Psychometric Re-evaluation of the Revised Version of the Competitive State Anxiety Inventory-2

Peter C. Terry (terryp@usq.edu.au)
Department of Psychology
University of Southern Queensland, Toowoomba QLD 4350 Australia

Angus Munro (angusm@bigpond.net.au)
Department of Psychology
University of Southern Queensland, Toowoomba QLD 4350 Australia

Abstract

The Competitive State Anxiety Inventory-2 (CSAI-2) has been the measure of choice among anxiety researchers in the sport domain since its development in 1990. A 17-item revised version, the CSAI-2R, was developed in 2003 by Cox and colleagues. The present study re-evaluated the psychometric characteristics of the CSAI-2R. Repeated measures data from 92 social-competitive tennis players at five points in time were subjected to principal axis factoring with promax rotation. Results supported the hypothesized, 3-factor measurement model. The measurement model was recovered cleanly at all time points, explaining between 58.1% and 68.8% of variance. Minimal complexity among items was evident. Cronbach alpha coefficients exceeded criterion values for all subscales at each time point (cognitive anxiety = .82 - .88, somatic anxiety = .79 - .89, self-confidence = .87 - .92). Inter-correlations among factors were in line with theoretical predictions and supported their conceptual independence. Overall, results supported the factorial validity of the revised scale in five replications. The present findings indicate that the CSAI-2R has satisfactory psychometric characteristics, unlike those reported by Lane and colleagues in 1999 for the original CSAI-2, which showed a flawed measurement model. Results suggest that researchers investigating anxiety in sport should use the CSAI-2R in preference to the original CSAI-2.

Introduction

Anxiety is one of the most frequently researched constructs in the field of sport and exercise psychology. This substantial body of research has produced a solid evidence base that pre-competition anxiety and athletic performance are related (Craft, Magyar, Becker, & Feltz, 2003; Klein, 1990), although the exact nature of the relationship has been, and remains, a contentious issue (Burton & Naylor, 1997; Woodman & Hardy, 2003).

There are at least 22 published scales available to measure anxiety (see Ostrow, 1996). However, the Competitive State Anxiety Inventory-2 (CSAI-2: Martens, Burton, Vealey, Bump, & Smith, 1990) has generally been the scale of choice for researchers since its development. Given its prominence as a research tool, indeed it was described by Woodman and Hardy (2003, p.453) as having "near *sine qua non* status", the CSAI-2 has naturally been the subject of considerable scrutiny of its psychometric characteristics. Several studies have now been published that have raised concerns about the factorial validity of the CSAI-2 in its English (Cox, Martens, & Russell, 2003; Lane, Sewell, Terry, Bartram, & Nesti, 1999), Greek (Tsorbatzoudis, Varkoukis, Kaissidis-Rodafinos, & Grouios, 1998), and Swedish (Lundqvist & Hassmén, 2005) versions. Collectively, re-evaluations of its psychometric properties have raised serious doubts about the validity of the CSAI-2 in its original form and by implication have cast a shadow over the findings of dozens of studies that have used it to measure anxiety. To address this situation, Cox et al. (2003) conducted a two-stage process using calibration and validation samples to arrive at an improved measure. Having deleted problematic items in the original CSAI-2 and having subsequently supported the factorial validity of a revised version of the measure, termed the CSAI-2R, they recommended that researchers and clinicians should in future use the revised measure in preference to the original. In an independent evaluation of its psychometric characteristics by Terry, Lane, and Shepherdson (2005), the measurement model of the CSAI-2R received partial support, although some fit indices were marginal. Given its potential to become the new scale of choice for researchers in the sport and exercise domains, further re-evaluation of the psychometric integrity of the CSAI-2R is necessary. Therefore, the purpose of the present study was to re-evaluate the factorial validity of the CSAI-2R, as recommended by Cox and colleagues.

Method

Participants

Ninety-two social-competitive tennis players from Sydney's Northern Suburbs, with ages ranging from 19 to 62 years (M = 39.7, SD = 9.8 yr.; male = 49, female = 43) participated in the study. Participants competed in a weekly competition over five weeks, completing the CSAI-2R before each match played. Players were entered into a prize draw in return for continued participation. A total dataset of 411 administrations of the scale were entered into the analyses.

