Validating Self-Report Measures of State and Trait Anxiety Against a Physiological Measure

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While anxiety research frequently uses only self-report measures to assess dimensions of state and trait anxiety, the present study sought to corroborate these self-report measures using a physiological measure, namely heart rate. Another aim of the present study was to test the multidimensional interaction model of anxiety in a social evaluation situation (i.e., a seminar presentation), using a physiological measure of state anxiety. Graduate psychology students completed a state anxiety questionnaire and were attached to a heart rate recorder prior to a class seminar *presentation*. One week later, students completed trait and state anxiety questionnaires and were again attached to a heart rate recorder prior to seminar *observation* by others. Heart rate was elevated during seminar presentation relative to seminar observation, reached maximum values during the first 15 minutes of seminar presentation and then decreased over time. State anxiety scores indicate that participants were experiencing considerably more anxiety just before presenting the seminar than just before observing a seminar. Heart rate during seminar presentation was significantly correlated with self-report state anxiety and self-report social evaluation trait anxiety, but not with seminar grade. Support was found for the multidimensional interaction model of anxiety using the physiological measure (i.e., heart rate).

STATE AND TRAIT ANXIETY

Anxiety has been defined as a stimulus, as a trait, as a motive, and as a drive (Endler, 1983). Spielberger (1966) suggested that much of the conceptual ambiguity in defining the construct of anxiety was due to the lack of a distinction between trait anxiety (A-trait) and state anxiety (A-state). A-trait refers to a more stable predisposition or proneness to state anxiety while A-state is conceptualized as a momentary or

situational emotional reaction accompanied by physiological arousal. Endler and his colleagues have identified dimensions of state and trait anxiety (Endler, 1983; Endler, 1997; Endler, Edward, & Vitelli, 1991). Specifically, two state anxiety components (cognitive-worry and autonomic-emotional) and four trait anxiety components (social evaluation, physical danger, ambiguous, and daily routines) have been identified. More recently, other components of trait anxiety, namely self-disclosure trait anxiety and separation trait anxiety have been identified and measures assessing them have been developed (Endler, 1999; Endler, Flett, Macrodimitris, Corace, & Kocovski, 2001; Flett, Endler, & Rector, 2001). The present study focuses on the original two facets of state and four facets of trait anxiety, and specifically on a social evaluation situation.

ASSESSMENT OF STATE AND TRAIT ANXIETY

The Endler Multidimensional Anxiety Scales (EMAS; Endler et al., 1991) are paper and pencil self-report measures of state and trait anxiety. In addition to the state anxiety measure (EMAS-S) and the trait anxiety measures (EMAS-T), the EMAS includes a measure that assesses the perception of the situation (EMAS-P).

It has long been suggested that the most comprehensive assessment of anxiety involves the use of a combination of behavioral, physiological and self-report assessment techniques (Amoroso & Walters, 1969; Magnusson & Endler, 1977; Martin, 1961; Walters & Parke, 1964). Examples of physiological measures of anxiety include heart rate, galvanic skin response and finger pulse volume (Fontana, Hyra, Godfrey, & Cermak, 1999; Martin, 1961). Results relating physiological measures to each other and to self-report measures have been equivocal. Heart rate has been shown to be strongly correlated with self-report state anxiety in a sports competition situation (Tenenbaum & Milgram, 1978). Finger pulse volume (a measure of digital vasoconstriction based on the premise that a sympathetic nervous system response is decreased blood flow to peripheral areas of the body) has been shown to be a valid physiological measure for social evaluative threat (Smith, Houston, & Zurawski, 1984). Finger pulse volume was found to be related to self-report state anxiety prior to the stressful situation (an interview), but not during the stressful situation (Smith et al., 1984).

Clements and Turpin (1996) assessed sweat gland activity while giving a presentation and while being a member of the audience. Sweat gland activity was found to increase prior to and during the presentation and decrease upon completion of the presentation. Levels of state anxiety were also found to be elevated during the presentation. There was, however, no relationship found between the physiological measure (sweat gland activity) and each of state and trait anxiety.

