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The Anxiety Response: Concordance Among Components[1]

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Under social-evaluative stress, self-reported distress (cognitive and somatic symptoms), behavioral anxiety (motor, facial, verbal, and social), physiological arousal (heart rate and skin resistance), and task performance (cognitive and motor) were recorded. Concordance was selective and consistent across response systems. There were significant relationships among measures of cognitive aspects, and among those concerned with somatic aspects, but not between these two areas. Furthermore, concordance was much higher in high- than in low-trait/test-anxiety participants, who even exhibited reversed concordance. These differences are explained in terms of stronger physiological signals in high trait/test anxiety. Alternative interpretations involving perceiving and/or reporting internal threat-related information in low trait/test anxiety are discussed.

The anxiety response is an ubiquitous emotional and motivational factor, with an important adaptive function. The construct of anxiety has long played a central role in psychological theories of behavior (e.g., Mowrer, 1960; Spence & Spence, 1966). More recently, it is also prominent in theories of cognition, both as an emotion biasing cognitive processes (e.g., Calvo & Castillo, 1997; see Williams, Watts, MacLeod, & Mathews, 1997), and as a motivational factor promoting the use of compensatory processing resources (e.g., Calvo & Eysenck, 1996; see Eysenck & Calvo, 1992). Yet

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anxiety has definitional problems as a construct, because of discordance among its components. In this paper, conditions modulating concordance are investigated, as well as an explanation for their effects.

Three components have been identified in the anxiety response as an emotional state: (a) subjective or self-reported distress; (b) behavior involving avoidance, motor tension, and verbal disruption; and (c) elevated physiological sympathetic arousal (Lang, 1978; see Bernstein, Borkovec, & Coles, 1986). In principle, there are reasons to assume that anxiety is a psychobiologically integrated state of the organism in which the three response components should be related. First, from an evolutionary perspective (Marks & Nesse, 1994; Ohman, 1996), as an adaptive response that helps to avoid dangerous situations, anxiety should mobilize *most* organismic resources (metabolic, behavioral, and mental) in *coordination* to maximize effectiveness, when signals of danger are detected. And, second, evidence obtained with *self-report* measures indicates that there are three intercorrelated, though distinct, (r = approx. .50) components in state anxiety—cognitive experience of threat, and perceived behavioral and physiological activation—(Calvo, Alamo, & Ramos, 1990; Heimberg, Gansler, Dodge, & Becker, 1987; Lehrer & Wolfolk, 1982; Scholing & Emmelkamp, 1992).

However, self-report data represent a weak object of scientific analysis. In addition, research with *objective* data has often failed to find significant relationships between the three response systems in anxiety (see reviews in Bernstein *et al.*, 1986; Fahrenberg, 1992; Miguel-Tobal, 1990; Silva, 1996). The findings revealing discordance among elements have led most researchers to conceptualize anxiety as a multidimensional construct involving three separate though relatively interacting components. Some researchers have even suggested abandoning the construct of anxiety, because observed discordance makes it confusing and superfluous as an explanatory entity (see Delprato & McGlynn, 1984). Others have suggested that discordance may appear partly because of limitations in measurement, and that a multimethod approach is required (Bernstein *et al.*, 1986; Eifert & Wilson, 1991; Farhenberg, 1992; Miguel-Tobal, 1990; Silva, 1996).

The multimethod approach implies (a) taking into account conditions and individual differences which might modulate concordance among the systems, and (b) using several measures for each of the three response systems, to improve sensitivity and detect specific relationships. To address these issues, in the present study (a) one modulating condition (i.e., trait/test anxiety) is considered; and (b) multiple measurement in each of the three response systems is performed under stress conditions.

With regard to the first issue, one condition that has been assumed to facilitate concordance is enhanced emotional responding (e.g., Hodgson & Rachman, 1974; Silva, 1996). Thus, anxious patients show greater in-

tersystems correlations than normal people (see reviews in Bernstein *et al.*, 1986, p. 380). This suggests that normal people who usually show strong anxiety reactions will also have more concordance than those with weaker reactions. Accordingly, trait anxiety—emotional vulnerability to psychological stress—might make an important contribution. Typically, it has been found that persons high in trait anxiety report greater subjective anxiety than those low in trait anxiety (see Eysenck, 1997; Miguel-Tobal & Cano-Vindel, 1986). Therefore, elevated concordance should be observed in high trait anxiety. The reason is that the stronger the anxiety response, the more salient the interoceptive and behavioral cues will be for the individual, and the more likely they are to be detected by a rater or a measurement instrument. As a consequence, greater accuracy will be possible in establishing relationships between the different response systems.

