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Abstract
This study aimed to provide further psychometric validation of the Sport Anxiety Scale-2 (SAS-2) by assessing the factor structure, invariance across gender, and convergent and divergent validity of the SAS-2 by correlating both related (i.e., anxiety sensitivity, brief fear of negative evaluation, intolerance of uncertainty, and negative affect) and unrelated constructs (i.e., positive affect, self-confidence). A total of 542 current and former competitive athletes completed a questionnaire through Amazon's Mechanical Turk system. All data were collected via online survey. Participants were randomly assigned to an exploratory factor analysis (n = 271) and confirmatory factor analysis group (n = 271). Results indicated that both exploratory and confirmatory factor analyses supported the three-factor model of anxiety involving somatic anxiety, worry, and concentration disruption. Additionally, this study found the SAS-2 to be reliable, gender invariant, and have strong construct validity. Our findings extend the generalizability of the SAS-2 in more varied populations of athletic backgrounds.

Keywords*:* athletes, psychometrics, reliability, validation

In order to optimize performance, athletes must seek the key balance between arousal and performance such that arousal is sufficient to sharpen attention but not so excessive to be distracting from the task at hand. This is the classic Yerkes-Dobson curve in psychology, adapted in performance by

Neiss (1988) where excessive arousal has been labelled competitive anxiety. The notion of competitive anxiety includes a negative, unpleasant emotional response to stressors within competition that can be expressed through feelings of apprehension and tension (Martens, Vealey, & Burton, 1990; Mellalieu, Hanton, & Fletcher, 2006). A meta-analysis using 48 studies found high levels of competitive anxiety to be a predictor of decreased sport performance (Woodman &Hardy, 2003). Competitive anxiety also can increase injury susceptibility, facilitate depression, and contribute to sport drop out (Gould, Greenleaf, & Krane, 2002; Woodman & Hardy, 2003). For those working with athletes, a key question in optimizing performance and minimizing competitive anxiety is how do we accurately measure their anxiety in the context of sport/performance.

The most common assessment of this construct is the Sport Anxiety Scale-2 (SAS-2; Smith, Smoll, Cumming, & Grossbard, 2006), but replication of the scale factor structure is needed in an English-speaking population. The SAS-2 is a shortened version of the Sport Anxiety Scale (SAS; Smith et al., 2006). In a sample of 9–11 years olds (n = 484) and 12–14 year olds (n = 554), Grossbard and colleagues (2009) found that young athletes differentiate between cognitive and somatic components. Although studies have examined the factor structure of the predecessor SAS (Prapavessis, Maddison, & Fletcher, 2005), or on non-English versions of the SAS-2 (Ramis, Viladrich, Sousa, & Jannes, 2015), only one study has explored the factor structure of the SAS-2 with an English-speaking sample. Therefore, additional work is needed to examine whether the three-factor structure proposed by Grossbard and colleagues (2009) is replicable in a U.S. sample. Based on limitations in previous studies of age, English speaking populations, and variance of sport, the current study aimed to further examine the psychometric properties the SAS-2, with former athletes from diverse sporting experience.

Consistent with other aspects of anxiety, there are gender differences in competitive anxiety (Abrahamsen, Roberts, & Pensgaard, 2008; Grossbard, Cumming, Standage, Smith, & Smoll, 2007; Thatcher, Thatcher, & Dorling, 2004). Grossbard et al. (2009) were the first to establish gender invariance with the SAS-2 in a sample of adolescent athletes. Ramis et al. (2015) examined gender invariance using 842 athletes from Spain, Belgium, and Portugal. Using the Spanish, Flemish, and Portuguese versions of the SAS-2 in their invariance testing, they found that these versions were invariant across gender, age, and sport-type. While these versions were translated from the original SAS-2, gender invariance testing on the English-version has only been done once before (Grossbard et al., 2009). Further evidence is needed to confirm that the SAS-2 is not biased in terms of gender.

Previous research has not explored competitive anxiety using self-reported scales in a sample of former athletes. In many studies examining competitive anxiety using self-reported scales, athletes have been assessed either immediately prior to (Kais & Raudsepp, 2005; Kaye, Frith, & Vosloo, 2015) or in reflection on how they generally feel in competition (Duica, Balazsi, Ciulei, & Bivolaru, 2014; Ramis et al., 2015). Research has supported that athletes are capable of accurately recalling competition levels of anxiety (Wilson, Raglin, & Harger, 2000).

