener, MacCallum, & Strahan, 1999; Tabachnick & Fidell, 2001). Through EFA, researchers can identify latent constructs that represent correlations among measured variables, and it is for this reason that EFA rather than PCA is appropriately used in scale construction (Cattell, 1978; Fabringer et al., 1999; McDonald, 1985).

Second, Martens et al. (1990) reported that they used both varimax (orthogonal) and oblique (correlated) rotations in interpreting and determining factor structure. When theoretical or empirical evidence indicates that latent constructs are correlated, logic dictates that oblique rotation should be used (Fabringer et al., 1999; Loehlin, 1998; McDonald, 1985). Given that the three subscales of the CSAI-2 are hypothesized to measure sport-specific state anxiety, one can argue that only oblique rotation procedures should have been used in developing the CSAI-2. Third, the sample sizes used in developing the CSAI-2 (between 80 and 160 participants) generally fall below commonly used guidelines for sample size (Cattell, 1978; Comrey & Lee, 1992; Tabachnick & Fidell, 2001).

Arbitrary Decisions Regarding the Inclusion of Items

In a few cases it seems that Martens et al. (1990) included items on the CSAI-2 with little empirical justification. For example, after conducting two EFA that resulted in a significant reduction of the original 79-item pool, they included for analyses two items that were originally omitted because they had a “hunch” these were worth retaining.
Furthermore, after conducting their final EFA on the 27-item version of the CSAI-2, Martens et al. (1990) determined that one cognitive anxiety item had weak discriminatory power. They eliminated the item and arbitrarily replaced it with a different one, but did not use any factor analytic procedures for inclusion of the item, whereas they did assess reliability and other forms of validity. Although only affecting a small number of items on the CSAI-2, the arbitrary decisions made by Martens et al. (1990) in terms of inclusion of items raises some doubt as to the factorial validity of the measure.

The Need for a Confirmatory Factor Analysis. When developing a scale designed to represent a multidimensional construct, it is important for researchers, after determining the initial properties of the scale through procedures such as EFA, to then confirm these properties through some type of confirmatory analysis, preferably on a separate sample. Perhaps the most common means of accomplishing this is through confirmatory factor analysis (CFA). Confirming the factor structure of a scale is important for two reasons: (a) CFA is generally theory-driven, which allows for a more focused analysis. (b) More important, conducting a CFA on a scale allows one to determine whether the factor structure that emerged with one sample remains consistent with other samples, thereby reducing the effect of chance relationships in any one particular sample. In developing the CSAI-2, Martens et al. (1990) did not report the results of a CFA, nor did they indicate the need to do so.

Martens et al. (1990) did conduct several EFA in developing the CSAI-2, but in some cases ran multiple EFA on the same data. For example, using a sample of 162 students they conducted an EFA on a 79-item version of the CSAI-2. After the results of this analysis supported a 36-item version, they ran another EFA with this revised CSAI-2 on the same data. This procedure was repeated on subsequent versions of the CSAI-2 with a different sample. The lack of initial confirmation of the CSAI-2 factor structure with a separate sample raises questions about the generalizability of the instrument.

Other Reported Analyses Involving the CSAI-2

A literature search on research using the CSAI-2 revealed only two published studies that have examined the psychometric properties of the CSAI-2, with the results of these studies raising further questions about the factor structure of the instrument. Tsorbatzoudis, Varkoukis, Kaissidis-Rodafinos, and Grouios (1998) conducted an EFA on the CSAI-2 with a sample of elite Greek athletes, and reported that three items hypothesized to load on the cognitive anxiety factor actually loaded on the self-confidence factor (Items 4, 13, and 25).