Correlations among the various physiological measures of anxiety are typically low (Martin, 1961). There may be a temporal factor. Bloom and Trautt (1977) found that, initially, participants were more anxious according to the finger pulse volume measure, whereas according to heart rate, participants were more anxious later on. Furthermore, typically only weak relationships are seen between physiological measures and psychological self-report measures (De Jong, Erdman, van den Brand,Verhage, Trusberg, & Passchier, 1994; Morrow & Labrum, 1978). This provides support for the view that

any measure of anxiety should be used along with other measures of anxiety. Various psychological, behavioral and physiological processes are involved in the experience of anxiety and there are individual differences.

This investigation examined the feasibility of using a physiological measure, heart rate, in conjunction with self-report measures in a social evaluation situation as a more reliable method of assessing individual differences in both state and trait anxiety. In addition to the aim of corroborating the self-report measures of state and trait anxiety, the present study sought to test the multidimensional interaction model of anxiety using a physiological measure of state anxiety.

MULTIDIMENSIONAL INTERACTION MODEL OF ANXIETY

The differential hypothesis, fundamental to the multidimensional interaction model of anxiety, states that changes in state anxiety are expected if there is congruency between the trait anxiety dimension and the type of situational stress (Endler, 1983, 1997). No change in state anxiety is expected if there is a lack of congruence between the type of stressful situation and the trait anxiety dimension. For example, a person high in social evaluation A-trait and low in physical danger A-trait is expected to show relatively larger changes in A-state when exposed to a situation he or she perceives to be social evaluation than when the situation is perceived to be physical danger.

One example of a test of the multidimensional interaction model of anxiety in a social evaluation situation was conducted in an equestrian setting (Trotter & Endler, 1999). Adolescent girls were assessed during practice and then again prior to a competitive horse jumping situation. The adolescent girls perceived this to be a social evaluation situation. There was a significant social evaluation trait anxiety by social evaluation stressor situation interaction. That is, there was a person by situation interaction when situational social evaluation situational threat was congruent with Social Evaluation A-Trait. No interactions occurred when person and situation variables were not congruent.

Various laboratory and field studies (in real life situations) have provided empirical support for the multidimensional interaction model of anxiety. Studies have been conducted in a wide variety of situations including (but not limited to) karate situations, dental surgery situations, actors performing on a stage, equestrian situations, in medical settings and bank settings (Endler, 1983, 1997). More than 80 percent of the tests of the multidimensional interaction model of anxiety have yielded positive results (Endler, 1997).

Present Study

Graduate students in psychology completed the state anxiety measure (EMAS-S) and were attached to a heart rate recorder prior to *presenting* a seminar. One week later, students completed the state and trait anxiety measures and were attached to a heart rate recorder prior to *observing* a seminar presentation by others. It was expected that the physiological measure of state anxiety (i.e., heart rate) would be significantly

related to the self-report measure of state anxiety (i.e., EMAS-S). Furthermore, the relationship between the autonomic-emotional component of state anxiety and heart rate was expected to be stronger than the relationship between the cognitive-worry component of state anxiety and heart rate. It was also expected that the item on the EMAS-S assessing change in heart rate would be correlated with the physiological measure of heart rate.

The seminar presentation, a social evaluation situation, was the stressful condition. It was therefore expected that a relationship would be present between self-report social evaluation trait anxiety and heart rate (a state measure). It was further expected that a relationship would not be present between the other three components of trait anxiety (physical danger, ambiguous, and daily routine) and heart rate because the seminar situation is not generally seen as physically dangerous, overly ambiguous, or a daily routine for this sample.

Thus, the present study had two aims: (i) to corroborate self-report measures of state and trait anxiety, and (ii) to test the multidimensional interaction model of anxiety using a physiological measure of state anxiety (i.e., heart rate).

METHOD

Participants

Seventeen psychology graduate students (13 women, 4 men) enrolled in a seminar course participated in the present study. The median age of the students was 26 years (range 24 to 43 years of age).

Measures

Self-Report Measures:
Endler Multidimensional Anxiety Scales – EMAS – State (Endler et al., 1991)
The EMAS-State consists of two five-point intensity Likert subscales containing ten items each; cognitive-worry and autonomic-emotional. It has high internal consistency, ranging from .78 to .91 (Endler et al., 1991).

Endler Multidimensional Anxiety Scales – EMAS – Trait (Endler et al., 1991)
The EMAS-Trait consists of four subscales containing 15 response items each on a five-point intensity Likert scale; social-evaluation, ambiguous, physical danger, and daily routines. Internal consistency for the social evaluation subscale has been found to range from .87 to .94 and test-retest has been found to range from .62 to .79 (Endler et al., 1991).