The purpose of this study was to examine the factorial structure and construct validity of the SAS-2, with a sample of broader ages and competitive levels of former athletes. Since the factor structure of the SAS-2 has only been examined once before in English (Grossbard et al., 2009), there is a need to replicate the original factor structure to first determine if the theoretical model is correct. Thus an exploratory factor analysis was necessary to explore the emergence of sports-related anxiety factors. Next, using a split-sample procedure, a confirmatory factor analysis was used to validate the factor structure from exploratory factor analysis to determine how well the model fit the data. In further psychometric testing, we also examined multigroup invariance across gender by comparing factor loadings, factor variances and covariances, and item residual variances (Byrne, 2004). Finally, we examined convergent and divergent validity of the SAS-2 by correlating both related (i.e., anxiety sensitivity, brief fear of negative evaluation, intolerance of uncertainty, and negative affect) and unrelated constructs (i.e., positive affect, self-confidence).

Method

Participants

Participants were randomly assigned to one of two groups for factor analytic studies: an exploratory factor analysis group (n = 271) and confirmatory factor analysis group (n = 271). Participants' ages in the exploratory sample ranged in age from 18 to 72 (M= 33.87, SD = 11.14). In the confirmatory sample, participants age ranged in age from 18 to 64 (M= 32.82, SD = 10.43). In both the exploratory and confirmatory samples, all participants indicated that they have participated in an organized sport. In the exploratory sample, 41% reported having to miss competing due to sports-related injury compared to 51.3% in the confirmatory sample. The type of sports played by participants at the highest level in both samples was fairly distributed, but basketball (approximately 13%) and soccer (approximately 14%) were the most endorsed sports. See Table 1 for additional characteristics of exploratory and confirmatory samples.

Table 1. Demographic Data of Exploratory and Confirmatory Samples

	Exploratory (n = 271)		*Confirmatory (n = 271)*	
Characteristic	*n*	*%*	*n*	*%*
Region				
Southeast	72	26.6	65	24.4
West	61	22.5	62	22.9
Northeast	60	22.1	51	18.8
Midwest	56	20.7	68	25.1
Southwest	22	8.1	25	9.2
Gender				
Men	130	48	131	48.3
Women	140	51.7	140	51.7
Other Gender	1	.4		
Ethnicity				
European American	212	78.2	210	77.5
African American	17	6.3	16	5.9
Asian American or Pacific Islander	11	4.1	13	4.8
Latino	13	2.7	6	2.2
Multiethnic	12	4.4	21	7.7
Native American/Other	6	2.2	5	1.8
Education				
Advanced degree	47	17.3	37	13.7
College graduate	122	45.0	120	44.3
Some College	83	30.6	92	33.9
High School Equivalency or Lower	18	6.6	22	8.1
Not Reported	1	.4		
Relationship				
Married, Living Together	127	46.9	116	42.8
Single, Dating, or Engaged	126	46.5	141	52
Divorced	17	6.3	14	5.2
Not Reported	1	.4		
Employment				
Full-time	41	15.1	44	16.2
Part-time	141	52.0	151	55.7
Student	38	14.0	21	7.7
Unemployed	23	8.5	26	9.6
Homemaker	16	5.9	15	5.5
Other	12	4.4	14	5.2
Highest Competition Played				
High School	140	51.7	148	54.6
College	47	17.3	43	15.9
Club	21	7.7	24	8.9
Intramural	24	8.9	13	4.8
League	24	8.9	25	9.2
Pro, Semi Pro, or Other	15	5.6	18	6.6
Time Since Last Competed				
Present to 1 year	35	12.9	32	11.8
2–3 years	28	10.3	30	11.1
4–6 years	49	18.1	45	16.6
7–10 years	50	18.5	46	17
11 or more years	109	40.2	118	43.5

Measures

Sport performance anxiety. The SAS-2 (Smith et al., 2006) was used to assess sport-performance anxiety. The SAS-2 is a 15-item measure that involves three subscales (Somatic Anxiety, Worry, and Concentration Disruption) each consisting of five items. A composite performance-anxiety score based on summing the three subscales scores can also be obtained. Items of the SAS-2 reflect the possible responses that athletes may have before or while they compete in sports (e.g., "My body feels tense,", "I worry that I will not play my best," "I lose focus on the game"). Participants respond how they typically felt based on a 4-point Likert scale, ranging from *not at all* (1) to *very much* (4). Smith et al. (2006) reported internal consistency (Cronbach's alpha) coefficients exceeding .80 for all subscales and .91 for the total score, which was consistent with the present study (α = .95). Reliability estimates for the three subscales were excellent (Worry, α = .94; Concentration Disruption, α = .92; Somatic Anxiety, α = .92).