More recently, Lane, Sewell, Terry, Bartram, and Nesti (1999) conducted confirmatory factor analyses on the CSAI-2 with a large sample of athletes representing several sports at varying competitive levels (N = 1,213). Because of the large sample size, data were randomly split into two samples. A separate CFA was conducted on data sets of 606 participants (Sample A) and 607 participants (Sample B). Goodness-of-fit indices from both analyses indicated a relatively poor fit to the hypothesized factor structure of the instrument (e.g., in all cases less than .85 for the non-normed fit index and the goodness-of-fit index). For both analyses, low factor loadings were reported for two cognitive anxiety items (Items 1 and 19) and one somatic anxiety item (Item 14). Furthermore, the results of the Lagrange Mul-
tiplier test, for both samples, indicated that the fit of the model would be significantly improved if items were allowed to load on more than one factor. Seventeen additional paths for Sample 1 and 20 additional paths for Sample 2 promised a reduction in the size of the chi-square statistic ($p < .01$).

**Purpose of the Study**

Clearly, the results of the studies by Tsorbatzoudis et al. (1998) and Lane et al. (1999) demonstrate the shortcoming of the theoretical factor structure of the CSAI-2. In the present study we did not propose to merely conduct another CFA on the CSAI-2, but to modify—with respect to its scale items—the CSAI-2 using one data set (calibration sample) and then to test the revised factor structure of the CSAI-2 with a second data set (validation sample). In this way it will be possible to present to the practitioner a revised version of the CSAI-2 that has also been subjected to a theoretically grounded confirmatory factor analysis. The research, as outlined below, was approved by the Campus Institutional Review Board for human participants.

**Method**

**Participants**

The participants for the calibration sample were 575 male and female intramural athletes from a large midwestern university. Due to missing data, the sample was reduced from 575 to 506 participants. The sample of 506 included 103 female volleyball players, 109 male volleyball players, 80 female basketball players, 77 male basketball players, 20 female individual sport participants, and 117 male individual sport participants. The average age was 20.0 years ($\pm$1.8 yrs) for the male athletes and 19.2 years ($\pm$1.3) for the female athletes.

The participants for the validation sample were 167 interscholastic and 164 Division I intercollegiate athletes ($N = 331$). The interscholastic sample was composed of 78 male and 89 female athletes competing in the year 2001 Illinois high school track and field championships. The average age was 17.0 years ($\pm$1.1) for the male and 16.1 years ($\pm$1.1) for the female high school athletes. The college sample was composed of 89 male and 75 female athletes from two large midwestern universities; they represented 8 sports: basketball, swimming, wrestling, track & field, tennis, baseball, softball, and volleyball. The average age was 20.1 years ($\pm$1.7) for the male and 19.9 years ($\pm$1.5) for the female college athletes.

**Materials and Procedures**

For the calibration sample, the Competitive State Anxiety Inventory-2 (Martens et al. 1900) was administered to participants approximately 15 min prior to a basketball game, 15 min prior to the first game of a volleyball match, or 15 min prior to an individual sport contest. For the validation sample, the CSAI-2 was administered approximately 30 min prior to competition. Before responding to items on the CSAI-2, all participants read an antisocial desirability statement encouraging them to be totally honest in their responses.

The CSAI-2 is a 27-item inventory that measures cognitive state anxiety, somatic state anxiety, and self-confidence in a competitive setting. Evidence indicates that the CSAI-2 is an internally reliable instrument with demonstrated pre-
dictive validity. Internal reliability coefficients of .81, .82, and .88 have been reported for cognitive anxiety, somatic anxiety, and self-confidence, respectively (Martens et al., 1990). Each item on the CSAI-2 is anchored by a 4-point Likert scale (1 = not at all, 2 = somewhat, 3 = moderately so, 4 = very much so). Item 14, a reverse-scored item, was reflected prior to data analysis.

Data Screening

Data were screened for outliers and indices of non-normality. For the calibration sample, only 7 of the 27 items that make up the CSAI-2 had skewness or kurtosis indices that were greater than 1.00. Of these 7, none had skewness or kurtosis indices greater than 2.00. As recommended by Stevens (1992), leverage or the “hat element” was calculated as a means of identifying multivariate outliers. A leverage index of greater than .16 was considered to be indicative of a multivariate outlier. This procedure resulted in the deleting of three intramural participants whose scores would have had an undue influence on the results of the CFA. Therefore a total of 503 participants from the calibration sample were included in subsequent data analyses. Data from the validation sample were also scrutinized for outliers and indices of non-normality. Using the same criteria as with the calibration sample, no participants from the validation sample were deleted.