Measures

The CSAI-2R is a 17-item scale that measures cognitive state anxiety (5 items), somatic state anxiety (7 items) and self-confidence (5 items) in a competitive setting. Respondents rate their feelings before competition (e.g., *I feel jittery, I am concerned about losing*) on a scale anchored by 1 = *not at all* and 4 = *very much so*. Subscale scores are calculated by summing items in each subscale, dividing by the number of items, and multiplying by 10. Score range is 10 – 40 for each subscale. The factorial validity of the CSAI-2R was previously supported by Cox et al. (2003) using confirmatory factor analysis on data from 331 athletes, which showed a good fit of the hypothesised measurement model to the data (χ^2 /df = 1.97; NNFI = .94, CFI = .95, RMSEA = .05).

Procedure

The project received ethical approval from the University of Southern Queensland and all participants provided written informed consent. Given the repeated measures taken, it was judged to be inappropriate to run confirmatory procedures on the entire dataset of 411 administrations of the CSAI-2R. Instead, it was decided to test whether the measurement model could be recovered cleanly using exploratory procedures in five replications, based on data collected prior to five matches for each participant. Therefore, the three-factor model was assessed using exploratory factor analysis in a confirmatory manner whereby it was hypothesized that the proposed measurement model would be identified among participants' data at each point in time. The attrition rate was good, resulting in participant numbers for the five analyses of 92, 88, 83, 76, and 72. Although these sample sizes are relatively small for the purpose of factor analysis, they were judged to be adequate, especially given the subsequent consistency of the findings (see Tabachnick & Fidell, 2001). Five items were hypothesized to load onto Factor 1 (cognitive anxiety) and Factor 3 (self-confidence) with seven items hypothesized to load onto Factor 2 (somatic anxiety). Replication of the measurement model using this method was judged to be a rigorous test of factorial validity.

Results

Assumptions underlying the statistical procedures used were confirmed. The full range of response categories was used by participants for each of the 17 items. Estimated correlation coefficients among the factors across the entire dataset were .64 for cognitive anxiety and somatic anxiety, -.50 for cognitive anxiety and self-confidence, and -.43 for somatic anxiety and self-confidence. These inter-correlations were in the predicted direction and of an appropriate magnitude for factors that are hypothesized to be correlated rather than orthogonal. Given these inter-relationships, oblique rather than orthogonal rotation of the extracted factor structure was used to help clarify the latent factors.

Principal axis factoring with promax rotation applied to Time 1 data recovered the hypothesized factor structure cleanly with only two exceptions (see Table 1). The self-confidence scale was unequivocal, with no cross-loadings. The somatic anxiety scale was also readily identifiable except that the factor loading for Item 14, *My hands are clammy*, was below the criterion level of .40. The cognitive anxiety scale was recovered cleanly except that Item 7, *I am concerned about choking under pressure*, cross-loaded more strongly with the somatic anxiety items.

Table 1: Factor matrix of the CSAI2-R at Time 1.

Factor (Item)	1	2	3
Som (16)	.80		
Som (12)	.72		
Som (6)	.72		
Som (3)	.71		
Som (1)	.49		
Som (10)	.44		
Som (14)	.13		
SC (11)		.86	
SC (17)		.84	
SC (8)		.76	
SC (15)		.71	
SC (4)		.67	
Cog (13)			.92
Cog (9)			.74
Cog (2)			.56
Cog (5)			.55
Cog (7)	.61		.17

Note. N = 92. Variance explained = 59%. Cog = cognitive anxiety, Som = somatic anxiety, SC = self-confidence. Cross-loadings < .40 are omitted.

At Time 2, the hypothesized structure was recovered cleanly for both the cognitive anxiety and self-confidence scales. The somatic anxiety scale also emerged cleanly except that item 6, *I feel tense in my stomach*, cross-loaded onto the cognitive anxiety scale (see Table 2). Results of the factor analysis at Time 3 showed that the hypothesized factor structure was recovered cleanly with no cross-loadings. The factor loading for Item 7, *I am concerned about choking under pressure*, fell marginally below the criterion level (see Table 3).