Competitive state anxiety inventory. The CSAI-2 (Martens, Burton, Vealey, Bump, & Smith, 1990) was used to measure cognitive anxiety (9 items; "I am concerned about losing", "I am concerned about choking under pressure"), somatic anxiety (9 items; "I feel nervous:, "My body feels tight"), and self-confidence (9 items; "I feel comfortable"; "I am confident I can meet the challenge"). Participants were instructed to indicate (a) how they typically feel before competing in sports if they were still competing or (b) reflect back to how they would typically feel when they competed at their highest level of competition using a 4 point Likert scale (1 = not at all; 4 = very much so). Each subscale total ranges from 9 to 36. Cronbach's alpha coefficients ranging from .70 to .90 have been reported (Martens et al., 1990). Reliability estimates for the subscales in the present sample were excellent, CSAI-2 Confidence (α = .91), CSAI-2 Somatic (α = .80), and CSAI-2 Cognitive (α = .85).

Anxiety sensitivity index. The ASI-3 (Taylor et al., 2007) is an 18-item self-report questionnaire that measures fear of anxiety-related sensations on a 5-point Likert-type scale from *Describes me very little* to *Describes me very much*. Total scores range from 0–72, with higher scores indicating greater anxiety sensitivity. Adapted from the ASI (Reiss, Peterson, Gursky, & McNally, 1986) the ASI-3 provides a more stable assessment of the three most commonly replicated lower-order anxiety sensitivity dimensions (i.e., cognitive, social, and physical concerns). The ASI-3 has been shown to have good reliability and internal consistency α = .76–.86 (Taylor et al., 2007). Kemper, Lutz, Bahr, Ruddel, and Hock (2012) found that the mean score on the ASI for a clinical population was 33.05 (*SD* = 15.81), whereas Taylor and colleagues

(2007) found that the mean for a nonclinical population was 12.8 (*SD* = 10.5). Cronbach's α for this sample was .93 for the total scale and .90, .92, and .79 for the physical, cognitive, and social subscales, respectively.

The Intolerance of Uncertainty Scale (IUS; Buhr & Dugas, 2002) is a 27-item scale using a five-point Likert-type response scale of 1 (*not at all characteristic of me*) to 5 (*very characteristic of me*). The IUS assesses emotional, cognitive, and behavioral reactions to ambiguous situations, implications of being uncertain, and attempts to control the future. Higher scores indicate greater intolerance of uncertainty. Sample items include "uncertainty stops me from having a strong opinion" and "uncertainty makes life intolerable." Buhr and Dugas (2002) reported strong internal consistency for the IUS (α = .94), which was consistent with reliability analysis from the present study (α = .91).

The Positive and Negative Affect Schedule (The PANAS; Watson, Clark, & Tellegen, 1988) is a 20-item self-report questionnaire that measures positive and negative affect on a 6-pont Likert-type scale from the extent they felt an emotion ranging from *Very slightly or not at all* to *Extreme*. There are two subscales, positive and negative affect. Each scale's total scores range from 10–50 with higher scores representing higher levels of positive or negative affect. It is a widely used, well-validated, and reliable measure of negative and positive affect (Watson, 2000). For this participants were asked to what extent they felt over the last week. Both PANAS-N and PANAS-PA have good test-retest reliability and has good internal consistency (Watson et al., 1988). For the present sample, Cronbach's α was .93 and .89 for positive and negative affect, respectively.

The Brief Fear of Negative Evaluation (BFNE; Leary, 1983) is a 12-item self-report questionnaire that measures participants' fear of negative evaluation on a 5-point Likert-type scale form the extent that a statement characterized them ranging from *not at all characteristic of me* to *extremely characteristic of me*. Four of the items are reverse scored and total scores range from 12–60 with higher scores representing higher fear of negative evaluation. The BFNE has good test-retest reliability and has good internal consistency, α = .90 (Leary, 1983). Cronbach's α for this sample for was .78

Sport participation questions. Participants were asked to indicate sports they have participated in and then identify which sport(s) they competed at the highest level (i.e., high school, recreation league, intramural, club, college, semi-professional, professional). For those that indicated college as their highest level, they were asked to indicate what level they played (i.e., NCAA Division I, II, III, NAIA). Participants were then instructed to indicate how long ago they competed at their highest level.

