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Measurement of Multidimensional Sport Performance Anxiety in Children and Adults: The Sport Anxiety Scale-2

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This article describes the development and validation of the Sport Anxiety Scale-2 (SAS-2), a multidimensional measure of cognitive and somatic trait anxiety in sport performance settings. Scale development was stimulated by findings that the 3-factor structure of the original Sport Anxiety Scale (SAS; Smith, Smoll, & Schutz, 1990) could not be reproduced in child samples and that several items on the scale produced conflicting factor loadings in adult samples. Alternative items having readability levels of grade 4 or below were therefore written to create a new version suitable for both children and adults. Exploratory and confirmatory factor analyses replicated the original SAS factor structure at all age levels, yielding separate 5-item subscales for Somatic Anxiety, Worry, and Concentration Disruption in samples as young as 9 to 10 years of age. The SAS-2 has stronger factorial validity than the original scale did, and construct validity research indicates that scores relate to other psychological measures as expected. The scale reliably predicts precompetition state anxiety scores and proved sensitive to anxiety-reduction interventions directed at youth sport coaches and parents.

Key Words: sport anxiety measurement, reliability, factorial and construct validity

The study of anxiety, its antecedents, its relations with other psychological variables, and its consequences has a long history of theoretical and empirical attention within sport psychology. Cognition and arousal are widely considered to be different components of the anxiety response, and a distinction has long been made between cognitive and somatic anxiety (Burton, 1998; Davidson & Schwartz, 1976; Deffenbacher, 1977; Smith, Smoll, & Wiechman, 1998). Moreover, although they interact with one another, cognitive and somatic anxiety can at times be elicited by different antecedents (Burton, 1998; Morris & Engle, 1981; Morris & Liebert, 1973), and they can be differentially related to performance, depending

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on the nature of the task (e.g., Deffenbacher, 1980; Gould, Petlichkoff, Simons, & Vevera, 1987; Smith, Smoll, & Schutz, 1990). Recent research indicates that different brain regions are involved in different aspects of anxiety, specifically, anticipatory anxiety (worrying) and anxious arousal during a task, supporting still further the cognitive-somatic distinction (Heller, Schmidtke, Nitschke, Koven, & Miller, 2002; Hoffman et al., 2005).

Theoretical advances stimulated the development of new measuring instruments to assess the construct of trait anxiety. During the 1980s and thereafter, sport-specific trait anxiety has frequently been assessed using the Sport Competition Anxiety Test (SCAT; Martens, 1977), a unidimensional measure that does not distinguish between or measure differences in somatic and cognitive anxiety. Although the SCAT has proven to be a valuable research instrument, it measures primarily somatic anxiety (Smith et al., 1990). It is therefore limited in its usefulness for investigating cognitive aspects of trait anxiety. In 1990, cognitive-affective models of anxiety and empirical findings concerning differential antecedents and consequences of cognitive and somatic anxiety prompted the development of a new sport-specific multidimensional trait anxiety measure, the Sport Anxiety Scale (SAS; Smith et al., 1990). Developed and cross-validated using both exploratory and confirmatory factor analysis, the 21-item SAS measures individual differences in somatic anxiety and in two aspects of cognitive anxiety, namely, worry and concentration disruption (Dunn, Causgrove Dunn, Wilson, & Syrotuik, 2000; Smith et al., 1990). Differential relations of the scales with performance measures have also been reported. For example, Smith et al. (1990) found that concentration disruption was the strongest negative predictor of performance in college football players. Since its development, the SAS has proven useful to researchers in a variety of sport contexts and appears to be a reliable and valid measure of cognitive and somatic sport performance anxiety (Giacobbi & Weinberg, 2000; Johnson, Ekengren, & Andersen, 2005; Smith, Ptacek, & Patterson, 2000).

Researchers have also been interested in studying performance anxiety in children. To extend measurement of competitive trait anxiety downward on the age continuum, Martens (1977) developed a children's form of the Sport Competition Anxiety Test (the SCAT-C). Like the adult version of the SCAT, this unidimensional measure proved to be a reliable and valid instrument, and it has been used in many studies to assess the antecedents and consequences of anxiety in children (see Martens, Vealey, & Burton, 1990). Though useful as a global measure of anxiety, the SCAT-C, like its adult counterpart, does not allow for the assessment of separate cognitive and somatic components of anxiety.

Indications that the SAS may not be appropriate for younger age groups appeared when Smith, Smoll, and Barnett (1995) used the SAS as an outcome measure (together with the SCAT-C) in a study involving a coach-training intervention designed to reduce situational sources of stress and thereby lower performance trait anxiety. The children in the study ranged in age from 9 to 12 years. Following data collection, a factor analysis of the SAS was carried out to ensure that it was appropriate to use its three subscales as dependent variable measures. The analysis yielded an uninterpretable 5-factor solution with numerous cross-loadings, indicating a failure to replicate the 3-factor structure so consistently found in older samples. It was therefore necessary to use the total score as the outcome measure. Although the intervention resulted in highly significant reductions in trait anxiety on both the SAS total score and the SCAT-C (which were highly correlated), it was not possible to assess effects of the intervention on the somatic anxiety, worry, and concentration-disruption components of sport performance anxiety. In unpublished data derived from 10- to 12-year-old children from a youth basketball program, the SAS's factor structure broke down again in similar fashion, this time with 6 uninterpretable factors (Everett & Barnett, 1995).

Failure to replicate the 3-factor SAS model in younger samples suggested two major possibilities, one methodological, the other developmental. At a methodological level, it seemed possible that the items, originally developed using high school and college athlete samples, were too difficult for some younger respondents to understand, and that poor comprehension of item content was responsible for the breakdown of the SAS factor structure. In a previous study using the SAS in a younger sample, Weiss, Ebbeck, and Horn (1997), anticipating this potential problem, deleted 3 of the 21 SAS items and rewrote 6 others "to enhance their comprehension for children" (p. 56). Unfortunately, Weiss et al. did not factor-analyze their adapted scale to determine whether their modifications resulted in the assumed 3-factor structure, so it is not clear whether they were successful in remedying the problem encountered by Smith et al. (1995). To assess potential readability problems in younger samples, we therefore subjected each SAS item to a Flesch-Kincaid readability assessment (Harrison, 1980) and found that many of the items had reading levels above the 9th grade. We therefore concluded that the high reading level of the SAS items renders the scale inappropriate for younger samples.