Most previous research on concordance in the anxiety response has not taken trait anxiety into account (Gilbert, 1991; Heimberg *et al.*, 1987; Tamaren, Carney, & Allen, 1985; van Doornen, 1986; van Heck, 1988; Walsh, Wilding, & Eysenck, 1994). Craske and Craig (1984) provided initial evidence in line with our hypothesis. They found a little concordance in high-anxiety individuals, but lack of concordance in their low-anxiety counterparts. However, as Craske and Craig acknowledged, the (only) slightly superior concordance for the high- vs. low-"relatively anxious" (in their own words) group might have been due to the small differences in trait anxiety between groups, as they were separated on the basis of a median split. Therefore, to examine the contribution of this emotional vulnerability factor to concordance, subjects with stronger differences in trait anxiety scores should be compared. Furthermore, to maximize the modulating effect of differences in emotional vulnerability, experimental stress conditions and type of vulnerability should be made congruent. In this regard, social-evaluative stress conditions have been proposed as a relevant psychological stressor (Baggett, Saab, & Carver, 1996). On the other hand, test anxiety, a specific emotional vulnerability trait, is particularly concerned with perception of ego-threat in social-evaluative situations (Sarason, 1984; Spielberger & Vagg, 1995). Accordingly, it is expected that test anxiety will have greater contribution to concordance than trait anxiety in these conditions.

With respect to the second implication of the multimethod approach, most previous research has used measures of two of the three response systems (Heimberg *et al.*, 1987; Steptoe & Vogele, 1992; Tamaren *et al.*, 1985; Walsh *et al.*, 1994). Some studies have gathered data from the three systems, but have not reported correlations between them (Baggett *et al.*, 1996; Beidel, Turner, & Dancu, 1985; Lamb, 1978). Others have estimated concordance among measures in the three systems (Craske & Craig, 1984; Gilbert, 1991; van Doornen, 1986; van Heck, 1988). Of these, some did

not distinguish between self-reported cognitive and somatic state anxiety (Gilbert, 1991; van Doornen, 1986; van Heck, 1988). Yet this distinction has proved critical (Heimberg *et al.*, 1987; Tamaren *et al.*, 1985). Others (van Doornen, 1986) have included only one general index of self-reported anxiety and one (heart rate) of physiological arousal.

Therefore, weak evidence or lack of concordance in previous research could be due partly to (a) the use of mean data that were aggregated across all subjects (without distinguishing between groups with different emotional reactivity levels), and (b) an insufficient range of measures in the three systems to detect specific relationships. Accordingly, the aim of the present study was to investigate whether trait and test anxiety are modulating conditions in the concordance among the components of the anxiety response. For this purpose, several measures within each of the three response systems were collected. More specifically, (a) two self-report measures of subjective experience of anxiety (cognitive and somatic) were used, as well as (b) two physiological measures (heart rate and skin resistance level, each under baseline resting, anticipation of threat, exposure to tasks, and recovery), and (c) four behavioral measures (motor, facial, verbal, and avoidance of eye contact); in addition, (d) both cognitive and motor task performance were assessed. To detect differential concordance, intercorrelations between these measures were obtained separately for participants high or low in trait or test anxiety. In both cases, social-evaluative stress was used to provoke the anxiety response.

METHOD

Participants

Seventy-eight undergraduates (52 women; 26 men; age: $M = 21.0$ years; $SD = 2.2$) participated for course credit. They were selected from a group of 232 students on the basis of their high or low scores in trait and/or test anxiety, as measured, respectively, by the trait scale of the State-Trait Anxiety Inventory (STAI; Spielberger, Gorsuch, & Lushene, 1982) and the Test Anxiety Inventory (TAI; Spielberger, 1980). There were 28 participants high and 28 low in trait anxiety, as well as 28 high and 28 low in test anxiety. In each of these four groups there was the same proportion of women ($n = 18$) and men ($n = 10$). Selection was made separately for women and men. As there was a positive correlation between the TAI and the STAI ($r = .53$, $p < .0001$), 34 participants were both either high ($n = 17$) or low ($n = 17$) in trait and test anxiety (this is why the total number of participants was 78, instead of 112).

Measures

There were four groups of variables. Three of them were concerned with each of the response systems in anxiety—self-report, physiological and behavioral—and one with performance in several tasks under evaluative stress. Task performance was included as an indirect measure of the effects of state anxiety or emotional reactivity.

Self-reported cognitive and somatic state anxiety was assessed by means of the Cognitive and Somatic Anxiety Scale (CSAS; Calvo *et al.*, 1990). The CSAS is a 20-item scale containing 10 statements concerned with cognitive anxiety (e.g., "I am worrying about my performance") and 10 statements concerned with somatic anxiety (e.g., "My hands feel moist"). The statements were rated on a 5-point scale ranging from 1 (*not at all*) to 5 (*very much*). It was constructed after factor analyses of items from several similar scales (e.g., the CSAQ, by Schwartz, Davidson, & Goleman, 1978; see Calvo *et al.*, 1990). Two factors with eigenvalues >1.5 accounted for a total of 60% of the variance. The correlation between the cognitive and the somatic factor was .66. The internal consistencies for each subscale were .88 and .86, respectively.

Behavioral anxiety was evaluated according to the method described by Lamb (1978) (see also Bernstein *et al.*, 1986). Behavioral anxiety was decomposed into four indices: motor, facial, verbal, and social anxiety. There were seven components of the *motor* anxiety measure: gratuitous torso movements (trunk contortions), nail biting, hair touching, face touching, object grabbing/touching, clothes or body touching, gratuitous head movements; five *facial* anxiety components: lip licking or biting, swallowing, throat clearing, sighs, grimaces or facial tics; four elements of *verbal* anxiety: speech blocks, "ah . . ." sounds during speech, pet words, and avoidance comments; and one index of *social* anxiety: cumulative avoidance of gaze from the camera while speaking (Baggett *et al.*, 1996; Farabee, Holcom, Ramsey, & Cole, 1993). All the indices were determined from videotaped records by two independent raters who observed the frequency of their occurrence in two series (5 min each) of twenty 15-sec intervals. One series corresponded to the anticipation (of tasks) phase, and the other to the speech phase (see Procedure). The interrater reliability was .98. The judges were blind to the hypotheses being tested and to the participants' dispositional anxiety status.