Procedure

Participants were recruited through Amazon's Mechanical Turk system. Mechanical Turk is an online market for labor requests such that requestors post jobs and workers choose jobs to complete for varying pay rates. Research indicates that data collection via Mechanical Turk is at least as reliable as traditional methods and compensation rates do not affect data quality (Buhrmester, Kwang, & Gosling, 2011). The labor requests for the present study were posted on Mechanical Turk as a listing format among other competing job requests. However, the listing was limited to those workers who live within the United States. Information on the number of potential workers who have access to the listing is not made available to requestors. Upon accessing the job request, participants are asked to go to a Qualtrics link to fill out survey questions. Before beginning the survey, they were required to affirm that they were at least 18 years old (19 years old in Nebraska and Alabama, and 21 years old in Mississippi) and that they had read and electronically signed the informed consent form. Recruitment was presented with the title, "Answer a survey about your interests and involvements in sports" with the description of, "Give us your opinion about your sports interests and involvement." After the survey was completed, participants were presented with a debriefing form and instructed to enter a specific code in order to receive compensation (e.g., $0.50 US). All procedures were approved by the university Institutional Review Board. A total of 899 responses were received, but 357 responses were eliminated due to missing data (N = 355) and duplicate data (N = 2). After missing data were removed, there was no indication of random responding as detected by validity checks. As described above, 357 responses were eliminated due to missing data (N = 355) and duplicate data (N = 2) out of a total of 899 responses received. Responses with missing data were those who indicated that they never played in any sports and subsequently exited the online survey.

All participants completed questions in the following order: sport participation, CSAI-2 PANAS, ASI-3, BFNE, and the IUS. BFNE. Finally, demographics information was collected. Participants were asked about age, race/ethnicity, gender, employment, state residency, educational level, marital status, highest level of sports completion, if still competing or how long ago competed.

Analysis Strategy

Factor structure. To ensure that the 3-factor structure of the SAS-2 was exhibited in a population of athletes from various sporting experience and time since they competed at their highest level, exploratory factor analysis (EFA) was employed to explore whether the theoretical model was correct.

To evaluate the goodness of fit of the factor structure on the data, a confirmatory factor analysis (CFA) was utilized. To examine the structure of the SAS-2 from the same sample, a two-step approach combining exploratory and confirmatory factor analysis as recommended by Hinkin (1998). While it is recommended that CFA be conducted on the variance-covariance matrix on the data collected from an independent sample, splitting the sample into random halves is an acceptable method if the initial sample is large enough in combining factor analysis methods (Krzystofiak, Cardy, & Newman, 1988). Therefore, the data was randomly split into two halves (n = 271; n = 271) to combine exploratory and confirmatory analysis approaches discussed below. In determining the number of factors to retain, the Kaiser rule, parallel analysis and Velicer's minimum average partial (MAP) tests were utilized (Cota, Longman, Holden, & Kekken, 1993; Velicer, 1976).

Following the EFA, Amos 20.0 was used to evaluate the fit of the data to the hypothesized measurement model with Maximum Likelihood Estimation. Good model fit is indicated by minimum values of .95 for CFI and GFI, .91 for NFI, and values equal or less than .08 for RMSEA (Hu & Bentler, 1999; Meyers, Gamst, & Guarino, 2013; Tabachnick & Fidell, 2001). Although a nonsignificant chi square is preferred, this index is too sensitive to sample size and other measures of fit are prioritized for judging model fit (Brown & Moore, 2006).

Gender invariance. To assess whether the factor structure differed for men and women, a multiple-group CFA procedure in AMOS as described by Byrne (2001, 2004) was utilized to conduct invariance analysis. Multiple-group analysis in structural equation modeling allows comparisons of the same construct across samples for any identified structural equation model simultaneously. This approach tests whether the groups meet the assumption of equality by examining whether different sets of path coefficient are invariant. In addressing equivalence across groups, invariance for both the items and the factorial structure will be tested across groups using the analysis of covariance structures. To test invariance, the fit statistics of non-constrained (where parameters are free to vary) and constrained models were compared simultaneously across gender groups. With a multiple-group approach, invariance testing imposes equality constraints on particular parameters and the data for all groups must be analyzed simultaneously to obtain efficient estimates. Overall, the procedure for testing multigroup invariance is based on analysis of covariance structures.

Construct validity. Convergent and divergent validity of the SAS-2 was demonstrated through Pearson correlations with existing measures and using the Bonferroni adjustment to correct for multiple comparisons.