Confirmatory Factor Analyses

Data from both the calibration and validation samples were subjected to confirmatory factor analyses using CALIS from SAS, as outlined by Hatcher (1994). The maximum likelihood estimation method was used in initial and follow-up analyses. Model fit was evaluated via the model chi-square test (Bollen, 1989), Bentler’s (1990) comparative fit index (CFI), Tucker and Lewis’ (1973) non-normed fit index (NNFI), and the root mean squared error of approximation (RMSEA; Steiger & Lind, 1980). A nonsignificant chi-square indicates little discrepancy between the observed and fitted models (covariance matrices), but with large samples the chi-square (χ²) test may be significant even if the model has a good fit to the data. Consequently, the CFI, NNFI, and RMSEA were also used to evaluate the fit of the hypothetical model to the data. In the case of the CFI and NNFI, observed indices of .95 or greater were sought, while in the case of the RMSEA we sought an approximation less than .06 (Hu & Bentler, 1999).

CFA of the Calibration Sample. The initial measurement model for the CFA on the calibration sample is shown in Figure 1. The structure of the initial model is based on the hypothetical three-factor structure of the CSAI-2, in which each factor is associated with nine manifest variables. Parameter constraints included setting the variances of the three latent variables to 1.00, and setting the path coefficients leading from error terms to manifest variables to 1.00. Parameters to be estimated included three covariances among latent factors, 27 path coefficients leading from factors to manifest variables, and 27 error variances. The measurement model was over-identified, with 378 items of information available and 57 parameters to be estimated.

Re-estimation of Calibration Model Through Item Deletion. The Lagrange Multiplier Index (Gamma) identifies additional paths in the measurement model that would reduce the size of the chi-square statistic and thereby improve the model’s
Figure 1 — Measurement model for the initial confirmatory factor analysis of the 27-item CSAI-2. Item numbers from the CSAI-2 are shown in parentheses.

While this strategy promises to improve the data’s fit to the model, it would also result in some items loading on more than one factor. Rather than adding paths from a second or third factor, we chose to delete problem items in a systematic and sequential manner. In Step 1 we deleted the CSAI-2 item associated with the largest Lagrange Multiplier Index and subjected the remaining data
to a follow-up CFA. This process continued as long as an item associated with a Lagrange Multiplier Index of greater than 10 could be found. The final best fitting model, based on the calibration sample, was applied to the validation sample.

**CFA on the Validation Sample.** Using the same procedures outlined for the calibration sample, we subjected data from the validation sample to a CFA of the best fitting model from the calibration sample.

**Results**

**Descriptive Statistics on the CSAI-2**

**Calibration Sample.** Means and standard deviations for the calculated factor scores of the CSAI-2 are listed in Table 1 along with comparable scores published by Martens et al. (1990) on an intercollegiate sample. The means and standard deviations of the current intramural athlete sample and Martens’ sample are similar. Martens et al. reported Cronbach alpha coefficients of .81, .82, and .88 for cognitive anxiety, somatic anxiety, and self-confidence, respectively, for the intercollegiate athlete sample. In the current intramural athlete sample we observed similar internal reliability coefficients of .83, .88, and .91, respectively.

**Validation Sample.** Means and standard deviations for the validation sample on the CSAI-2 factor scores are also listed in Table 1. They may be compared with those derived from the calibration sample and the Martens et al. (1990) normative sample. The Cronbach alpha coefficients for the validation sample were .81, .81, and .86 for cognitive anxiety, somatic anxiety, and self-confidence, respectively. Again, these are very similar to the coefficients reported by Martens et al. (1990) and similar to the current calibration sample.

