Conceptual and Statistical Issues in Research Involving Multidimensional Anxiety Scales

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Research on anxiety has advanced through several historical phases involving increasingly finer delineations of the construct and the instruments used to measure it. Early research involved the use of global trait measures such as the Manifest Anxiety Scale (Taylor, 1953). Spielberger (1966) popularized the important distinction between trait and state anxiety and provided parallel measures of the two constructs. Researchers also found that anxiety is situation-specific to some extent, and they developed trait measures of specific kinds of anxiety such as test anxiety (Sarason, 1978), social anxiety (Watson & Friend, 1969), and competitive sport anxiety (Martens, 1977).

Another important distinction has been made between cognitive and somatic components of the anxiety response (e.g., Davidson & Schwartz, 1976; Lazarus, 1966), and both global and situation-specific measures of these two aspects of anxiety have appeared (Liebert & Morris, 1967; Morris, Davis, & Hutchings, 1981; Sarason, 1984). In recent years, multidimensional sport-specific measures of both state anxiety and trait anxiety have appeared. The Competitive State Anxiety Inventory—2 (CSAI-2; Martens, Burton, Vealey, Bump, & Smith, 1982) has separate somatic and cognitive state anxiety subscales plus a self-confidence scale. The Sport Anxiety Scale (SAS; Smith, Smoll, & Schutz, in press) measures somatic trait anxiety and two aspects of cognitive trait anxiety—worry and concentration disruption.

The availability of multidimensional sport anxiety measures seems certain to advance our understanding of the antecedents, dynamics, and consequences of anxiety in sport. Several important and informative studies have already appeared involving the assessment of relations between cognitive and somatic anxiety and sport performance using the CSAI-2 (e.g., Burton, 1988; Gould, Petlichkoff, Simons, & Vevera, 1987), and more are certain to follow. This comment focuses upon several conceptual and statistical considerations that seem germane to our efforts to understand sport anxiety and its correlates.

Perhaps the most intriguing theoretical and empirical questions have to do with specifying the separate antecedents and consequences of cognitive and somatic state and trait anxiety. Although most current models of anxiety (e.g., Lazarus

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& Folkman, 1984; Smith, 1985) posit causal interactions between cognitions and arousal, researchers have found that cognitive and somatic components of anxiety may have different antecedents, temporal characteristics, and consequences, and they sometimes respond differentially to interventions (Gould, Petlichkoff, & Weinberg, 1984; Morris et al., 1981; Sarason, 1984). On cognitive tasks, cognitive anxiety has consistently been found to be more strongly and negatively related to performance than has somatic anxiety (Morris et al., 1981; Sarason, 1984). Gould et al. (1987) and Burton (1988), on the other hand, have provided evidence for a curvilinear relation between somatic anxiety and performance on motor tasks using intraindividual measures.

Given the availability of multidimensional measures of cognitive and somatic anxiety, it would seem a relatively simple matter to answer empirical and theoretical questions about these components of anxiety by administering the scales and studying antecedent and consequent variables in relation to them. When the focus of our research is on purely empirical questions such as, “Which subscale predicts subsequent performance best?” we certainly can proceed in this manner. However, many researchers would probably agree that the most interesting and meaningful questions in this area of research are theoretical rather than strictly predictive ones. Complications arise in answering questions such as, “How do the cognitive and somatic components of anxiety each affect this behavior?” because cognitive and somatic anxiety scales are almost invariably found to be substantially correlated with one another (as would be expected if cognitive and somatic components are causally related to one another in the manner that most contemporary cognitive-affective theories suggest). Depending on the type of statistical analysis employed by the investigator, the common variance shared by the correlated subscales creates a strong potential for drawing erroneous conclusions of either the Type I or Type II variety.

Because the CSAI-2 and the SAS subscales were derived on the basis of principal components analyses with varimax rotations that yielded orthogonal (uncorrelated) factors of cognitive and somatic anxiety, it is sometimes mistakenly assumed that the cognitive and somatic subscale scores are therefore statistically independent. On the contrary, subscale scores derived from unweighted item scores (i.e., summing the scores for the items on each subscale) are highly correlated with one another on both the trait (SAS) and state (CSAI-2) measures. It is not unusual for cognitive and somatic subscales to correlate in the .50 to .60 range (Karteroliotis & Gill, 1987; Smith et al., in press). Because the subscales share a substantial amount of common variance, it can be difficult to disentangle their specific effects. In statistical terms, multicollinearity can become an issue, and the difficulties this raises for multivariate analyses are well documented (see Cohen & Cohen, 1983; Tabachnick & Fidell, 1989).

In some cases, statistical analyses may yield a nonsignificant result for an anxiety subscale that has a highly significant bivariate correlation with the criterion variable. For example, one common method for analyzing multidimensional anxiety scale data is by means of stepwise and hierarchical regression analysis, with cognitive and somatic subscale scores treated as predictor variables and performance as the criterion variable. If cognitive anxiety is entered first in a hierarchical analysis by choice, or if it is entered first in a stepwise analysis because it correlates most highly with the dependent variable, the test of its contribution to performance variance accounted for will include the variance it shares with