Results

Sample Characteristics

A one-way ANOVA was used to determine group differences on various measures between individuals still competing in sports and individuals who are no longer competing. No significant group differences were found on the SAS-2, IUS, ASI, BFNE, CSAI, and negative affect. However, individuals still competing (*M*= 3.57; *SD* = .95) reported significantly higher levels of positive affect compared to individuals who are not currently competing (*M*= 3.18; *SD* = .88), F (1, 540) = 5.49, $p < .02$. Additionally, no significant group differences were found among marital status, education, employment, or ethnicity on cognitive-affective measures.

Exploratory Factor Analysis

An EFA of the 15 items of the Sports Anxiety Scale-2 (SAS-2) was performed on half of the data ($n = 271$). Prior to evaluating analyses with IBM SPSS, the Kaiser-Meyer-Olkin measure of sampling adequacy was .95, indicating that the present data were suitable for analysis (Kaiser, 1970). Similarly, Bartlett's test of sphericity was significant ($p < .001$), indicating sufficient correlation between the variables to proceed with the analysis. Principle axis factoring was selected as the method of extraction. Since the factors of the SAS-2 are measuring aspects of the same underlying construct, they are expected to strongly correlate. As such, a promax (oblique) rotation was employed. The Kaiser rule suggested three-factor solution with eigenvalues greater than 1.00 (e.g., 9.13, 1.62, 1.08, .44, .38, .33, .31, .28, .26, .23, .21, .20, .16, .16, .15), cumulatively accounting for 78.97% of the variance (minimum eigenvalue = 1; Kaiser, 1970). Using the procedures of parallel analysis recommended by O'Connor (2000), mean eigenvalues were computed from a factor analysis of 1,000 random data sets generated from half of the data set. Only two eigenvalues from the original data set for a specific factor were bigger than the eigenvalues computed from the random data set. In contrast, results from Velicer's MAP test supported a three-factor solution (i.e., testing differences in averaged squared correlations). A three-factor solution was retained as supported by no coefficient cross loadings above .40 and consistency in factor structures from previous studies (Grossbard et al., 2007; Ramis et al., 2015).

Examining the substantiveness of individual items to their respective factors was completed by utilizing a cutoff of >.40. The standardized coefficients from the pattern matrix of the promax-rotated solution are presented in Table 2. Factor 1 consisted of 5 items coincident with the original

Table 2. SAS-2 Factor Structure and Item Loadings from Exploratory and Confirmatory Factor Analyses

Exploratory					*Confirmatory*			
Item	*Factor 1*	*Factor 2*	*Factor 3*	*h²*	*Item*	*Factor 1*	*Factor 2*	*Factor 3*
5	**.967**	−.115	−.022	.79	9	**.81**		
8	**.920**	−.009	.002	.84	8	**.89**		
9	**.856**	.078	.008	.82	3	**.91**		
11	**.840**	.092	.008	.81	11	**.88**		
3	**.777**	.014	.123	.75	5	**.88**		
1	.010	**.898**	−.063	.74	4		**.70**	
7	−.128	**.875**	.075	.73	13		**.81**	
15	.044	**.859**	−.020	.75	7		**.75**	
4	.084	**.858**	−.044	.77	1		**.90**	
13	.021	**.741**	.165	.76	15		**.83**	
2	.073	−.103	**.921**	.82	12			**.82**
6	−.018	.019	**.918**	.84	6			**.86**
14	−.004	.039	**.877**	.81	14			**.85**
10	−.033	.094	**.839**	.77	2			**.82**
12	.106	.047	**.782**	.78	10			**.87**

Three factor promax-rotated solution was used for standardized regression coefficients for EFA. Significant coefficients from the pattern matrix from EFA are those >.40 and appear in **boldface**. Factor 1 = Worry, Factor 2 = Concentration Disruption, and Factor 3 = Somatic. SAS-2 = Sport Anxiety Scale-2.

Worry subscale. The first factor was labeled as "Worry" to maintain consistency with previous exploratory work on the SAS-2 and yielded a strong reliability coefficient (α = .94). Factor 2 consisted of 5 items indicating that it is difficult for the athlete to concentrate during sports play and focus with directions from authority. Factor 2 was labeled, "Concentration Disruption" and also demonstrated excellent reliability (α = .92). Factor 3 also consisted of 5 items indicating that tension in the muscles, stomach, and overall body sensations are uncomfortable. Factor 3 was labeled, "Somatic Anxiety" and also demonstrated excellent reliability (α = .92). Means, standard deviations, and item-total correlations of the SAS-2 are shown in Table 3. The Worry factor revealed a correlation with Concentration Disruption (r = .57) and Somatic Anxiety factors (r = .68). Concentration Disruption and Somatic Anxiety factors revealed a correlation of r = .67.