<table>
<thead>
<tr>
<th>Sample</th>
<th>Gender</th>
<th>N</th>
<th>Cognitive anxiety</th>
<th>Somatic anxiety</th>
<th>Self-confidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calibration (Intramural athletes)</td>
<td>Male</td>
<td>300</td>
<td>17.4 ± 5.2</td>
<td>15.6 ± 5.0</td>
<td>27.1 ± 6.0</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>203</td>
<td>16.7 ± 4.9</td>
<td>14.3 ± 4.6</td>
<td>27.2 ± 6.2</td>
</tr>
<tr>
<td>Martens et al. (1990) (Intercollegiate athletes)</td>
<td>Male</td>
<td>158</td>
<td>17.7 ± 4.8</td>
<td>17.7 ± 4.9</td>
<td>25.4 ± 5.2</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>220</td>
<td>18.4 ± 6.0</td>
<td>16.9 ± 4.9</td>
<td>24.7 ± 5.9</td>
</tr>
<tr>
<td>Validation (Intercollegiate athletes)</td>
<td>Male</td>
<td>89</td>
<td>19.1 ± 5.5</td>
<td>16.5 ± 4.9</td>
<td>26.1 ± 4.9</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>75</td>
<td>19.7 ± 4.7</td>
<td>16.5 ± 4.8</td>
<td>23.9 ± 6.1</td>
</tr>
<tr>
<td>Validation (Interscholastic athletes)</td>
<td>Male</td>
<td>78</td>
<td>20.5 ± 5.2</td>
<td>18.4 ± 4.7</td>
<td>24.0 ± 4.9</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>89</td>
<td>20.0 ± 6.2</td>
<td>19.1 ± 5.5</td>
<td>23.4 ± 5.9</td>
</tr>
</tbody>
</table>
Results of CFA of the Calibration Sample

Initial CFA of the CSAI-2. The standardized path coefficients and error variances (1-\(R^2\)) of the initial CFA for the calibration sample are shown in Table 2. All path coefficients leading from latent variables (factors) to measurement variables (CSAI-2 items) were significant with \(p\) values < .001. Although all the paths were significant, the path coefficients leading from cognitive anxiety as a latent variable to cognitive anxiety Items 1 (.46) and 7 (.33) were relatively small. These two cognitive anxiety items correspond to the CSAI-2 statements, respectively, “I’m concerned about this competition” and “I’m concerned about reaching my
goal.” Estimated correlation coefficients among the three latent variables were .71 for cognitive anxiety and somatic anxiety, –.62 for cognitive anxiety and self-confidence, and –.67 between somatic anxiety and self-confidence.

With the exception of moderately high correlations among latent variables and low path coefficients for cognitive anxiety Items 1 and 7, results to this point appear to support the hypothesized three-factor structure of the CSAI-2. Inspection of the standardized residual covariance matrix (actual minus reproduced covariance matrix), and indices of goodness of fit, however, suggest a less than ideal fit of the data to the hypothesized model. A total of 125, or 33%, of the asymptotically standardized residuals were greater than 2.00. This suggests a great deal of variation between the actual and predicted variance/covariance matrix. Relative to goodness-of-fit indicators (Table 3), the chi-square statistic was significant, $\chi^2 (321) = 1210$, $p = .0001$, and the CFI, NNFI, and RMSEA were .87, .86, and .074, respectively. The lower and upper 90% confidence limits for the RMSEA were .070 and .079. These combined results suggest a poor fit of the data to the hypothetical CSAI-2 model (Figure 1). A poor fit appears to be due primarily to failure to accurately reproduce the covariance matrix as opposed to observing insignificant path coefficients.