Physiological Measure:
Heart rate was recorded on an ambulatory Oxford Medilog 9000 system. Pre-gelled electrodes were attached to the upper sternum and fifth left rib at the mid axillary line

TABLE 1
Means and Standard Deviations (SD) for EMAS-S, EMAS-T, and Heart Rate Ratio

	Mean	SD
EMAS-State		
Seminar Presentation		
EMAS-S-Cognitive-Worry	23.94	8.25
EMAS-S-Autonomic-Emotional	29.24	7.18
EMAS-S-Total	53.18	13.41
Seminar Observation		
EMAS-S-Cognitive-Worry	12.94	4.35
EMAS-S-Autonomic-Emotional	13.88	3.90
EMAS-S-Total	26.82	7.98
EMAS-Trait		
Social Evaluation	50.53	12.20
Physical Danger	62.24	12.25
Ambiguous	42.53	12.77
Daily Routines	23.65	6.45
Heart Rate Ratio	1.33	0.14

Note. $N = 17$; EMAS = Endler Multidimensional Anxiety Scales; Heart rate ratio = ratio of mean heart rate during the first 30 minutes of seminar presentation / mean heart rate during the first 30 minutes of seminar observation.

for each participant. The electrodes were attached to a small recorder that continuously recorded the data on a cassette tape.

Achievement Measure:

Each seminar was assessed by the course instructor and assigned a grade. For this study, seminar grade was used as a situation specific measure of achievement. Grades were normally distributed, ranged from A+ to B and were converted to numbers for analyses as follows: A+ = 5; A = 4; A—= 3; B+ = 2; B = 1. There was one A+, four A grades, five A—grades, six B+ grades and one B.

Procedure

Students in a graduate level seminar course were approached to participate in this study. Participation was voluntary. In partial fulfillment of course requirements, each student was expected to deliver a three-hour seminar. The seminar presentation was expected to be a stressful situation. Attending class when another student was presenting a seminar was expected to be a non-stressful or baseline situation. Each student was attached to the Medilog recorder prior to their own seminar presentation. Just before the seminar was to begin, the student completed the EMAS-S. One week later, when the student was observing another student presentation, the physiological recorder was again attached to the student in order to obtain a baseline measure of

TABLE 2
Correlations between EMAS-State, EMAS-Trait, and Heart Rate

	Heart Rate Ratio
EMAS-State	
Seminar Presentation	
EMAS-S-Cogntive-Worry	.405 *
EMAS-S-Autonomic-Emotional	.531 **
EMAS-S-Total	.457 *
EMAS-S-Heart Rate Item	.443 *
Seminar Observation	
EMAS-S-Cognitive-Worry	.384
EMAS-S-Autonomic-Emotional	.396
EMAS-S-Total	.181
EMAS-Trait	
EMAS-T-Social Evaluation	.497 *
EMAS-T-Physical Danger	.014
EMAS-T-Ambiguous	.244
EMAS-T-Daily Routines	-.020

Note. $N = 17$; EMAS = Endler Multidimensional Anxiety Scales * $p < .05$ ** $p < .01$

physiological arousal during a non-stressful situation. At this time, the student completed the EMAS-S once again and the EMAS-T.

RESULTS

The mean EMAS-S and EMAS-T scores are presented in Table 1. Participants' mean EMAS-S scores suggest that participants were experiencing considerably more anxiety just before presenting a seminar than just before observing a seminar. The pattern of EMAS-T scores reported by participants in the present study is very similar to the pattern of scores reported by Endler et al. (1991) for Canadian undergraduates.

Relationships among self-reports of state anxiety, trait anxiety, physiological arousal and achievement were investigated. It was expected that a relationship would exist between self-report state anxiety and physiological arousal. Table 2 shows correlations between the EMAS (self-report measures of state and trait anxiety) and heart rate. A significant relationship was found to exist between the physiological measure of state anxiety (i.e., heart rate) and the self-report measure of state-anxiety (EMAS-S) obtained during the stressful situation ($r = .46$). Furthermore, results are presented for the cognitive-worry and the autonomic-emotional components of state anxiety separately. As expected, the correlation between autonomic-emotional and heart rate is higher than that between cognitive-worry and heart rate. Additionally, the correlation between the heart rate item on the EMAS-S ($r = .44$) is very close to the reported correlation for the whole EMAS-S scale and heart rate.