Failure to reproduce the original factor structure in younger children may also reflect developmental aspects of emotional self-perception. A well-defined factor structure derived from a self-report measure indicates that respondents are perceiving distinctions among items and responding differentially to them in ways that produce clusters of items that share common variance and therefore are assumed to have common psychological meaning (Nunnally & Bernstein, 1994). Therefore, another potential reason for the breakdown of the 3-factor SAS structure is that children's emotional self-perception capabilities do not allow them to differentiate between the three aspects of subjectively experienced anxiety indexed by its items.

There are few studies in the literature that address this question of cognitive-affective discrimination. Most developmental research has focused on the ability of children to draw distinctions between discrete emotions, rather than on their ability to make cognitive-affective distinctions. For example, in a cross-sectional study of children in the 3rd, 5th, and 7th grades, Turner and Barrett (2003) performed confirmatory factor analyses of scores on the Revised Children's Manifest Anxiety Scale (Reynolds & Richmond, 1985) and the Children's Depression Inventory (Kovacs, 1980/1981). At all grade levels, a 2-factor anxiety/depression model exhibited a strong fit, indicating that children as young as age 7 differentiated between the subjective experiences of anxiety and depression. However, Clark and Watson's (1991) tripartite model, which postulates separate factors of physiological hyperarousal, negative affectivity, and low positive affect, also fit the data well at all three age levels. Because the negative affectivity factor has a significant number of worry items (but also noncognitive arousal items), this finding suggests a possible perceptual distinction between physiological and cognitive aspects of these emotions at even the 3rd-grade level. A study of age-related worry by Muris, Merckelbach, Meesters, and van den Brand (2002) also showed that worry emerged as a cognitive response to stress as early as age 3 and became more elaborated with increasing chronological age, but this study did not relate worry to somatic anxiety.

Few studies have explored the cognitive-affective components of anxiety from a developmental perspective. In one instance, however, White and Farrell (2001) administered the Revised Children's Manifest Anxiety Scale to children between the ages of 10 and 14 and used confirmatory factor analysis (CFA) to test several models, all of which posited separate arousal and worry factors. Their analyses provided evidence of cognitive-somatic differentiation. However, the average participant in this study was nearly 12 years old and no analyses were done by age group, so that we cannot be certain of cognitive-somatic differentiation in the younger age groups. Moreover, this question has not been explored within the context of performance anxiety. The availability of a trait scale with age-appropriate items could be a useful research tool in determining whether and at what age level cognitive-somatic differentiation in emotional experience emerges in children's sport-related anxiety reactions.

Although the major reason we undertook to develop a new scale was the assessment of multidimensional anxiety in children, recent developments involving the SAS prompted us to expand its range of potential application to older samples. Results of several studies indicate that the factorial validity of the SAS is not as sound as originally suggested. Analyses by Dunn et al. (2000) and by Prapavessis, Maddison, and Fletcher (2005) replicated the basic 3-factor structure, but called into question the factorial integrity of the Concentration Disruption scale. Specifically, two of the items on that scale either cross-loaded or loaded more strongly on the Worry scale. Utilizing item response theory analyses, Prapavessis et al. (2005) also found that one of the items on the Somatic scale had marginal measurement properties. Moreover, their CFAs, while supporting the 3-factor structure of the SAS, yielded a goodness-of-fit index (GFI) of .88 and a non-normed fit index (NNFI) of .81, well below established standards for acceptable fit (Hu & Bentler, 1999). Although a revised scoring system for the SAS improved model fit slightly (CFI = .92, RMSEA = .063; Smith, Cumming, & Smoll, 2006a), we were hopeful that the new scale would exhibit stronger psychometric properties and a better model fit. Our major focus was on developing a child-appropriate scale, but we saw no reason why reducing the item reading level would not be of potential benefit in assessing older athletes as well.

In this article, we describe the development and psychometric properties of the Sport Anxiety Scale-2 (SAS-2). Our goal was to provide researchers with a reliable and valid multidimensional measure of sport performance anxiety that would mirror the factor structure of the original SAS, but measure its dimensions more precisely. Such a measure would enable researchers to measure individual differences in somatic anxiety, worry, and concentration disruption; to study the antecedents and consequences of cognitive and somatic performance anxiety in children and adults; and to measure multidimensional anxiety in longitudinal studies that begin in childhood. Because the scale was developed within the context of a coach and parent intervention project in which performance anxiety was one of several outcome variables, we desired a relatively brief scale that could be used as part a battery of outcome measures that would not overwhelm young children.

A by-product of scale construction was the ability to address an important developmental question, namely, whether and when children beyond the age of 9 years discriminate between somatic and cognitive aspects of the anxiety response.

Method

Participants

Both child and college-age athletes were involved in the development of the new scale. A total of 1,038 child athletes (571 males and 467 females) ranging in age from 9 to 14 years (*M* = 11.5 years, *SD* = 1.51) participated in the SAS-2 scale-development and validation phases. The majority of the participants were Caucasian (78%), along with smaller numbers of Asian Americans (9%), African Americans (6%), Hispanics (4%), and individuals reporting more than one ethnicity (3%). The sample included 277 children 9 and 10 years of age, 418 between 11 and 12 years, and 342 at ages 13 and 14 years, with similar proportions of males and females at each age level. The samples were drawn from several community basketball programs in Seattle and from volleyball, soccer, and hockey summer camps in Seattle, New York, and Boston. One sample of 188 athletes was used in the process of item selection, and an independent sample of 850 children was used for factorial validation of the scale using CFA. Other subsamples (specified below) were used to assess test-retest reliability, relations with other scales, and to test predictive validity in relation to state anxiety.

To assess the psychometric properties of the SAS-2 for older athletes and to correlate the subscale and total scores of the new scale with the SAS in the age population in which the original scale was developed, we selected from a sample of 1,294 college students enrolled in an introductory psychology class 593 college freshman students (237 males and 356 females) who were currently involved in organized athletic activities ranging from intramural and club sports to intercollegiate sports, and/or who had participated in high school varsity sports during the past 3 to 9 months. This sample had a mean age of 18.36 (*SD* = 3.17). Ethnic group composition was 59% Caucasian, 33% Asian-American, and 8% African American or “other.”

Procedure

Children’s data were collected in group sessions within the activity context by trained research assistants following the obtaining of signed consent by parents/guardians. College-age participants were administered the SAS and the SAS-2 in counterbalanced order during group sessions under anonymous conditions.