### Table 3  Confirmatory Factor Analysis Fit Indices for the CSAI-2

<table>
<thead>
<tr>
<th>Fit index</th>
<th>Calibration sample ($N = 503$)</th>
<th>Validation sample ($N = 331$)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Initial CFA</td>
<td>Final revised CFA</td>
</tr>
<tr>
<td>Chi-square ($\chi^2$)</td>
<td>1210.00</td>
<td>251.10</td>
</tr>
<tr>
<td>$\chi^2$ df</td>
<td>321.00</td>
<td>116.00</td>
</tr>
<tr>
<td>CFI</td>
<td>.87</td>
<td>.97</td>
</tr>
<tr>
<td>NNFI</td>
<td>.86</td>
<td>.96</td>
</tr>
<tr>
<td>RMSEA</td>
<td>.074</td>
<td>.047</td>
</tr>
</tbody>
</table>

*Note: All $\chi^2$ values were statistically significant, $p < .01$*

**Follow-up CFA of CSAI-2.** Using the procedures outlined in the Methods section, we re-estimated the calibration model through systematic and sequential item deletion. Following each item deletion, a follow-up CFA was calculated on the revised measurement model. This process resulted in the deletion of 10 CSAI-2 items and 10 follow-up CFA. The goodness-of-fit indicators for the final 17-item model suggested a very good fit to the data. As shown in the second column of Table 3, the chi-square statistic was significant, $\chi^2 (116) = 251$, $p < .0001$. The other fit indices, however, indicated a good fit, with values for the CFI, NNFI, and RMSEA of .97, .96, and .047, respectively. The lower and upper 90% confidence limits for the RMSEA were .039 and .055. These combined results suggest a good fit of the data to the revised CSAI-2 model. The improvement of the fit of the data to the revised CSAI-2 model seems to be due primarily to the removal of items that load on more than one factor. Items that were removed from the CSAI-2 included four cognitive anxiety items (1, 4, 19, 25), two somatic anxiety items (2, 14), and four self-confidence items (3, 6, 12, 21).^2
Results of CFA on the Validation Sample

As illustrated in Figure 2, the revised CSAI-2 measurement model (CSAI-2R) is composed of 17 items. Five cognitive anxiety items are hypothesized to load on Factor 1 (cognitive anxiety), seven somatic anxiety items are hypothesized to load on Factor 2 (somatic anxiety), and five confidence items are hypothesized to load on Factor 3 (self-confidence).
The standardized path coefficients and error variances (1-\(R^2\)) of the CFA for the validation sample are also shown in Figure 2. All path coefficients leading from latent variables (factors) to measurement variables (revised CSAI-2 items) were significant, with \(p\) values <.001. All path coefficients but one were greater than .50. Estimated correlation coefficients among the three latent variables were .61 for cognitive anxiety and somatic anxiety, –.58 for cognitive anxiety and self-confidence, and –.35 between somatic anxiety and self-confidence. These coefficients could suggest reduced correlation among the latent variables compared to the calibration sample (greater independence), but we cannot rule out the possibility that the reduced intercorrelation is partly due to a reduction in the number of items per latent variable.

Relative to goodness-of-fit indicators (Table 3), the chi-square statistic was significant, \(\chi^2 (116) = 228, p < .0001\). However, the CFI, NNFI, and RMSEA were .95, .94, and .054, respectively, which indicates a good fit. The lower and upper 90% confidence limits for the RMSEA was .044 and .065. Overall, these results suggest a very good fit to the data, consistent with our a priori criteria.

**Discussion**

The purpose of the present study was to assess the factor structure of the CSAI-2 with a calibration sample, make theoretically and empirically guided modifications, and test the revised version of the instrument with a validation sample. Results from the calibration sample indicated that the CSAI-2 model did not provide a satisfactory fit to the data. Based on results from the Lagrange Multiplier Test, we deleted 10 CSAI-2 items, which resulted in a greatly improved model fit. This revised CSAI-2 was then tested via CFA in a second sample, with results again indicating a good model fit. Thus, based on these results and those from other studies (Lane et al., 1999; Tsorbatzoudis et al., 1998), we conclude that this revised version of the CSAI-2 (CSAI-2R) has stronger psychometric properties in terms of its factor structure than the original instrument.