Physiological arousal: Heart rate (HR) and tonic skin resistance level (henceforth skin resistance or SR) were recorded continuously during a prebaseline *adaptation* phase (until they became stable; 9 min average), a *baseline* phase (3 min), an *anticipation* phase (5 min), a *tasks* phase (10 min; with a 5-min *speech* subphase within), and a *recovery* phase (5 min).

Recording took place in a temperature and humidity-controlled laboratory, which was noise-shielded and dimly illuminated. The participants were seated in a comfortable armchair. HR is assumed to reflect arousal directly (i.e., the more HR, the more anxiety), whereas SR is an inverse index (i.e., the higher SR, the less anxiety). HR was monitored with a photoelectric finger pulse transducer (Biociber, Model C1450) attached to the distal phalanx of the middle finger on the participants' nondominant hand, connected to a Letica preamplifier (Module LE135, Cardioback Biofeedback, Scientific Instruments). SR was recorded bipolarly with BSR-SC (Biociber) Ag–AgCl electrodes (surface area = 1 cm) attached to the thenar (C6) and hypothenar (C8) eminences of the subject's nondominant hand, with 0.05 M NaCl electrolyte. SR was detected using a constant current generator, connected to a Letica preamplifier (Module LE138, Dermal Biofeedback, Scientific Instruments). The HR and SR data were relayed on-line to an ALR-486 computer, in which the signals were digitized, and the data were averaged on a second-by-second basis for subsequent analysis.

Performance Under Evaluative Stress. Cognitive-linguistic performance was measured by the amount of time talking during 5 minutes of an impromptu speech, which was required from each participant on a different topic about popular issues (e.g., "Drugs"). Motor performance in a fine motor task, the Steadiness test, required that participants held a metal-tipped stylus in an apparatus with nine progressively smaller holes (Model 32011, Lafayette Instruments) without touching the sides. The participant's arm and hand were suspended in the air (i.e., not leaning on the table or the body) while holding the stylus. An electric impulse counter (Model 58022, Lafayette Instruments) recorded the errors (number of times the stylus touched the sides). There was one 20-sec practice trial for the largest hole, and a 20-sec trial for each of the eight remaining holes, each followed by a 10-sec rest interval (total time: 4 min 30 sec).

Social-Evaluative Stress. To create a social-evaluative stress situation, participants were presented with ego-threat instructions in writing, and asked to perform two aptitude tasks (motor test and speech) in front of a video camera. Ego-threat instructions and videotaping started at the beginning of the anticipation phase (see Procedure), that also included a 5-min interval for the preparation of speech. The ego-threat instructions (Calvo, Ramos, & Estevez, 1992) indicated that the purpose of the experiment was to assess linguistic ability and psychomotor skill, along with participants' physiological responses to measure their resistance to stress. In addition, participants were told that their individual results on the tasks would be evaluated and compared with those of other students. They were also instructed to perform at their best. Thus, they were led to anticipate evaluation of their competence.

Procedure

Individual sessions took place in a laboratory room, according to the following sequence of phases. First, after the general instructions to the participants (about the safety of the procedure, the importance of keeping still and relaxed), and the attachment of the electrodes, the physiological adaptation period began. Next, baseline HR and SR were determined. Subsequently, the anticipation phase of evaluative stress started with the placement of the camera in front of the participant, the ego-threat instructions, and the participant's preparation of the speech for 5 min. During this phase, motor and facial anxiety were recorded. Next, a tasks stage began, in which participants performed the steadiness test and the speech. During speech, motor, facial, verbal, and social anxiety were recorded. There was a rest interval of 2 min between the tasks. Subsequently, in the recovery phase, the camera was removed, participants were told that there would be no more tasks, and asked to relax. Finally, they were requested to fill in the CSAS, in order to measure the cognitive and somatic anxiety that they were feeling during the tasks phase.

RESULTS

Differences in the Anxiety Response as a Function of Trait/Test Anxiety, and Effectiveness of the Stress Manipulation

Table I summarizes scores on each variable for participants high and low in trait and in test anxiety. Univariate t tests for independent samples revealed that, compared with participants low in trait or test anxiety, their high-anxiety counterparts showed more self-reported cognitive and somatic anxiety, higher HR in the baseline and the anticipation phase (only of borderline significance for test anxiety), and lower SR in the anticipation phase (only for test anxiety, and of borderline significance). In contrast, the high/low-trait/test-anxiety groups were comparable with respect to the other variables.