Our goal was to develop a brief instrument having 5 to 7 items on each of the three somatic and cognitive subscales, providing researchers with a short instrument that could be administered as part of a larger test battery. A rational-theoretical (construct-based) strategy was used to generate new items written to represent each SAS subscale’s underlying construct, but at a reading level appropriate for younger children. The underlying theoretical model was a cognitive-affective model advanced by Smith (1996; also see Smith et al., 1998; Smith & Smoll, 2004), which posits a 3-component model with a higher-order global anxiety latent variable. For purposes of generating items, the somatic construct involved various indices of autonomic arousal centered in the stomach and muscles. The worry construct involved concerns about performing poorly and the resulting negative consequences. Finally, the concentration disruption construct involved difficulties in focusing on task-relevant cues. The constructs were narrowly defined in order to avoid confounding of content (e.g., we avoided items like, "I'm concerned that I won't be able to concentrate") that sometimes produced cross-loadings on the SAS Concentration Disruption and Worry factors (Dunn et al., 2000; Prapavessis et al., 2005).

Each new item was subjected to a Flesch-Kincaid reading level analysis using the Microsoft Word 2003 program and was retained if it was at or below grade 4.0 on that measure and if its content seemed similar to a corresponding SAS item. After a preliminary screening during which 13 young athletes between the ages of 8 and 11 were asked to read potential items and identify any they did not fully understand, an initial pool of 30 items was generated (10 each for the Somatic, Worry, and Concentration Disruption subscales). Participants responded on a 4-point extent-of-experience scale containing the following anchors: 1 (*not at all*), 2 (*a little bit*), 3 (*pretty much*), and 4 (*very much*). The instructions had a reading grade level of 3.6.

Results

Exploratory Factor Analyses

Exploratory factor analyses (EFA) played an integral role in item selection. The 30 items were administered to the sample of 188 boys and girls between the ages of 9 and 14 (M = 11.31, SD = 1.42) who were participating in a community basketball program.

Following logarithmic transformation of item scores to decrease positive skewness of item distributions, principal axis factor analyses were carried out with rotation to oblimin (oblique) solutions. Oblique rotation allows for correlated factors, as we might expect with components of anxiety, which are known to be correlated. Factor analysis revealed three clear factors with eigenvalues exceeding 1.00 and a distinct elbow following the third factor on a scree plot. These three factors corresponded to the Somatic, Worry, and Concentration Disruption subscales of the SAS. All item loadings exceeded .50 on their factor and less than .30 on other factors. In additional to an overall analysis involving the entire sample, supplementary analyses were conducted in the 9-to-11 and 12-to-14 age groups. Selection of items based on their factor loadings at each age level, their judged content validity, and their contributions to scale reliability resulted in a 15-item SAS-2 containing three subscales, each consisting of 5 items. To approximate simple factor structure as closely as possible, we retained items only if they had oblique factor loadings of at least .60 on their primary factor and loadings lower than .20 on the other factors. The items selected for the 15-item scale ranged in Flesch-Kincaid reading scores from grade 0.5 to grade 3.9, with a mean reading level of grade 2.3. The entire scale, including items, instructions, and response category labels, had a reading level of grade 2.4.

A principal axis factor analysis with oblique rotation based on these 15 items yielded the factor structure shown in Table 1 for the combined child sample. The

Table 1 Exploratory Factor Analysis of the SAS-2 with Oblique Rotation for Children Ages 9 to 14

SAS-2 Item	Somatic	Worry	Concentration Disruption
2. My body feels tense	**.60**	.12	.18
6. I feel tense in my stomach	**.87**	.00	–.05
10. My muscles feel shaky	**.69**	.19	–.06
12. My stomach feels upset	**.78**	.04	.02
14. My muscles feel tight because I am nervous	**.74**	.03	.14
3. I worry that I won't play well	.01	**.78**	.04
5. I worry that I will let others down	.09	**.66**	.07
8. I worry that I will not play my best	-.05	**.81**	.00
9. I worry that I will play badly	.00	**.92**	.01
11. I worry that I will mess up during the game	.05	**.80**	–.03
1. It is hard to concentrate on the game	–.02	.02	**.78**
4. It is hard for me to focus on what I am supposed to do	.09	.10	**.86**
7. I lose focus on the game	.09	–.06	**.67**
13. I cannot think clearly during the game	.18	.04	**.68**
15. I have a hard time focusing on what my coach tells me to do	–.08	.11	**.76**

Note. $n = 188$. Item factor loadings ≥.60 are boldfaced.

three unrotated factors accounted for 64% of the item response variance. The same three factors, all with factor loadings exceeding .60 and accounting for more than 60% of the response variance, also occurred at the 9-to-11 and 12-to-14 age levels. Because, by convention, EFAs and CFAs should not be performed on the same sample, we elected to conduct a CFA as the primary analysis to test model fit in the college sample. However, for the reader who might be curious about EFA factor loadings in this age group, a follow-up principal axis analysis with oblimin rotation yielded a factor structure similar to that shown in Table 1, with item factor loadings ranging from .64 to .92 on the primary factors, and no loading on another factor exceeding .20. As expected on theoretical and empirical grounds, the SAS-2 subscale scores, derived by summing raw scores on the individual items, were substantially correlated with one another in the child sample (Somatic with Worry = .64; Somatic with Concentration Disruption = .62; Worry with Concentration Disruption = .63).

In the college sample, the corresponding interscale correlations were somewhat lower (Somatic with Worry = .55; Somatic with Concentration Disruption = .35; Worry with Concentration Disruption = .47). These results are similar to those obtained with the original SAS (Smith et al., 1990) and with other anxiety measures containing cognitive and somatic scales (Morris & Engle, 1981; Sarason, 1984), and they are consistent with cognitive-affective models of anxiety, which posit causal relations among the subcomponents of anxiety (Smith et al., 1998).

Confirmatory Factor Analyses

In the theoretical model underlying the SAS (Smith et al., 1998; Smith & Smoll, 2004), performance anxiety is regarded as a global construct that has three related somatic and cognitive subcomponents. Accordingly, both the SAS and the SAS-2 are designed to provide separate scores on each of the subscales, plus a total score that reflects the global construct. Various researchers have chosen to use the total score, the subscale scores, or both in their research (Smith et al., 1998). Accordingly, a model involving one somatic and two cognitive factors and a higher-order anxiety factor was the theoretically preferred model. We also evaluated the fit of the data to two other models: a 3-factor model reflecting the somatic anxiety, worry, and concentration-disruption components without the second-order global (total score) factor, and a global single-factor model. These analyses were carried out in a sample of 850 children (M = 11.23, SD = 1.87) participating in a variety of community and summer-camp sports and not utilized in the EFA phase, and with the college freshman sample of 593 athletes. To test scalar fit to the hypothesized model, CFAs were conducted on the total child sample and the college sample. As part of another study focusing on the developmental issue (Grossbard, Smith, Smoll, & Cumming, 2006), CFAs were also conducted on the 9 and 10, 11 and 12, and 13 and 14 year-old groups to explore the developmental issue regarding cognitive-somatic discrimination and to assess factorial invariance across these age groups.