Confirmatory Factor Analysis

We evaluated the fit of the data to two models such as: (model 1) a theoretical model of three factors specified as Performance Worry, Performance Concentration, and Somatic Discomfort and (model 2) a uni-factorial model. Given that women tend to report more anxiety compared to men, factorial invariance of the SAS-2 was later assessed with respect to gender.

Table 3. Univariate Summary Statistics, and Item-Total Correlations of the SAS-2 for the Confirmatory Sample (n = 271)

Item	*M*	*SD*	r_{corr}
1	1.58	.71	.64
2	2.10	.83	.75
3	2.30	.87	.79
4	1.60	.75	.75
5	2.31	.93	.69
6	2.03	.89	.75
7	1.46	.70	.64
8	2.23	.89	.76
9	2.23	.90	.77
10	1.80	.85	.74
11	2.26	.86	.80
12	1.83	.91	.78
13	1.53	.73	.73
14	1.90	.86	.78
15	1.54	.76	.63

SAS-2 = Sport Anxiety Scale-2.

A CFA on the exploratory three-factor structure of the SAS was assessed on a separate (randomly assigned) sample of participants (n = 271). In testing model 1, the three factors were fixed to covary given that they were highly correlated and subscales were facets of a related construct. The configured confirmatory model also revealed strong fit to the data as indicated by model fit indexes, $\chi2(87) = 184.64$, $p < .001$, NFI = .95, CFI = .97, GFI = .91, RMSEA = .06.

In model 2, a uni-dimensional model of the SAS items yielded unacceptable fit to the data, $\chi2(90) = 921.72$, $p < .001$, NFI = .75, CFI = .76, GFI = .72, RMSEA = .19. While the model fit may have been improved by adding correlations to specific error terms, these modifications were not made, as a more conservative approach was preferred.

Testing Model Invariance of the SAS-2

Model 1 of the SAS-2 was selected to for invariance testing because it reflected the most adequate fit to the data and the theoretical model of sports anxiety (see Figure 1). Model 1 was reassessed in IBM Amos 19 for whether or not the confirmatory factor structure was invariant across gender. Self-identified men (n = 261) and women (n = 280) from both EFA and CFA samples were combined for the invariance analysis because of inadequate sample sizes with the CFA sample alone. One participant who self-identified as transgender was removed from the present analysis due an inadequate sample size for this group. The analysis evaluated the difference between

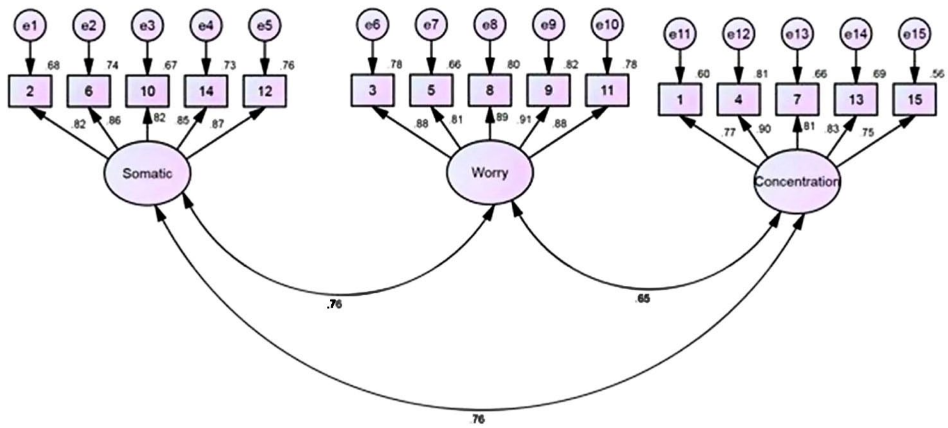

Figure 1. Measurement model of the Sport Performance Anxiety measure.

an unconstrained model, which assumes that the groups are yielding different estimates of the parameters and a constrained model, which assumes the groups are yielding equivalent estimates of the parameters when the model is applied to the data. Two model comparisons were completed. The first comparison that included only the factor-loading pattern coefficients was not statistically significant, $\chi2(12) = 6.63$, $p = .88$, CFI = .97, GFI = .92. The second comparison (combined factors of path coefficients and variance/ covariance of the factors) was also not statistically significant, $\chi2(18) = 18.45$, $p = .77$, CFI = .97, GFI = 92. Across comparisons, the unconstrained and constrained models were not different and had good model fit between men and women. Therefore, invariance testing suggests that both men and women can be described by the confirmatory factor model.