The effectiveness of the stress manipulation was confirmed by a 2 (High- vs. Low-Trait or Test Anxiety) × 4 (phase: Baseline vs. Anticipation vs. Speech vs. Recovery) MANOVA on HR and SR scores. There was a main effect of phase both for HR, $F(3, 151) = 7.32, p < .001$ (with trait anxiety), $F(3, 151) = 10.82, p < .0001$ (with test anxiety), and SR, $F(3, 156) = 9.42, p < .0001$ (with trait anxiety), $F(3, 156) = 9.81, p < .0001$ (with test anxiety). Tukey's a posteriori contrasts revealed an increase in HR from baseline to anticipation ($p < .025$) and a decrease in HR from

Table I. Means and Standard Deviations on Variables for Participants High and Low in Trait and Test Anxiety, and Statistics for Assessing Significant Differences[a]

	Trait anxiety						Test anxiety					
	High (n = 28)		Low (n = 28)				High (n = 28)		Low (n = 28)			
Anxiety response	*M*	*SD*	*M*	*SD*	*t*	*p* <	*M*	*SD*	*M*	*SD*	*t*	*p* <
Self-reported												
Cognitive	11.0	7.7	6.1	3.9	3.01	.01	11.6	7.9	6.8	4.1	2.82	.01
Somatic	13.8	9.0	8.6	5.9	2.53	.02	13.0	8.1	8.3	6.1	2.40	.02
Behavioral												
Anticipation phase												
Motor	21.8	12	24.3	16	0.66	ns	23.2	15	23.0	14	0.04	ns
Facial	9.0	5.9	9.8	8.7	0.40	ns	8.6	5.9	11.0	9.1	1.18	ns
Speech phase												
Motor	21.5	7.8	22.9	7.9	0.68	ns	20.3	7.9	23.5	5.9	1.71	.10
Facial	15.3	6.2	15.3	5.5	0.02	ns	16.3	6.7	15.2	6.5	0.67	ns
Verbal (AC)	1.2	1.4	0.9	1.4	0.28	ns	1.1	1.3	.7	1.2	1.14	ns
Social (GA)	10.3	4.8	12.2	3.3	1.64	ns	11.3	4.2	11.9	4.0	0.55	ns
Physiological												
Heart rate (HR, in bpm)												
Baseline	86.9	16.2	75.9	9.5	3.01	.01	86.2	13.9	79.5	14.9	1.69	.10
Anticipation	91.3	14.6	80.3	9.6	3.20	.01	92.6	12.1	82.2	14.0	2.89	.01
Speech	83.3	13.8	81.4	8.4	0.58	ns	82.6	8.0	83.5	11.9	0.32	ns
Recovery	81.7	16.6	78.3	9.9	0.86	ns	78.6	13.4	81.2	13.1	0.71	ns

Skin resistance (SR, in kohms)												
Baseline	220	86	232	124	0.41	ns	211	68	222	111	0.42	ns
Anticipation	182	49	210	119	1.11	ns	169	50	210	120	1.68	.10
Speech	179	37	181	44	0.12	ns	174	35	178	48	0.34	ns
Recovery	194	53	188	52	0.44	ns	190	54	186	54	0.31	ns
Performance												
Motor (errors)	151	96	114	46	1.79	.10	136	77	121	74	0.71	ns
Cognitive (time)	4.0	4.9	2.7	3.1	1.20	ns	3.2	4.0	3.3	4.1	0.16	ns

[a]AC: Avoidance comments; GA: gaze avoidance. *Cognitive* and *somatic* anxiety scores were obtained from the participants' self-reported ratings on 10-item five-point scales for each. *Motor* anxiety (sum of 7 indices), *facial* anxiety (sum of 5 indices), *verbal* anxiety (each of 4 independent indices), and *social* anxiety (1 index) were obtained from observational ratings on 20-item (15-sec intervals) scales each. *Heart rate,* expressed in beats per minute; *skin resistance,* in mean kohms. *Motor performance,* measured in errors; *cognitive performance,* in terms of speaking time. All measures are assumed to be directly related to anxiety, except for skin resistance and cognitive performance, which are inversely related to anxiety.

anticipation to recovery ($p < .01$); SR dropped from baseline to anticipation ($p < .05$), speech ($p < .01$), and recovery ($p < .01$).

In addition, regarding HR, there were interactive effects of trait anxiety and phase, $F(3, 151) = 4.32$, $p < .01$, and of test anxiety and phase, $F(3, 151) = 7.96$, $p < .001$. A posteriori comparisons (Tukey t test) indicated that HR was higher for participants high in trait and in test anxiety than for their low-anxiety counterparts both in the baseline and in the anticipation phase (all ps $< .01$), but there were no differences in the speech and the recovery phases. To control for the effect of baseline HR differences on the anticipation phase, baseline scores were included as a covariate, with anticipation HR scores being the dependent variable. Main effects of test anxiety, $F(1, 52) = 6.51$, $p < .025$ (but not of trait anxiety, $p > .10$), revealed that anticipation HR was still higher in high-test-anxious participants.

With respect to SR, there was a test (but not trait) anxiety by phase interaction, $F(3, 156) = 3.27$, $p < .025$. A posteriori comparisons (Tukey t test) showed that participants high in test anxiety exhibited lower SR in the anticipation phase than those low in test anxiety ($p < .01$), but there were no differences in the other phases. Furthermore, the differences in the anticipation phase remained significant after including baseline SR scores as a covariate, $F(1, 53) = 8.64$, $p < .01$. Therefore, both with HR and SR, participants high in test anxiety were more aroused than those low in test anxiety during the anticipation phase even after the contribution of baseline arousal was partialed out.