Maximum likelihood estimation using the Amos 5.0 program (Arbuckle, 2003) was used in all analyses. Items were specified to load on only one factor each. A variety of commonly reported fit indices, including model chi-square, the comparative fit index (CFI), the goodness of fit (GFI) index, the Bentler-Bonnet non-normed fit index (NNFI), and the root mean square error of approximation (RMSEA) were used to assess model fit (see Hu & Bentler, 1999). The latter indices have been developed to address perceived inadequacies of the chi-square test, particularly its tendency to yield significant results with large sample sizes, therefore increasing the likelihood of Type II error (Bollen, 1989). The NNFI and the RMSEA are less affected by sample size and are therefore preferred by many experts (e.g., Fan, Thompson, & Wang, 1999). Because the item distributions were positively skewed, as is typical of anxiety scales, we performed a logarithmic transformation of item scores to better meet the CFA assumption of multivariate normality prior to the analyses (Tabachnick & Fidell, 2001). No modification analyses were performed on the data, although there was clearly an opportunity to improve model fit by doing so. This produced more conservative tests of the models but facilitates replicability and comparisons by other investigators (Byrne, 2001).

Confirmatory factor analysis results for each age group are presented in Table 2. Using criteria recommended by Hu and Bentler (1999), acceptable model fit was found in each age group. At each age level, the data conformed well to both models tested, with CFIs equaling or exceeding .95. For the combined child sample, the CFI was .97, NNFI was .96, and RMSEA was .05. It thus appears that the 3-factor model of anxiety, with or without a higher-order global anxiety component,

Table 2 Confirmatory Factor Analysis Goodness-of-Fit Statistics for Alternative Models for Children Ages 9 to 14 and for College-Age Athletes

Group/Model	df	χ^2	NNFI	CFI	RMSEA	RMSEA 90% CIs
9 to 10 years old[a]						
Three factors	87	126.89*	.97	.97	.044	.028–.059
Higher order	89	133.81*	.97	.97	.042	.025–.058
11 to 12 years old[b]						
Three factors	87	188.66**	.94	.95	.060	.048–.071
Higher order	89	192.70**	.94	.95	.060	.048–.071
13 to 14 years old[c]						
Three factors	87	184.31**	.94	.95	.064	.051–.077
Higher order	89	185.69**	.94	.95	.065	.052–.078
9 to 14 years old[d]						
Three factors	87	270.48**	.96	.96	.050	.043–.057
Higher order	89	285.96**	.96	.96	.051	.045–.058
College sample[e]						
Three factors	87	303.12**	.95	.95	.065	.057–.073
Higher order	89	315.55**	.94	.95	.066	.058–.073

Note. NNFI = Non-normed fit index (Tucker-Lewis index); CFI = Bentler comparative fit index; RMSEA = root mean square error of approximation; 90% CI = 90% confidence interval for RMSEA.

[a]n = 155; [b]n = 431; [c]n = 264; [abc]based on Grossbard et al., 2006; [d]n = 850; [e]n = 593.

*p < .01, **p < .001.

fits the data quite well. Acceptable fit indices for both models were also obtained in the college sample, indicating similarly high factorial validity for this age group. Because some researchers may prefer to also use the total score as a general index of sport performance anxiety, we present the standardized coefficients for the 3-factor/higher-order model in Figure 1.

Factorial invariance refers to the extent to which a factor structure model exhibits consistency across measurement periods or groups (Meredith, 1993). Of major interest was whether the 3-factor structure of the SAS-2 exhibited structural stability across age groups. Using Amos 5.0, we tested whether the standardized item coefficients for the three factors, the variance related to the three subfactor residuals, and the regression coefficients between the latent variables differed significantly as a function of age. To test invariance, we compared the fit characteristics of nonconstrained (in which parameters were free to vary) and constrained models when tested simultaneously across the three children's age groups (Byrne, 2001). The models did not differ significantly from one another, χ^2 (6) = 10.62, p > .05, indicating age-related consistency in the SAS-2 factor structure.