Construct Validity

The relationship between scores on SAS-2 scales and other measures of sports anxiety and affect were compared to evaluate construct, convergent, and divergent validity. As shown in Table 4, all correlation analyses were adjusted for multiple comparisons with the Bonferonni correction to correct for alpha inflation (e.g., $p < .003$). The SAS-2 total score and subscales were substantially correlated with anxiety sensitivity, fear of negative evaluation, intolerance of uncertainty, and negative affect in the expected direction as evidence for convergent validity. Additionally, the somatic subscale of the SAS-2 was found to positively correlate with the somatic subscales from the ASI and CSAI-2. Among the cognitive subscales, the SAS-2 was strongly positively correlated with associated cognitive subscales from other measures, but not with unrelated subscales (i.e., positive affect and CSAI-2

Table 4. Correlations of the SAS-2 Subscales and Total Score with Other Measures

Measure	*1*	*2*	*3*	*4*
1. SAS-2 Somatic-				
2. SAS-2 Worry	.72*			
3. SAS-2 Concentration Disruption	.70*	.60*		
4. SAS-2 Total score	.91*	.89*	.85*	
5. ASI Total score	.47*	.46*	.40*	.50*
6. ASI Physical	.43*	.31*	.49*	.45*
7. ASI Cognitive	.48*	.39*	.60*	.53*
8. ASI Social	.47*	.46*	.40*	.50*
9. BFNE	.42*	.46*	.39*	.48*
10. IU	.27*	.20*	.23*	.26*
11. CSAIS Somatic	.80*	.61*	.63*	.77*
12. CSAI Cognitive	.63*	.81*	.56*	.76*
13. CSAI Self-Confidence	−.46*	−.55*	−.33*	−.52*
14. CSAI Total	.46*	.41*	.42*	.49*
15. NA	.41*	.33*	.44*	.44*
16. PA	−.03	−.06	−.09	−.09

SAS-2 = Sports Anxiety Scale; ASI = Anxiety Sensitivity Scale; BFNE = Brief Fear of Negative Evaluation; IU = Intolerance of Uncertainty; CSAI = Competitive State Anxiety Inventory; PA = Positive Affect; NA = Negative Affect. Bonferonni correction used to control for multiple comparisons so significance was observed at $p < .003$; *$p < .003$.

Self-Confidence). Together, the SAS-2 appears to have strong convergent validity as evidenced by strong positive correlations with related constructs. However, positive affect was negatively correlated with the SAS-2, providing evidence for discriminant validity.

Discussion

Factor Structure and Reliability of SAS-2

In the original scale development of the SAS-2, exploratory factor analyses on young children 9 to 14 revealed three distinct subscales each consisting of 5 items (Somatic, Worry, and Concentration Disruption) and accounting for 64% of the item response variance (Smith, et al., 2006). This factor structure has also been replicated in younger adults as well (Duica et al., 2014; Ramis et al., 2015; Smith et al., 2006). Our results support this structure by finding the same subscales in an older and more diverse sample of participants from previous competitive sports backgrounds. Additionally, the amount of variance explained for item responses was larger (i.e., 78.97%) than previous studies examining psychometric properties of the SAS-2. Other studies have confirmed the factor structure of SAS-2 in primarily adolescent (e.g., 9–14 years) or college-aged individuals (Grossbard et al., 2009; Ramis et al., 2015; Smith et al., 2006). Our results are consistent with previous research that has found particular components of competitive anxiety to be more salient in athletic endeavors. Smith, Smoll, and Schutz (1990) found the original SAS scale for Concentration Disruption to be a significant predictor of game performance in college football players. These results demonstrate a strong effect of Concentration Disruption across a broad spectrum of sports. Our findings extend the generalizability of the SAS-2 by establishing good model fit of the three factor structure in more varied populations of athletic competition levels from various regions. Specifically, the factor structure for the SAS-2 is supported in former athletes from competitive levels ranging from high school to professional who span in previous competitive experience from present athletes to those reflecting on over 11 years since last competing.

In examining the interscale correlations, our results are similar to those that have found moderate relationships among somatic anxiety with worry, somatic with concentration disruption, and worry with concentration disruption (Grossbard et al., 2009; Smith et al., 2006). Internal reliabilities (i.e., Cronbach's alpha) of the SAS-2 subscales in the current study were strong and was consistent with previous estimates (Grossbard et al., 2009: alpha coefficients ranged from .80 to .89; Smith et al., 2006: alpha coefficients ranged from .84–.89). Thus, in this sample the SAS-2 was both stable and upheld its factor structure.