Correlation Analyses and Concordance

We performed two types of analyses to examine concordance: (a) pairwise correlations between variables within each high- or low-trait/test-anxiety group, and (b) tests of the significance of the difference between the correlations for the high- vs. low-anxiety groups[5] (see Tables II, III, and IV). In general, the pattern of relationships was similar for *trait* and *test anxiety,* except for relatively greater concordance between self-reported and behavioral anxiety in high-test vs. high-trait anxiety. In contrast, it was different for high- and low-trait/test-anxiety participants, with the former showing much higher concordance than the latter between the self-report system and the objective response systems (behavioral, physiological, and

[5]Only those variables involved in significant correlations for any of the four groups of participants are included in the tables. There were 452 possible correlations (113 for each

Table II. Pearson Relations Between Self-Reported Cognitive and Somatic Anxiety and Behavioral Anxiety, Physiological Arousal, and Task Performance[a]

Self-reports of anxiety[b]	Trait anxiety High r	Trait anxiety Low r	Trait anxiety z	Test anxiety High r	Test anxiety Low r	Test anxiety z
Behavioral ratings						
Cognitive						
Verbal (AC)	.20	-.15	—	.40[c]	-.31	2.64[e]
Verbal (SB)	.24	.27	—	.38[c]	.15	0.89 ns
Social (GA)	.37[c]	.47[d]	—	.53[e]	.35	0.82 ns
Somatic						
Motor (AP)	.24	.13	—	.43[d]	-.11	2.03[d]
Motor (SP)	.14	.21	—	.41[c]	.01	1.43 ns
Physiological arousal						
Skin resistance						
Cognitive						
Anticipation	.04	.49[e]	1.78[c]	.04	.42[c]	1.46 ns
Recovery	.10	.39[c]	1.10 ns	.10	.31	—
Heart rate						
Somatic						
Baseline	.39[c]	-.23	2.28[d]	.33	-.17	—
Anticipation	.46[d]	-.24	2.64[e]	.38[c]	-.15	1.96[d]
Recovery	.40[c]	-.36	2.86[e]	.50[e]	-.15	2.50[d]
Performance						
Cognitive						
Speaking time	-.35	-.33	—	-.62[e]	-.29	1.50 ns
Somatic						
Motor errors	.55[e]	.14	1.71[c]	.54[e]	.13	1.68[c]

[a]See Footnote 5.
[b]AC: Avoidance comments; SB: speech blocks; GA: gaze avoidance; AP: anticipation phase, SP speech phase. (See Table I to identify measures).
[c]$p < .05$.
[d]$p < .025$.
[e]$p < .01$.

high/low-trait/test-anxiety group) between variables in the four anxiety response systems (self-report, behavioral, physiological, and performance); of them, 48 were statistically significant (as indicated in the tables) and involved meaningful relationships. The following formula was used to test the significance of the difference between correlations in the high- (trait/test) vs. the low-anxiety groups (e.g., Glass & Stanley, 1970). The test was performed only when the correlation between two variables was significant in one group and not in the other, but not when the correlation was either significant or nonsignificant in both groups.

$$z = \frac{(1/2) * \log n\ [(1 + r_1/1 - r_1)] - (1/2) * \log n\ [(1 + r_2/1 - r_2)]}{\sqrt{(1/n_1 - 3) + (1/n_2 - 3)}}$$

Table III. Pearson Correlations Between Rated Behavioral Anxiety and Physiological Arousal[a]

	Trait anxiety			Test anxiety		
Behavioral anxiety[b]	High *r*	Low *r*	*z*	High *r*	Low *r*	*z*
Physiological arousal						
Heart rate						
Facial (AP)	.42[c]	.28	0.57 ns	.39[c]	.35	0.18 ns
Facial (SP)	.19	.16	—	.14	.44[d]	1.18 ns
Motor (AP)	.19	−.16	—	.39[c]	.43[c]	0.18 ns
Motor (SP)	.32	−.27	—	.45[d]	.02	1.64 ns
Verbal (AH)	.55[e]	.21	1.46 ns	.44[d]	.16	1.11 ns
Verbal (SB)	.11	.10	—	.31	.43[c]	0.50 ns
Skin resistance						
Facial (AP)	.04	−.08	—	.00	−.42[c]	1.61 ns
Motor (AP)	.20	−.41[c]	2.29[d]	.16	−.27	—

[a]See Footnote 5.
[b]AP: Anticipation phase; SP: speech phase; AH: "aah . . ." sound while speaking; SB: speech blocks. (See Table I to identify measures).
[c]$p < .05$.
[d]$p < .025$.
[e]$p < .01$.

performance; Table II), but there was equivalent concordance among the objective systems for all groups (Tables III and IV).