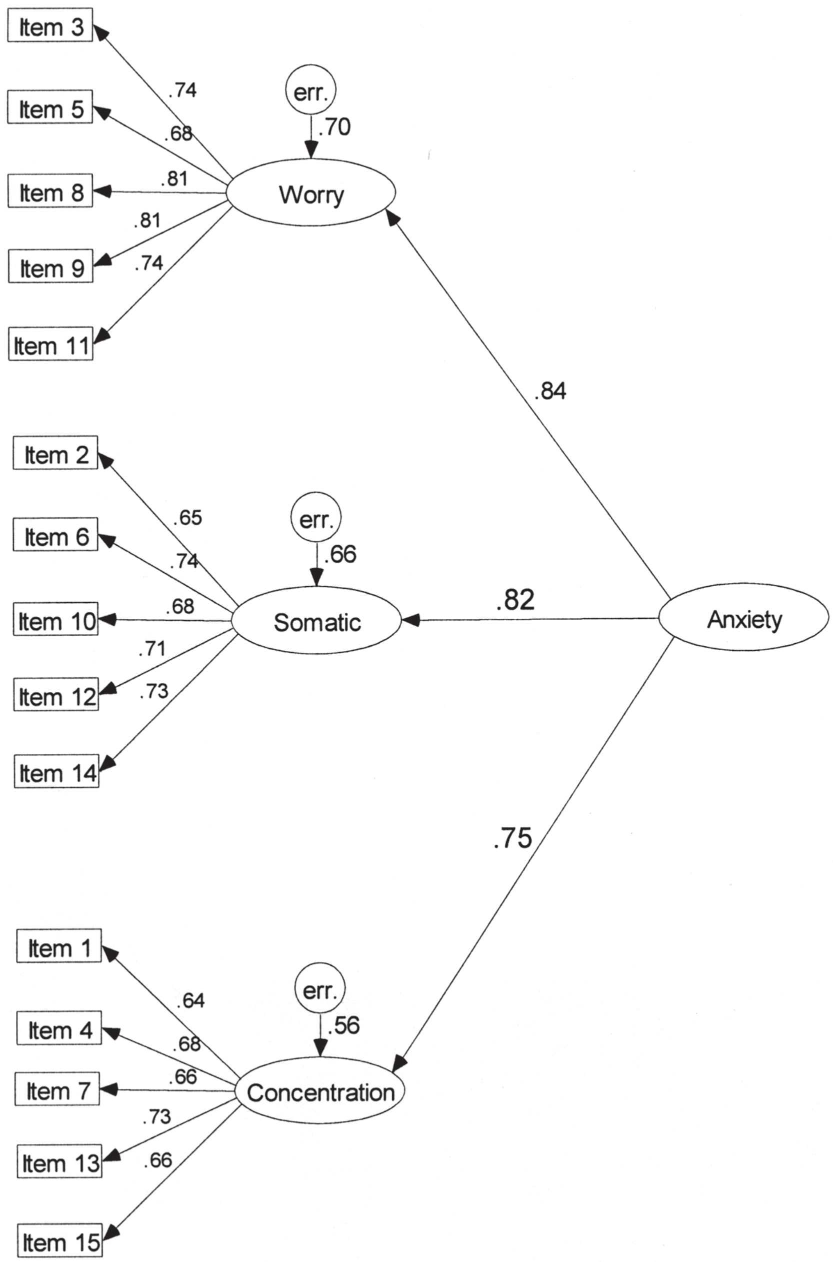

Figure 1 — Confirmatory factor analysis of the SAS-2 items in relation to a 3-factor model with a second-order global anxiety factor. The values in the figure are standardized coefficients.

Finally, we tested an alternative (null) single-factor model that posits no distinctions between the three cognitive-somatic factors. This model achieved a poor fit for all age groups, yielding CFIs and RMSEAs of .86 and .10, respectively, in the 9-to-10 age group, .76 and .13 in the 11-to-12 group and .73 and .15 in the 13-to-14 group. These indices are below acceptable fit levels (Hu & Bentler, 1999). Clearly, the null single-factor model is not a statistically tenable alternative to either 3-factor model shown in Table 2.

Normative Data

Means and standard deviations for the children aged 9 to 10, 11 to 12, and 13 to 14 derived from the Grossbard et al. (2006) developmental study are presented in Table 3 as normative data. Descriptive statistics for the college sample are also presented. In all age groups, mean scores on the Worry scale tended to be higher than those on the other two scales, and Somatic scores exceeded Concentration Disruption. Scores tended to be higher for college student athletes than for the children on all but the Concentration Disruption scale. As is typically found when anxiety scales are administered to nonclinical samples, score distributions exhibited a positive skew.

Scale Reliability

Internal consistency and test-retest reliability analyses were carried out for the final 15-item SAS-2. Cronbach's alpha served as the measure of internal consistency, assessed in the total sample of 1,038 children. For total score based on all 15 items,

Table 3 Means and Standard Deviations of SAS-2 Scores for Child and College-Age Groups

	Age Group			
SAS-2 Scale	**9–10 years[a]**	**11–12 years[b]**	**13–14 years[c]**	**College[d]**
Somatic Anxiety	8.29 (3.14)	7.70 (2.80)	8.34 (3.36)	9.78 (3.61)
Worry	9.05 (3.53)	9.37 (3.54)	10.50 (3.75)	12.12 (3.85)
Concentration Disruption	7.54 (2.71)	6.82 (2.28)	7.29 (2.88)	6.93 (2.37)
Total Score	24.88 (8.14)	23.88 (7.14)	26.14 (8.40)	28.83 (8.05)

Note. *SD*s in parentheses. Subscale scores can range from 5 to 20; total anxiety score can range from 15 to 60. Data on 9- to 14-year-old groups based on Grossbard et al., 2006.

[a]$n = 277$, [b]$n = 418$, [c]$n = 343$, [d]$n = 593$.

alpha = .91 (95% CI = .90–.92). Subscale reliability coefficients were .84 (CI = .82–.85) for Somatic, .89 (CI = .87–.90) for Worry, and .84 (CI = .82–.85) for Concentration Disruption. Total score alpha coefficients exceeded .89 for all age groups. For the subscales, coefficients ranged from .81 to .92 for all age groups with the exception of Concentration Disruption at age 11 to 12, which yielded a coefficient of .74. In the college sample, the alpha coefficients for the Somatic, Worry, and Concentration Disruption scales were .89 (95% CI = .87–.90), .91 (CI = .90–.92), and .84 (CI = .82–.86), respectively, and the total score alpha was .91 (CI = .90–.92). Thus, the SAS-2 exhibits acceptable internal consistency at both the total score and subscale levels, and its reliability is quite similar to that found for the SAS in older samples (Smith et al., 1990).

Test-retest reliability was assessed in a sample of 21 competitive figure skaters ranging in age from 10 to 18 years (M = 12.6 years, SD = 1.75). The athletes were retested 1 week after the initial administration. Test-retest coefficients were .76 for Somatic, .90 for Worry, .85 for Concentration Disruption, and .87 for total score, indicating acceptable measurement stability.

Construct Validity

Acceptable reliability and factorial validity do not ensure that a scale is measuring the construct it is designed to measure. The underlying construct must be embedded in a nomological network that specifies relations with other theoretically related and unrelated constructs (Cronbach & Meehl, 1955). This entails assessing both the convergent and discriminant aspects of construct validity (Campbell & Fiske, 1959). Convergent validity was assessed by correlating the SAS-2 with other measures with which the scale was expected to correlate, and discriminant validity was assessed validity through correlations with theoretically unrelated variables.

Because a major objective of our work was to develop a multidimensional scale that would be valid for child samples, we focused particularly on the validity of the scale in this population. In various subgroups of youth aged 9 to 14 years old, we obtained measures of achievement-related goals, coach-initiated motivational climate, self-esteem, and social desirability, all of which have been shown to be related to anxiety in previous research. Relations with goal orientations were assessed in a sample of 189 male and female basketball players ranging in age from 10 to 14 (M = 11.52 years, SD = 1.65). Relations with motivational climate, self-esteem, and social desirability were measured in a sample of 572 athletes drawn from community programs and sport camps (M = 11.27 years, SD = 2.14). We also assessed the predictive validity of the SAS-2 by relating it to state anxiety reactions in future competitive situations. Finally, we assessed the scale's sensitivity to an intervention that has been shown to decrease children's trait anxiety.

Correlations With the SAS. If the SAS-2 is measuring the same constructs as the original SAS, we should expect it to correlate highly with the SAS. We therefore correlated the two measures in the college sample (n = 593) described above. This analysis was restricted to the college sample because of the lack of factorial validity of the original SAS for children. As shown in Table 4, the SAS-2 subscales correlated far more highly with their corresponding SAS scales than they did with other SAS scales. Total scores on the two scales correlated at .90. The lowest correlation involved the corresponding Concentration Disruption scales.