A close review of the Lane et al. (1999) study shows many similarities between items they identified as problem items and those deleted from the CSAI-2 in the present study. The single discrepancy was CSAI-2 Item 21, which was deleted from the CSAI-2 in the present study but not identified as a problem item by Lane et al. (1999). Item 21, “I feel mentally relaxed,” is a self-confidence item that loaded on both self-confidence and somatic anxiety. It is not difficult to see why this item would load on both, as the word “relaxed” has a self-confidence connotation as well as a somatic connotation. Similarly, Item 14, a somatic anxiety item, was removed because it loaded on somatic anxiety and self-confidence. Item 14 reads “my body feels relaxed,” with again the word “relaxed” possibly having either a somatic or a confidence connotation. Most other items that were not included in the CSAI-2R contain words that can connote two different things. For example, Item 2 contains the word “nervous,” Item 3 the word “ease,” and Item 6 the word “comfortable,” all of which could refer to anxiety or confidence, depending on how it is used in the statement.

There were several aspects of this study that represent methodological improvements over the original work on the CSAI-2 (Martens et al., 1990). First, in testing the factor structure and revising the instrument, we used a more rigorous analytic technique than the original work (CFA vs. EFA). Second, the sample sizes
for this study were considerably larger than those used in developing the original CSAI-2. The sample sizes in the present study ranged from 331 to 503, whereas in the work of Martens et al. they ranged from 80 to 162. Third, only items that met strict criteria (high loadings on the CFA and no cross-loadings) were retained on the revised version of the CSAI-2.

Finally, and perhaps most important, the factor structure of the revised CSAI-2 developed in the calibration sample was tested on a second and completely independent sample. The revised CSAI-2 was developed on a sample of intramural athletes and then validated on sample of high school and college athletes. This methodology is stronger than that applied in the development of the CSAI-2, where some research participants participated in more than one stage of scale development. The fact that the factor structure of the revised instrument was strong across these two very different groups of athletes provides excellent support for its use in diverse athlete populations.

The results of our study, as well as the prior work on the CSAI-2 (Lane et al., 1999; Tsorbatzoudis et al., 1998), highlight in at least two ways the importance of replication when developing a psychological inventory. First, it is important to not only conduct some type of analysis designed to confirm a theoretically or empirically derived factor structure (e.g., CFA), but to do so on independent samples. This is especially the case when EFA is used to determine the factor structure of an instrument, because it is always possible that part of the factor structure may be due to sample-specific nuances in the data. Conducting a CFA on a separate sample allows the scale developer to address chance relationships that may have confounded the factor structure of the instrument.

Second, it is important that once an instrument has been developed and published, researchers continue to test its psychometric properties. All too often once an instrument has been published, studies addressing its psychometric properties cease to be published. This is unfortunate because, even if a researcher develops and confirms the factor structure of an instrument via independent samples, due to practical factors the samples may not be truly independent, and the generalizability of the instrument remains questionable. The researcher may have taken a large group of participants and randomly divided them into two subgroups, or perhaps the two samples were from the same geographic location. Another possible confound could be the effect of time, whereby the theoretical conceptualization for a measure was accurate during one time period but was no longer valid some years later. When other researchers test measures across different time periods, potentially confounding effects of factors such as geography and time can be addressed.

There were limitations to the present study. Data were collected in different locations where the external environment was varied (e.g., prior to an intramural competition vs. prior to a state championship competition), which made complete standardization of administration impossible. Also, even though independent samples of varying age and competitive level were used for the calibration and validation of the CSAI-2R, all athletes were located in the U.S. Midwest.

Future research on the CSAI-2R could encompass several directions. First, we encourage researchers to engage in additional psychometric work on the factor structure of the instrument. While we tested the revised instrument on diverse samples of athletes, our samples certainly were not fully representative of all athlete groups. Therefore researchers are encouraged to examine the factor structure of the CSAI-2R with groups not included in our samples, such as college athletes.
from competitive levels other than NCAA Division I, professional athletes, and club sport athletes. Future studies could also address the measurement invariance of the revised instrument across various subgroups of interest. It will be important to confirm that the factor structure of the revised instrument remains consistent between genders, across racial/ethnic groups, and across age groups.