Self-Reported Versus Objective (Behavioral, Physiological, Performance) Anxiety (Table II). For participants high in dispositional anxiety (mainly test anxiety), self-reported cognitive (but not somatic) anxiety was significantly related to gaze avoidance and verbal indices of behavioral anxiety, as well as inversely related to speaking time in the cognitive task. In a complementary way, self-reported somatic (but not cognitive) anxiety was related to motor indices of behavioral anxiety, heart rate, and errors in the psychomotor task. In contrast, for low-trait/test-anxiety participants, there were no significant correlations between self-reported and behavioral anxiety (except for cognitive anxiety and gaze avoidance), nor between any self-report index and task performance. Furthermore, between self-report measures and physiological arousal, these low-anxiety participants even exhibited what could be called reversed concordance, i.e., correlations in the opposite direction to theoretically expected relationships (see Discussion). This happened between cognitive anxiety and skin resistance, and the same (nonsignificant) tendency was observed between somatic anxiety and heart rate. Additional tests (see Footnote 5) revealed that 10 comparisons out of 16 (i.e., 62.5%) involved correlations that were significantly different in the high- vs. low-anxiety groups.

Table IV. Pearson Correlations Between Performance in the Cognitive and the Motor Task, and Behavioral and Physiological Measures of Anxiety[a]

	Trait anxiety			Test anxiety		
Performance[b]	High *r*	Low *r*	*z*	High *r*	Low *r*	*z*
Behavioral ratings						
Speaking time						
Facial (AP)	-.38[c]	-.04	1.29 ns	-.26	-.14	—
Social (GA)	-.90[e]	-.88[e]	—	-.87[e]	-.96[e]	—
Verbal (AH)	-.53[e]	-.36	0.75 ns	-.55[e]	-.58[e]	—
Motor errors						
Motor (AP)	.42[c]	.13	1.14 ns	.30	-.03	—
Motor (SP)	.49[e]	.01	1.89[c]	.72[e]	-.08	3.53[e]
Verbal (AC)	.34	.41[c]	0.28 ns	.28	.10	—
Physiological arousal						
Heart rate						
Motor errors						
Baseline	.42[c]	-.03	1.71[c]	.23	.10	—
Speech	.51[e]	.00	2.00[d]	.40[c]	.07	1.25 ns
Recovery	.55[e]	.16	1.64 ns	.44[d]	.36	0.32 ns
Skin resistance						
Motor errors						
Baseline	-.43[c]	-.03	1.53 ns	-.21	.15	—
Anticipation	-.39[c]	.07	1.71[c]	-.28	.16	—

[a]See Footnote 5.
[b]AP: Anticipation phase; GA: gaze avoidance; AH: "aah . . ." sound while speaking; SP: speech phase; AC: avoidance comments. (See Table I to identify measures).
[c]$p < .05$.
[d]$p < .025$.
[e]$p < .01$.

Behavioral Anxiety Versus Physiological Arousal Versus Task Performance. There was equivalent concordance for high- and low-trait/test-anxiety participants between *behavioral anxiety* and *physiological arousal* (Table III). Furthermore, except for one comparison (i.e., correlation between motor anxiety in the anticipation phase and SR in the speech phase) out of ten (i.e., 10%), the correlations were not significantly different in the high- vs. low-anxiety groups, when we performed the test of reliability of differences (see Footnote 5). Likewise, the pattern of relationships between *task performance* and *behavioral anxiety* was comparable for both groups (Table IV). Only two comparisons (i.e., correlation between motor errors and motor anxiety in the speech phase, in trait and test anxiety) out of six (i.e., 33%), were significantly different in the high- vs. low-anxiety groups. Regarding the relationship between *task performance* and *physiological arousal* (Table IV), three correlations (i.e., motor errors and baseline/speech HR,

and motor errors and anticipation SR) out of seven comparisons (i.e., 43%), were significantly different in the high- vs. low-(trait)-anxiety groups.

DISCUSSION

Mean general concordance was rather low, which is consistent with conclusions from most previous studies (see reviews in Bernstein *et al.*, 1986; Fahrenberg, 1992; Silva, 1996). However, specific results are very informative. Particularly relevant are those concerned with the selectivity of associations between variables, and those regarding the modulating effect of trait and test anxiety. Correlations revealed (a) a lack of, or even reversed, concordance in low-trait/test anxiety, but higher (positive) concordance in high-trait/test anxiety, between the self-report system and the objective response systems, whereas (b) there was reasonable concordance between these two objective systems for all participants.

Specificity and Coherence of Concordance

Concordance is selective and consistent across response systems, providing a theoretically coherent picture. There were correlations among all measures concerned with somatic aspects: self-reported somatic anxiety, behavioral indices of motor anxiety, physiological reactivity, and performance in the motor task. There were also relationships among measures concerned with cognitive aspects: self-reported cognitive anxiety, behavioral indices of verbal and social anxiety, and performance in the cognitive task. In contrast, there was no concordance between the cognitive and the somatic area. Furthermore, there was a temporal matching between physiological and behavioral responses, which means that the highest correlations occurred when the assessment of both components coincided in the same phase (anticipation, speech, or recovery).