Table 2: Factor matrix of the CSAI2-R at Time 2.

Factor (Item)	1	2	3
SC (4)	..86		
SC (17)	.80		
SC (11)	.79		
SC (8)	.78		
SC (15)	.69		
Som (10)		.83	
Som (12)		.69	
Som (16)		.67	
Som (3)		.64	
Som (14)		.61	
Som (1)		.54	
Som (6)		.24	.40
Cog (5)			.93
Cog (9)			.89
Cog (2)			.63
Cog (13)			.55
Cog (7)			.36

Note. N = 88. Variance explained = 61%. Cog = cognitive anxiety, Som = somatic anxiety, SC = self-confidence. Cross-loadings < .40 are omitted.

Table 3: Factor matrix of the CSAI2-R at Time 3.

Factor (Item)	1	2	3
SC (8)	.84		
SC (11)	.76		
SC (17)	.75		
SC (4)	.70		
SC (15)	.69		
Som (6)		.81	
Som (12)		.80	
Som (16)		.58	
Som (10)		.56	
Som (14)		.46	
Som (3)		.45	
Som (1)		.41	
Cog (9)			.89
Cog (2)			.78
Cog (5)			.70
Cog (13)			.56
Cog (7)			.36

Note. N = 83. Variance explained = 58%. Cog = cognitive anxiety, Som = somatic anxiety, SC = self-confidence. Cross-loadings < .40 are omitted.

The hypothesized factor structure was also clearly identifiable among Time 4 data. Results in Table 4 show that the self-confidence and cognitive anxiety scales were recovered cleanly with no cross-loadings. The somatic anxiety scale was also clear except that the factor loading for Item 14, *My hands are clammy*, did not reach the criterion level.

Table 4: Factor matrix of the CSAI2-R at Time 4.

Factor (Item)	1	2	3
SC (11)	.93		
SC (17)	.89		
SC (15)	.85		
SC (4)	.78		
SC (8)	.76		
Som (12)		.94	
Som (6)		.86	
Som (3)		.68	
Som (10)		.67	
Som (16)		.61	
Som (1)		.40	
Som (14)		.22	
Cog (9)			.94
Cog (5)			.87
Cog (2)			.80
Cog (13)			.61
Cog (7)			.61

Note. N = 76. Variance explained = 66%. Cog = cognitive anxiety, Som = somatic anxiety, SC = self-confidence. Cross-loadings < .40 are omitted.

At Time 5, the hypothesized factor structure was recovered perfectly for all three scales (see Table 5). All factor loadings exceeded the criterion level and no cross-loadings were apparent.

Internal consistency (alpha) coefficients for the CSAI-2R subscales at all five data collection points are shown in Table 6. Alpha coefficients strongly supported the internal consistency of the subscales. For the self-confidence subscale, there were no instances where alpha would have increased with the removal of an item. For cognitive anxiety, removal of Item 7, *I am concerned about choking under pressure*, at Time 3 would have increased alpha marginally to .83. For somatic anxiety, removal of Item 14, *My hands are clammy*, would have increased alpha marginally at Time 1 (to .81), Time 4 (to .87) and Time 5 (to .90).

Table 5: Factor matrix of the CSAI2-R at Time 5.

Factor (Item)	1	2	3
Som (6)	.89		
Som (16)	.83		
Som (10)	.79		
Som (12)	.73		
Som (3)	.66		
Som (1)	.58		
Som (14)	.54		
SC (11)		.90	
SC (8)		.89	
SC (17)		.83	
SC (15)		.82	
SC (4)		.78	
Cog (13)			.90
Cog (9)			.85
Cog (2)			.79
Cog (5)			.73
Cog (7)			.47

Note. N = 72. Variance explained = 69%. Cog = cognitive anxiety, Som = somatic anxiety, SC = self-confidence. Cross-loadings < .40 are omitted.

Table 6: Internal consistency coefficients for the subscales of the CSAI-2R at five data collection points.