Second, although the results of this study provide promising information regarding the internal consistency and construct validity of the CSAI-2R, studies assessing other forms of reliability and validity (i.e., criterion validity) are warranted. Research in this area could address the relationship between the CSAI-2R and other theoretical constructs that should be related to scores on the instrument, such as self-efficacy, sport confidence, and intrinsic motivation. It would be particularly intriguing to test the instrument’s convergent validity by examining the relationship between CSAI-2R scores and physiological measures of anxiety. Finally, researchers might undertake studies that address the utility of the CSAI-2R in the applied arena of performance enhancement. Such studies would address both the predictive and discriminant validity of the instrument and help establish the CSAI-2R as a useful clinical tool.

The CSAI-2 has been one of the most popular instruments in the field of sport psychology. However, results of the present investigation add support to the growing body of evidence that the CSAI-2, as originally conceptualized, has psychometric weaknesses. In this study we developed a revised version of the instrument, using sound psychometric methods, which maintains the theoretical structure of the original instrument. Although we encourage researchers to continue examining the psychometric properties of this revised instrument, we recommend that both researchers and clinicians use the CSAI-2R in place of the CSAI-2.

References


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**Notes**

1. The Gamma Lagrange Multiplier Index suggest paths, leading from latent variables to manifest variables, that if added will reduce the size of the $\chi^2$ by a certain amount. Associated with each index is a $p$-value indicating the probability that this expectation is false. Improved fit of the data to the hypothetical model is associated with a reduction of $\chi^2$. Indices greater than 10 or with $p$-values less than .0001 should be carefully scrutinized (Schutz, Eom, Smoll, & Smith, 1994).

2. The deleted CSAI-2 items are listed below as a function of subscale:

**Cognitive Anxiety**
1. I am concerned about this competition.
4. I have self-doubts.
19. I’m concerned about reaching my goal.
25. I’m concerned I won’t be able to concentrate.

**Somatic Anxiety**
2. I feel nervous.

**Self-Confidence**
3. I feel at ease.
6. I feel comfortable.
12. I feel secure.
21. I feel mentally relaxed.
Appendix

Revised Competitive State Anxiety–2 (CSAI-2R)

Directions: A number of statements that athletes have used to describe their feelings before competition are given below. Read each statement and then circle the appropriate number to the right of the statement to indicate how you feel right now – at this moment. There are no right or wrong answers. Do not spend too much time on any one statement, but choose the answer which describes your feelings right now.

1. I feel jittery (somatic anxiety, 5).
2. I am concerned that I may not do as well in this competition as I could (cognitive anxiety, 7).
3. I feel self-confident (self-confidence, 9).
4. My body feels tense (somatic anxiety, 8).
5. I am concerned about losing (cognitive anxiety, 10).
6. I feel tense in my stomach (somatic anxiety, 11).
7. I’m confident I can meet the challenge (self-confidence, 15).
8. I am concerned about choking under pressure (cognitive anxiety, 13).
9. My heart is racing (somatic anxiety, 17).
10. I’m confident about performing well (self-confidence, 18).
11. I’m concerned about performing poorly (cognitive anxiety, 16).
12. I feel my stomach sinking (somatic anxiety, 20).
13. I’m confident because I mentally picture myself reaching my goal (self-confidence, 24).
14. I’m concerned that others will be disappointed with my performance (cognitive anxiety, 22).
15. My hands are clammy (somatic anxiety, 23).
16. I’m confident of coming through under pressure (self-confidence, 27).
17. My body feels tight (somatic anxiety, 26).

Note: Original CSAI-2 item number is in parentheses along with factor classification. Each item is set to a 4-point Likert scale as in the original CSAI-2.

Scoring key:
- Somatic anxiety: 1, 4, 6, 9, 12, 15, 17
- Cognitive anxiety: 2, 5, 8, 11, 14
- Self-confidence: 3, 7, 10, 13, 16

Subscale score is obtained by summing, dividing by number of items, and multiplying by 10. Score range is 10 to 40 for each subscale. If an athlete fails to respond to an item, merely sum and divide by items answered.

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