This is in line with evidence for some single indices in previous research (Heimberg *et al.*, 1987; Tamaren *et al.*, 1985). In the present study we have obtained evidence for a wider range of response systems and variables within them. Low concordance in previous research may have been due to inclusion of an insufficient number of variables in each response system to allow detection of specific and theoretically meaningful relationships. Particularly useful are the distinctions between cognitive and somatic anxiety in the subjective or self-report system, between motor/facial versus verbal/social anxiety in the behavioral system, and also between cognitive and motor task performance. Therefore, though concordance is low in

quantitative terms, the qualitative differences suggest that the anxiety response has a multidimensional nature with components interrelated at specific levels.

Modulation of Concordance by Trait and Test Anxiety

Concordance is higher in persons high in trait or test anxiety than in their low-anxiety counterparts. Low concordance in previous research may have been caused by the fact that mean scores were usually aggregated and averaged across high- and low-anxiety individuals. In a study that took trait anxiety into account (Craske & Craig, 1984), some indications compatible with the findings reported here appeared (see introduction).

The contribution of *trait* and *test* anxiety to concordance was comparable: In quantitative terms, the number of significant correlations (and differences between correlations) was equivalent for trait and test anxiety; in qualitative terms, there were no clear differences in patterns of relationships. This occurred in spite of the fact that the stress manipulation was more effective in test than trait anxiety (i.e., changes from baseline to anticipation HR and SR). Therefore, though only moderately correlated (r = .53), general trait anxiety seems nearly as good a predictor of concordance under evaluative stress conditions as the more specific test anxiety. Actually, it has been suggested that trait anxiety, as measured by the STAI, has a strong component of fear towards social/ego-evaluative threats (Eysenck & van Berkum, 1992). Two explanations for the effects of trait/test anxiety on concordance can be put forward: One focuses on arousal level and the other on suppression of negative feelings.

Strong Interoceptive Signal in High Anxiety, and Positive Concordance

Concordance might depend on the strength of the objective components of the anxiety response: The stronger the physiological and behavioral cues, the more perceptually salient they would be, and so the person could be more aware of them. In these conditions, the subjective experience and report of internal feelings of anxiety could be more easily related by the person to his/her own physiological and behavioral response. As a consequence, concordance would increase.

The present *behavioral* anxiety data do not support this explanation, as there were no significant differences between high- and low-trait/test-anxiety participants in the motor, facial, verbal or social indices of emotional reactivity, either in absolute levels or in changes from the anticipation phase to the speech phase (only motor and facial). However, the physi-

ological arousal data provided some favorable evidence. First, high-trait/test-anxiety participants were more aroused in the baseline and the anticipation phase than their low-anxiety counterparts. Though the difference was not statistically significant for SR, the higher HR and SR levels could have exceeded a perceptual threshold more readily for the high- than the low-anxiety participants. Second, at least for participants high in test anxiety, the relative change in HR and SR (M = 6.4 bpm and 42 Kohms, respectively) from baseline to anticipation phase was greater than for those low in test anxiety (M = 2.7 and 12, respectively). Most important, the differences in the anticipation phase remained significant after baseline differences were partialed out. Accordingly, greater arousal during the baseline and the anticipation phase could have provided the high-trait/test-anxiety participants with a stronger interoceptive signal for accurate self-report and thereby facilitate concordance within peripheral response systems.

Nevertheless, this hypothesis has some limitations in accounting for our data. The perception of arousal cues during the baseline and anticipation phases must have been particularly influential, compared with the speech and recovery phases, where the physiological reactivity was equivalent for high- and low-trait/test-anxiety participants. In addition, this hypothesis is consistent with studies that have found significant differences in physiological reactivity as a function of trait anxiety (e.g., Beidel *et al.*, 1985), but not with those showing no significant differences (e.g., Baggett *et al.* 1996; Steptoe & Vogele, 1992; Walsh *et al.*, 1994). Furthermore, while this hypothesis could account for the relatively high concordance in high-trait/test-anxiety participants, it does not explain the reversed concordance in those low in anxiety, or even their lack of concordance, specifically when the self-report system is involved.

Suppression of Internal Feelings of Negative Affect in Low Anxiety, and Discordance

An alternative explanation focuses on the lack of, or even reversed, concordance for persons low in trait/test anxiety. Essentially, it is proposed that they—but not those high in anxiety—possess a cognitive bias to avoid processing threat stimuli (i.e., perceptual suppression) or to inhibit reporting of subjective feelings of distress (i.e., verbal response suppression), or both. This mechanism would have a defensive function to avoid awareness of affects incompatible with positive self-images (perceptual suppression), and to avoid negative evaluations from other people (response suppression). Experimental evidence for this bias has sometimes been found in low-anxiety individuals, both for external (MacLeod & Mathews, 1988;

Mogg, Bradley, & Hallowell, 1994) and internal events (Calvo & Eysenck, 1998; see Eysenck, 1997). This bias would specifically affect the self-report system. As a consequence of distortion in this system, concordance between self-report measures and the objective response (behavioral and physiological) systems would be reduced in low trait/test anxiety, but concordance between the objective response systems would be unaffected.