Results from CFA of the SAS-2 revealed strong model fit to the data, providing strong evidence for a three-factor structure of sports-related anxiety. This was consistent with work by Grossbard et al. (2009) who found good model fits for both a three-factor and higher order structure of the SAS-2. In the current study, the model fit to the data of the three-factor model of the SAS-2 was superior to a single factor model, providing evidence that SAS-2 subscales are meaningful beyond more global measurement.

Gender Invariance Testing

Beyond confirming the factor structure and good internal reliability of the SAS-2, our study found the scale to also be gender invariant. Only two studies to date have examined gender invariance of the SAS-2 but only in ages 9 to 14 years (Grossbard et al., 2009; Ramis et al., 2015). Grossbard et al. (2009) found the English version of the SAS-2 to be gender invariant, while Ramis et al. (2015) found the Spanish, Flemish, and Portuguese versions of the SAS-2 to be gender invariant in adolescent athletes. Therefore, results from the present study further support that the SAS-2 measures sports-related anxiety that is not biased due to gender. However, we did not test for invariances due to age or sport-type because of sample limitations.

Construct Validity

To further establish psychometric support, we examined construct validity of the SAS-2. According to Cronbach and Meehl (1955) the underlying construct must be embedded in a nomological network that specifies relations with other theoretically related and unrelated constructs. This includes assessing both the convergent and discriminant aspects of construct validity (Campbell & Fiske, 1959). To establish convergent validity we found the SAS-2 to be positively correlated with aspects of anxiety sensitivity, fear of negative evaluation, intolerance of uncertainty, sports related anxiety, and negative affect. Anxiety sensitivity (AS) is defined as a tendency to respond fearfully to one's own anxiety symptoms (Lilienfeld, 1996). Those who are highly anxious tend to have more preoccupations about the fear of being negatively evaluated (Conroy, 2004). Furthermore, research has supported that intolerance of uncertainty, which is the interpretation of ambiguous information as threatening, is implicated across emotional problems (i.e., anxiety and depression; Boswell, Thompson-Hollands, Farchione, & Barlow, 2013). The positive relationships between related components from anxiety sensitivity and sports related anxiety to the SAS-2 provided strong evidence for convergent validity. Previous research has demonstrated convergent validity of the SAS-2 by establishing positive relationships with achievement goal orientations motivational climates, and global self-esteem (Smith et al., 2006). As expected SAS-2 scores were positively associated with ego orientations and ego climate scores while being negatively associated with task orientation, mastery (task) climate scores, and global self-esteem (Smith et al., 2006).

Discriminant validity was established by finding low negative correlations of the SAS-2 with positive affect and the CSAI-2 Self-Confidence subscale. Positive affect is a good discriminant factor as it measures adaptive emotions while the SAS-2 is a maladaptive measure of sports anxiety. Similarly, the Self-Confidence subscale from the CSAI-2 is an adequate discriminant factor as it is positively correlated with sports performance. Previous research has found discriminant validity to be established through low negative correlations between SAS-2 subscales and social desirability as well as perceived competence in youth basketball players (Smith et al., 2006).

Limitations

Despite strong evidence of psychometric support for the SAS-2 in a broader population, several limitations to this study need to be acknowledged. The most important limitation of this study is that a large majority of the sample reflected back to their sporting experiences and provided retrospective data. Prior to completing the SAS-2 participants were asked to think back to when they were last competing at their highest level and answer the items accordingly. While the retrospective nature of the present study is a limitation, there were not any group differences between those who were still competitively playing and those who were not. Although the current study collected data from a broader, community-based sample, future work is needed to determine if the SAS-2 is invariant across time (i.e., one's athletic career). Also, the sample was primarily European- American so future studies should investigate the SAS-2 psychometric properties in more culturally diverse samples. Although participants were asked to gauge their highest level of competition, type of sport played was not collected.

Conclusion

This study provides further psychometric support for the SAS-2 using a broader and more generalizable sample of current and former athletes. Stringent psychometric analyses using exploratory factor and confirmatory analyses were used to examine the dimensions of the SAS-2, which resulted in a three-factor structure: somatic anxiety, worry, and concentration disruption. Further, the analyses indicated that the SAS-2 demonstrates good internal consistency and is gender invariance. Finally, evidence of strong construct validity was provided through associations with related and unrelated constructs. Both convergent and divergent validity were obtained. These findings demonstrate that the SAS-2 is a psychometrically sound tool for assessing competitive anxiety in former athletes. Furthermore, our results indicate that competitive anxiety is best understood by capturing information from domains such as somatic anxiety, worry, and concentration disruption.

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