Table 4 Correlations of SAS-2 Subscales and Total Score With Other Variables

		SAS-2 Scale			
Item	***N***	**Somatic Anxiety**	**Worry**	**Concentration Disruption**	**Total Score**
Sport Anxiety Scale					
Somatic	593	.90*	.57*	.35*	.79*
Worry	593		.86*	.51*	.77*
Concentration Disruption	593			.69*	.58*
Total score	593				.90*
POSQ Goal Orientation					
Task	189	–.25*	–.10	–.29*	–.24*
Ego	189	.23*	.21*	.27*	.27*
Motivational Climate[a]					
Mastery	572	–.28*	–.29*	–.32*	–.34*
Ego	572	.30*	.28*	.35*	.35*
Self-Esteem	563	–.40*	–.47*	–.50*	–.53*
Social Desirability	563	–.13*	–.20*	–.16*	–.19*

[a]Data from Smith et al., 2006b.

*$p < .01$.

This may be attributable to the previously cited factorial shortcomings of the SAS Concentration Disruption scale and the likelihood that the SAS-2's scale is a more valid measure of this construct. The SAS-2 scales may therefore be regarded as appropriate substitutes for the original SAS in adult samples.

Achievement Goal Orientations. The nature of achievement goals and their relation to anxiety have received considerable empirical attention (see Chi, 2004 and Duda & Hall, 2001 for reviews). In both educational and sport settings, research inspired by achievement goal theory has shown that an ego goal orientation is positively associated with performance anxiety, whereas a mastery or task orientation is negatively related to performance anxiety (Bandalos, Finney, & Geske, 2003; McGregor & Elliott, 2002; Vealey & Campbell, 1988). Table 4 shows relations between the SAS-2 and the task and ego achievement goal orientation subscales of the Perception of Success Questionnaire (POSQ; Roberts & Treasure, 1995) in a sample of 189 child athletes. As predicted, SAS-2 subscale and total scores were positively and significantly correlated with POSQ ego orientation scores and negatively correlated with task orientation scores at levels approximating those found in earlier studies with other anxiety measures, including the SAS.

Motivational Climate. Previous research has shown that the nature of the achievement environment created by significant adults, such as teachers and coaches, is related to performance anxiety (Papaioannou & Kouli, 1999; Walling, Duda, & Chi, 1993; White, 1998). Ego-oriented motivational settings, where emphasis is placed on besting and comparing oneself with others, are associated with higher performance anxiety. In contrast, mastery (task)-oriented climates are associated with lower anxiety. Table 4 shows correlations between athletes' SAS-2 scores and scores on the Motivational Climate Scale for Youth Sports (Smith, Cumming, & Smoll, 2006b), designed to measure the motivational climate initiated by youth sport coaches. As expected on theoretical and empirical grounds, Smith et al. reported that SAS-2 scores were negatively related to mastery (task) climate scores and positively related to ego climate scores. When analyzed at a team-mean rather than individual-athlete level, several of the correlations increased in magnitude. Most notably, the correlations between team-level ego motivational climate and mean anxiety level of the team was .47 for Concentration Disruption and .41 for SAS-2 total score.

Self-Esteem. Trait anxiety has consistently exhibited negative relations with measures of self-esteem (Brown, 1998; Wylie, 1979). To test this relation using the SAS-2, we administered the anxiety scale and the Washington Self-Description Questionnaire (WSDQ; Smoll, Smith, Barnett, & Everett, 1993), a measure of global self-esteem, to 563 child athletes. As shown in Table 4, the SAS-2 subscales and total score exhibited the expected negative relations with WSDQ scores.

State Anxiety. Performance trait anxiety is regarded as a predisposition to experience high anxiety states under conditions of threat (Smith et al., 1998; Spielberger, 1966). Thus, an athlete who is high in sport-specific trait anxiety would be expected to experience high levels of somatic arousal, worry, and/or concentration disruption when exposed to stressful competitive sport situations.

To assess the predictive validity of the SAS-2 in a preliminary fashion, 10- to 12-year-old athletes ($n = 28$) from five youth basketball teams were administered the SAS-2 at the beginning of the season and then were administered a state anxiety scale before an important late-season game 10 weeks later. The state anxiety measure was adapted from the SAS-2 to allow us to assess relations between the SAS-2 trait scales and corresponding state subscales (e.g., "I am worrying that . . ." rather than "I worry that . . ."). The items were answered on the same scale as the SAS-2, but in terms of "how you feel right now." Moderate-to-high predictive relations were observed between the trait and state scales. Somatic trait and Somatic state scales correlated .38 ($p < .05$). The corresponding trait-state correlations for the cognitive scales of Worry and Concentration Disruption were .74 ($p < .001$) and .46 ($p < .01$), respectively. Total scores on the trait and state measures correlated .64 ($p < .001$). Although replications with larger samples and in diverse sports are needed, these results offer initial support for the predictive validity of the SAS-2.

Sensitivity to Anxiety-Reduction Interventions for Coaches and Parents. Smith, Smoll, and Curtis (1979) developed a coach-training program that is designed to help coaches create a more positive and less stressful competitive sport situation for young athletes. Coach Effectiveness Training (CET) provides coaches with guidelines designed to create a socially supportive environment through frequent use of positive reinforcement, encouragement, and technical instruction, while discouraging the use of punitive behaviors. Coaches are also encouraged to create a task or mastery-oriented motivational climate, which also has anxiety-reduction properties.

Smith et al. (1995) showed significant reductions in performance anxiety as measured by the SAS total score and by the Sport Competition Anxiety Test for Children (Martens, 1977) among children who played for coaches who were exposed to the CET intervention. Children who played for an untrained control group showed slight increases in anxiety. Because the SAS factor structure could not be replicated in this sample of 10- to 12-year-old children, it was not possible to assess reductions in the multiple dimensions of anxiety in this study.

To assess the effects of the intervention on SAS-2 total and subscale scores, an experimental group of 20 basketball coaches was administered an updated version of CET called the Mastery Approach to Coaching, which focuses more explicitly than CET did on promoting a mastery-oriented motivational climate. A control group of 16 coaches received no training. Children who played for the two groups of coaches were administered the SAS-2 prior to and 10 weeks later near the end of the season.