Factor	α				
	1	2	3	4	5
Cognitive anxiety	.82	.84	.82	.88	.88
Somatic anxiety	.80	.82	.79	.86	.89
Self-confidence	.87	.89	.87	.92	.92

Note. Time 1: n = 92; Time 2: n = 88; Time 3: n = 83; Time 4: n = 76; Time 5: n = 72.

Descriptive statistics for the CSAI-2R scores over the five samples are shown in Table 7. Mean subscale scores did not differ significantly across the five administrations (Wilks = .98, p > .05) and were similar to those previously reported for the CSAI-2R, suggesting that anxiety responses reported by participants were representative of the population of interest.

Inter-correlations among the CSAI-2R subscale scores are shown in Table 8. Inter-relationships among subscale scores were in the same direction and of similar magnitudes at each of the five data collection points. Cognitive and somatic anxiety scores showed a moderate positive relationship at each time point. Cognitive anxiety and self-confidence scores showed a moderate negative relationship at each time point. Somatic anxiety and self-confidence scores showed a low-to-moderate negative relationship at each time point, although some variation in the strength of the relationship was evident. This consistent pattern of inter-correlations among subscales provides further supporting evidence of the psychometric integrity of the measure.

Table 7: Descriptive statistics for the subscales of the CSAI-2R at five data collection points.

Factor	Mean (SD)				
	1	2	3	4	5
Cog anxiety	17.5 (6.4)	17.1 (6.2)	16.9 (6.0)	16.2 (6.2)	16.6 (6.6)
Som anxiety	13.9 (4.5)	14.2 (4.6)	13.2 (3.8)	13.4 (4.4)	13.8 (5.0)
Self-conf	23.8 (7.4)	24.0 (7.8)	23.5 (7.5)	24.0 (8.4)	23.3 (7.8)

Note. Time 1: n = 92; Time 2: n = 88; Time 3: n = 83; Time 4: n = 76; Time 5: n = 72.

Table 8: Correlation coefficients between the subscales of the CSAI-2R at five data collection points.

Factor	r Som	r SC
Time 1 (n = 92)		
Cognitive anxiety	.61	-.30
Somatic anxiety		-.39
Time 2 (n = 88)		
Cognitive anxiety	.49	-.37
Somatic anxiety		-.11
Time 3 (n = 83)		
Cognitive anxiety	.48	-.45
Somatic anxiety		-.34
Time 4 (n = 76)		
Cognitive anxiety	.56	-.41
Somatic anxiety		-.43
Time 5 (n = 72)		
Cognitive anxiety	.61	-.50
Somatic anxiety		-.38

Note. Som = somatic anxiety, SC = self-confidence.

Discussion

The hypothesized factor structure of the CSAI-2R received strong support in the present study. With only a small number of minor deviations, the measurement model was recovered cleanly across five replications. Inter-correlations among subscale scores were in line with theoretical predictions and remained consistent across the five replications. Internal reliability coefficients were high for all three subscales at all five time points. From a psychometric perspective, small question marks were raised over the integrity of Items 6, 7, and 14. The present results were generally consistent with the psychometric

characteristics provided by Cox et al. (2003), who developed the revised scale. The present results provided a greater level of support for the validity of the CSAI-2R than those reported previously for the English version of the CSAI-2R by Terry and colleagues (2005) and by Lundqvist and Hassmén (2005) for the Swedish version. This variation in level of support might be explained, in the latter case, by small changes in meaning associated with translation of the scale from English to Swedish. It is not clear, however, why the level of support for the validity of the English version of the CSAI-2R in the present study was stronger that previously reported by Terry, Lane and Shepherdson (2005). Given the widespread use of anxiety measures in sport psychology research, it appears that further psychometric re-evaluations of the CSAI-2R are warranted before the scale becomes established as the measure of choice among researchers. Nevertheless, it is apparent that all evaluations of the CSAI-2R conducted to date have been supportive of its psychometric integrity to a greater or lesser degree, and have not identified significant psychometric deficiencies. The present results further support the notion that the CSAI-2R has superior psychometric properties to the original CSAI-2. It is therefore recommended that researchers investigating anxiety responses in competitive situations should consider using the CSAI-2R in preference to the CSAI-2.

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