Table 2 also shows the relationship between heart rate and each of the four facets of

trait anxiety. A significant correlation was found between EMAS-T-SE and heart rate. Furthermore, the lack of a significant correlation was found between the other EMAS-T situational components and heart rate. The seminar presentation was not deemed to be physically dangerous, ambiguous or a daily routine situation, therefore a relationship between these other facets of trait anxiety and heart rate was not expected. Since a seminar presentation involves social evaluation, it was expected that self-report of social evaluation trait anxiety would be related to heart rate. These results show that individual differences in EMAS-T-SE are related to individual differences in heart rate during a social evaluation situation but individual differences in EMAS-T-PD, EMAS-T-AM, or EMAS-T-DR are not related to heart rate during a social evaluation situation. This pattern of results provides corroboration for the differential hypothesis of the interaction model of anxiety.

Finally, there was no relationship between seminar grade and either physiological arousal or self-report measures of state or trait anxiety. This outcome is not very surprising considering the complex nature of high level behaviors such as seminar presentation.

DISCUSSION

The results of this study suggest that validating self-report responses with physiological measures is feasible. The ambulatory heart rate recorder was found by the participants to be non-distracting and comfortable. Considering the lack of use of such corroborating physiological measures in the area of personality, and the relative ease and unobtrusive nature of the physiological data collection, this approach might add insight into individual differences. This study thus used three measures of anxiety: the self-report measure of state anxiety, self-report measure of trait anxiety and the physiological heart rate measure, with the latter being considered relatively more objective than the first two.

Although these results are relatively preliminary due to the small sample size, the findings are encouraging and substantive. Self-report of state anxiety and specifically self-report of physiological state in a stressful situation was corroborated by a physiological measure. The result that state anxiety as assessed by heart rate was correlated with self-report state anxiety is consistent with Tenenbaum and Milgram's (1978) findings. Moreover, as expected, the autonomic-emotional component of state anxiety (the component containing items assessing physiological responses) evidenced a stronger relationship with heart rate than the cognitive-worry component of state anxiety. One item on the EMAS state anxiety scale is "Heart beats faster." This one item showed a relationship with the physiological measure of heart rate that was very similar to the relationship between heart rate and the whole EMAS state scale (containing 20 items). Relying on one item is generally not viewed as psychometrically sound, however this result speaks to the validity of this particular self-report item.

Further the differential hypothesis (Endler, 1983, 1997) was supported. The seminar presentation situation was perceived as a social evaluation situation. A relationship was found between the situational congruent self-report A-trait (i.e., social evaluation

trait anxiety) and heart rate during the seminar presentation while no relationship was present between heart rate and other trait anxiety dimensions not congruent with the social evaluation situation (i.e., physical danger, ambiguous, daily routines). This supports past research that has also found support for the multidimensional interaction model of anxiety in social evaluation and other stressful situations (Endler, 1997; Trotter & Endler, 1999).

Neither self-report of state or trait anxiety nor heart rate were related to achievement. This finding is in line with results reported by Endler, Kantor and Parker (1994) who also failed to find a relationship between state anxiety measures obtained before students wrote an examination and performance on the examination. It is also consistent with others who have also failed to find a relationship between achievement and anxiety (Dew, Galassi, & Galassi, 1984; Kaufman, Eller, & Applegate, 1990). Part of the reason for the non-significant relationship could be due to the lack of variance in the grades (10 of the grades were between A+ and A-; 6 were B+).

Magnusson and Endler (1977) have pointed out that although much of personality theory refers to observable behavior, the majority of research is based on self-reports of such behavior. The assumption that self-reports are accurate representations of reality is, they feel, tenuous. In this study there is a strong suggestion that self-reports of anxiety, and specifically self-reports of physiological state are accurate reflections of physiological arousal in a stressful, socially evaluative situation. Magnusson and Endler's (1977) criticism should still be taken very seriously and more personality research should make use of multiple measures (e.g., behavioral, physiological) instead of relying solely on self-report measures. The present study does, however, support the validity of the use of self-reports for the measurement of anxiety.

NOTES

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