Results revealed statistically significant ($p < .005$) Time × Conditions interactions on all SAS-2 subscales and on total score (Smith, Smoll, & Cumming, in press). Children exposed to trained coaches exhibited reductions in anxiety scores over the course of the season, whereas children who played for the untrained coaches showed increases on all subscales and total score as competitive pressures increased near the end of the season. In the intervention condition, significant reductions occurred for SAS-2 total score ($p < .01$), Somatic Anxiety ($p < .01$), and Worry ($p < .025$), but the decrease on Concentration Disruption was not significant. Thus, the SAS-2 appears to be sensitive to an intervention that has been shown in earlier research to reduce performance trait anxiety.

In a second study in which mastery-promoting motivational climate interventions were directed at both the coaches and parents of young athletes, a similar pattern of significant Time × Condition interactions were found for SAS-2 total score and all subscales (Smoll, Smith, & Cumming, 2006). Again, significant reductions in total score, Somatic Anxiety, and Worry occurred in the intervention condition, but the decrease in Concentration Disruption was not significant. It thus appears that Concentration Disruption is less affected by motivational climate interventions than are the other scales.

Social Desirability. Because it is socially undesirable to endorse anxiety items (Edwards, 1970), discriminant validity requires that variance on an anxiety measure not be attributable solely to socially desirable responding. To assess the relation of the SAS-2 to social desirability response set, we administered an 18-item version of the Children's Social Desirability Scale (Crandall, Crandall, & Katkovsky, 1965) to our large validation sample. Based on previous research, we expected the SAS-2 to correlate moderately and negatively with social desirability. Instead, we obtained low negative correlations not exceeding −.20 between the SAS-2 subscales and social desirability. These correlations are somewhat lower than those obtained between the adult SAS and the Marlowe-Crowne Social Desirability Scale, an adult measure of the same social desirability construct (Smith et al., 1990). Results thus indicate that the SAS-2 is minimally influenced by social desirability response set and support its discriminant validity.

Perceived Competence. Athletes at all levels of self-perceived competence can exhibit trait anxiety, and previous research has shown low negative relations between fear of failure, as measured by the Performance Failure Appraisal Inventory (PFAI), and perceived competence (Conroy, Willow, & Metzler, 2002). Given the conceptual convergence of the fear of failure and performance anxiety constructs (and the correlation of .50 between the PFAI and the SAS reported by Conroy et al.), we should expect a similar pattern of results for the SAS-2. We therefore administered the SAS-2 and a 9-point measure of self-rated competence in basketball (ranging from *very poor* to *among the best*) to a sample of 570 youth basketball players. Low negative correlations were observed between anxiety and perceived competence. Somatic Anxiety correlated −.07, whereas the cognitive Worry and Concentration Disruption exhibited correlations of −.16 and −.06, respectively. The SAS-2 total score correlated −.11 with perceived competence in basketball. This result provides further evidence of discriminant validity in that the SAS-2 is measuring something other than perceived competence.

The scale used in our research, together with the scoring key for the SAS-2 subscales, is presented in the appendix to this article.

Discussion

Development of the SAS-2 was prompted by several issues relating to the factorial validity of the original SAS. First, several studies suggested that at least three items on the original measure had major measurement shortcomings (Dunn et al., 2000; Prapavessis et al., 2005). Second, although the original SAS exhibited satisfactory fit indices in CFAs, we felt a need to improve its fit to the hypothesized 3-factor model. A final impetus was a failure to find the usual 3-factor structure of the SAS when the scale was administered to younger athletes in the 10- to 12-year-old range. This failure raised two questions, one methodological, the other theoretical. The methodological question related to the applicability of the SAS to samples younger than those for which it was developed. Reading level analyses revealed that many of the SAS items had reading level scores above the 9th grade. One possibility, therefore, was that the 3-factor structure failed to replicate because of item-comprehension difficulties in younger samples.

Failure to replicate the 3-factor SAS factor structure also raised the theoretically interesting question of whether the three-component cognitive-affective model of anxiety applies to younger children's experiences of anxiety. Perhaps children do not fully differentiate between cognitive and somatic components of anxiety until some point in adolescence. Surprisingly, we found that with a few exceptions (e.g., Turner & Barrett, 2003), little developmental research had been done on cognitive-somatic discrimination in children's self-perceptions of their emotional reactions.

Development of a new version of the SAS with age-appropriate reading levels has helped address both the methodological and the theoretical issues. Within the 9- to 14-year-old range, and in the college sample, the new measure yielded a factor structure that replicated the three-component structure of the original SAS. At even the youngest levels of our age sample, CFA revealed a good fit between children's item responses and the 3-factor model, with or without a higher-order general performance anxiety factor. Moreover, the factor structure remained invariant across age groups. It thus appears that, at least down to 9 years of age, children do indeed differentiate between the experiential aspects of anxiety that correspond to the Somatic, Worry, and Concentration Disruption factors. Moreover, the SAS-2 subscales and the scale as a whole have high internal consistency and acceptable test-retest reliability over a period of up to 3 months.

Confirmatory factor analyses strongly supported both a 3-factor model and a 3-factor model with a higher-order (total score) factor. Thus, researchers can justifiably use the three subscale scores, the total score, or all four scores in their empirical work. Especially encouraging are the high factor loadings and a complete absence of cross-loadings at all age levels, as well as the substantial increase in CFA fit indices compared with results derived from the original SAS. We should note that, although modification indices we applied could have improved model fit (particularly the RMSEA index), we elected to report unmodified CFAs, resulting in more conservative tests of model fit.

Although the SAS-2 subscales are substantially correlated with one another, as cognitive-affective theories would predict, it is worth noting that the 3-factor solution with similarly high loadings was also found when an EFA orthogonal (varimax) rather than an oblique rotation was performed on the SAS-2 items. This is important because factor scores generated from an orthogonal rotation are essentially uncorrelated. Using orthogonal factor scores as either predictor or outcome variables can help clarify the independent roles of cognitive and somatic anxiety for theoretical purposes (see Smith, 1989 for a discussion).

Although additional work relating the SAS-2 to other measures is clearly needed, preliminary results are promising. The scales exhibited low correlations with a measure of social desirability, and they were essentially unrelated to self-perceived competence, providing evidence of discriminant validity. Results bearing on convergent validity were also encouraging. In the college sample, correlations between the SAS and the SAS-2 were high enough to conclude that the two measures are tapping the same constructs. The fact that the respective Concentration Disruption scales correlated less substantially than the other scales may be attributable to suboptimal items in the original SAS scale that have cross-loaded with Worry in some studies (Dunn et al., 2000; Prapavessis et al., 2005). On psychometric grounds, the SAS-2 thus appears to be an improvement over the SAS.

Relations between SAS-2 scores and achievement goal constructs were consistent with theoretical expectations and previous findings. At the level of individual athletes, ego achievement orientation was positively associated with anxiety and task orientation was negatively related. The type of motivational climate created by coaches was also associated with differences in anxiety. At both the athlete and team level, the more ego-oriented the motivational climate was judged to be, the higher were the levels of somatic and cognitive anxiety reported by the athletes. We should note, however, that these results are correlational in nature, and all measures are based on athlete reports, so that causal inferences cannot be made with certainty. Theoretically, we would expect that an ego-oriented motivational climate would increase the potential threat value of the athletic situation and increase anxiety (Duda & Hall, 2001; Roberts & Treasure, 1995), but in the absence of athlete-independent measures of the motivational climate (such as observational measures), we cannot rule out the possibility that anxious athletes tend to view athletic situations as more ego-oriented, or that some third variable is responsible for the relation between motivational climate and anxiety. This topic is clearly deserving of future empirical attention and will require independent sources of data on motivational climate.

Two other sets of results provided evidence for the validity of the SAS-2. First, the SAS-2 successfully predicted state anxiety scores collected 10 weeks later. This is a key validity finding, given that trait anxiety is viewed as a predisposition to experience state anxiety in challenging or threatening situations (Spielberger, 1966). The new state anxiety measure derived from the SAS-2 also allowed us to test the predictive power of each of the subscales. Although all of the SAS-2 subscales predicted corresponding state anxiety components at a statistically significant level, the strongest predictive power was seen for the Worry subscale and the SAS-2 total score.

The SAS-2 also proved to be sensitive to a coach-training intervention previously shown to decrease trait anxiety in young athletes (Smith et al., 1995). In a more recent experimental study (Smith et al., in press), children who played for trained coaches exhibited a decrease in performance anxiety over the course of the sport season, whereas children who played for untrained coaches increased in anxiety over the same period, paralleling the results shown in the earlier study. All of the subscales and the total score exhibited this significant Time × Conditions interaction. Similar results were obtained in a second study, this one involving complementary interventions directed at both coaches and parents (Smoll et al., 2006). It thus appears that the SAS-2 may be useful as an outcome measure in research designed to evaluate anxiety-reduction interventions in sport.

In summary, reliability and validity studies indicate that the SAS-2 has good psychometric properties. Further, there is evidence for factorial, convergent, discriminant, and predictive validity. From a reading-level perspective, the measure appears appropriate for use with children down to age 8 or 9 and with older populations as well. The SAS-2 can be used to extend multidimensional anxiety research downward to younger age groups while measuring the same anxiety components in older populations. The instrument seems suitable not only for basic research on the cognitive and somatic aspects of anxiety, but also for assessing the efficacy of interventions designed to reduce anxiety. Moreover, the instrument may be helpful in tailoring interventions to individual athletes who differ in their patterns of somatic and cognitive anxiety. For example, an athlete with a high somatic anxiety component might be particularly responsive to arousal-control interventions such as relaxation training, whereas one high in concentration disruption might profit maximally from a more cognitively oriented attention-control training approach.

Several limitations and unanswered questions should be noted. As in all instances of instrument development, replication of results in future studies is needed. As an example, the factorial issues involving several items in the original SAS were not apparent in the samples used in the scale's original development. Only when the factor structure was studied in new samples (Dunn et al., 2000; Prapavessis et al., 2005) did the item-loading disparities appear. Although our samples were large ones containing both males and females, several age levels, and involving several sports, additional research is needed within other athletic populations. Also absent in our construct validation studies is information on relations with athletic performance measures. There is a need for such studies in view of well-documented relations of anxiety with performance outcomes (Burton, 1998; Smith et al., 1998). More research is also needed with older-age samples, as our validity studies focused on child athletes. Given the positive results on the CFA fit indices in the college sample, we are cautiously optimistic that the SAS-2 will be useful in the study of sport performance anxiety in adult populations as well. We should note, however, that the college sample represented a range of competitive sport levels and, in some cases, athletes who had not competed at a high level for 3 to 9 months. Although such a sample is suitable for correlational analyses on a trait measure like ours, the validity of SAS-2 scores in relation to other variables and in other adult sport populations requires future empirical attention. As Nunnally and Bernstein (1994) note, validation of an instrument is a continuing process, not an end point, and much remains to be done to extend the validity findings reported here.

The problems encountered in using the SAS with athletes younger than the high school and college athletes used in its development, and the success of the SAS-2 in remedying these problems, illustrate the importance of assessing reading level in existing measures and devising instruments that are age-appropriate for younger populations. Many of the measures commonly used in sport psychology research, like the SAS, were developed using college-age and adult samples. Our recommendation is that researchers exercise caution in applying such instruments (even those with high face validity) to younger athlete populations without assessing reading level and the ability of children to understand item content. In using multidimensional scales, it is also important to apply factor analysis to ensure that the dimensions measured by the scale are reproducible in the younger age group. Failure to do so may yield misleading results if the scale in question is inappropriately applied to a child sample.

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Appendix: Sport Anxiety Scale-2

REACTIONS TO PLAYING SPORTS

Many athletes get tense or nervous before or during games, meets or matches. This happens even to pro athletes. Please read each question. Then, circle the number that says how you USUALLY feel before or while you compete in sports. There are no right or wrong answers. Please be as truthful as you can.

	Before or while I compete in sports:	Not At All	A Little Bit	Pretty Much	Very Much
1.	It is hard to concentrate on the game.	1	2	3	4
2.	My body feels tense.	1	2	3	4
3.	I worry that I will not play well.	1	2	3	4
4.	It is hard for me to focus on what I am supposed to do.	1	2	3	4
5.	I worry that I will let others down.	1	2	3	4

	Before or while I compete in sports:	Not At All	A Little Bit	Pretty Much	Very Much
6.	I feel tense in my stomach.	1	2	3	4
7.	I lose focus on the game.	1	2	3	4
8.	I worry that I will not play my best.	1	2	3	4
9.	I worry that I will play badly.	1	2	3	4
10.	My muscles feel shaky.	1	2	3	4

	Before or while I compete in sports:	Not At All	A Little Bit	Pretty Much	Very Much
11.	I worry that I will mess up during the game.	1	2	3	4
12.	My stomach feels upset.	1	2	3	4
13.	I cannot think clearly during the game.	1	2	3	4
14.	My muscles feel tight because I am nervous.	1	2	3	4
15.	I have a hard time focusing on what my coach tells me to do.	1	2	3	4

Scoring Key. Somatic: Items 2, 6, 10, 12, 14; Worry: Items 3, 5, 8, 9, 11; Concentration Disruption: Items 1, 4, 7, 13, 15.