Our results are consistent with this suppression interpretation. For participants *high* in trait/test anxiety, concordance was similar regardless of the systems involved. In contrast, for those *low* in dispositional anxiety, there was only one significant relationship between self-reported anxiety and behavioral anxiety, and no correlation was significant between self-report and task performance. Furthermore, between self-reported anxiety and physiological arousal only reversed concordance was observed for these participants: The more aroused they actually were (skin resistance), the less distressed they *said* they were (self-reported cognitive anxiety); there was also the same tendency in the relationship between self-reported somatic anxiety and heart rate. This finding is particularly suggestive of a bias to avoid experiencing or expressing subjective anxiety. It seems so strong that self-report goes in the opposite direction to objective arousal. Indications of concordance for the same low-anxiety participants were observed between the objective response systems, instead. Thus, when tests of significance of the difference between correlations were performed, (a) between self-report and objective measures, 62.5% of comparisons were significantly different for the high, and the low-trait/test-anxiety groups. In contrast, (b) between the objective systems, only 26% of comparisons revealed significant differences; and, of these, most (83%) involved motor performance (which represents only an *indirect* reflection of anxiety, and can be influenced by nonanxiety factors, such as ability), and only *one* comparison (17%) involved behavioral/physiological anxiety responses (which are more genuine manifestations of objective anxiety than is task performance).

Turpin (1991, p. 372) mentioned in passing that trait anxiety and cognitive avoidance might be critical factors, among others, concerning desynchrony in the anxiety response. In support of this suggestion, our findings allow us to argue in favor of the joint contribution of both factors: Low trait/test anxiety is probably associated with discordance because of avoidance of internal threat processing and/or responding. However, from our findings we cannot say whether this avoidance bias involves automatic perceptual suppression of awareness of negative feelings, or whether it involves controlled response inhibition of those feelings (see Beck & Clark, 1997, for a comprehensive model). The fact that the bias has been observed with on-line measures of threat processing, such as the probe detection task (e.g., MacLeod & Mathews, 1988), under conditions of subliminal or

masked presentation of stimuli (e.g., Mogg *et al.*, 1994), and which do not require response selection, clearly suggests that the bias involves perceptual suppression. But our self-report measures are susceptible to being influenced by both perceptual and response suppression, as they involve both awareness of symptoms and voluntary decision in choosing a response.

In conclusion, the anxiety response can be regarded as a useful construct for research in motivation and emotion, as long as some constraints are considered. Anxiety is a subjective, behavioral, and biological phenomenon, in which the components are related not as a whole, but at specific levels. Concordance between components depends on vulnerability to social-evaluative stress, that is, trait/test anxiety. Differences in concordance can possibly be accounted for partly in terms of strength of physiological reactivity signals, greater in high than in low trait/test anxiety. Alternative interpretations are also possible: (a) Affect, active in low- but not high-trait/test anxiety, could also make a contribution, as could (b) a response effect in which people perceive the signals but suppress response to them. These two interpretations can be complementary, with one mainly applying to high-trait/test anxiety and the other to low-trait/test anxiety. Nevertheless, they are not entirely compatible nor completely independent. Thus, for example, do low-anxiety persons show lower concordance because they find difficult to perceive their own physiological reactivity (due to a weaker interoceptive signal), or because they suppress response to it, or both? The stronger the interoceptive signal, the more readily it can be perceived and the more difficult it is to suppress. Therefore, further research is needed to disentangle the two explanations.

This conceptualization has importance for research on anxiety (a) because most studies, including our own, have measured the anxiety response under social-evaluative stress conditions (e.g., Baggett *et al.*, 1996), and (b) because of the ubiquity and adaptive relevance of this kind of stress in a competitive society (e.g., Leitenberg, 1990).

REFERENCES

Baggett, H. L., Saab, P. G., & Carver, C. S. (1996). Appraisal, coping, task performance, and cardiovascular response during the evaluated speaking task. *Personality and Social Psychology Bulletin, 22,* 483-494.

Beck, A. T., & Clark, D. A. (1997). An information processing model of anxiety: Automatic and strategic processes. *Behavior Research and Therapy, 35,* 49-58.

Beidel, D. C., Turner, S. M., & Dancu, C. V. (1985). Physiological, cognitive and behavioral aspects of social anxiety. *Behavior Research and Therapy, 23,* 109-117.

Bernstein, D. A., Borkovec, T. D., & Coles, M. G. H. (1986). Assessment of anxiety. In A. R. Ciminero, K. S. Calhoun, & H. E. Adams (Eds.), *Handbook of behavioral assessment* (pp. 353-403). New York: Wiley.

Calvo, M. G., Alamo, L., & Ramos, P. M. (1990). Test anxiety, motor performance and learning: Attentional and somatic interference. *Personality and Individual Differences, 11,* 29-38.

Calvo, M. G., & Castillo, M. D. (1997). Mood-congruent bias in interpretation of ambiguity: Strategic processes and temporary activation. *Quarterly Journal of Experimental Psychology, 50A,* 163-182.

Calvo, M. G., & Eysenck, M. W. (1996). Phonological working memory and reading in test anxiety. *Memory, 4,* 289-305.

Calvo, M. G., & Eysenck, M. W. (1998). Cognitive bias to internal sources of information in anxiety. *International Journal of Psychology, 33,* 287-299.

Calvo M.G., Ramos, P. M., & Estevez, A. (1992). Test anxiety and comprehension efficiency: The role of prior knowledge and working memory deficits. *Anxiety, Stress and Coping, 5,* 125-138.

Craske, M. G., & Craig, K. D. (1984). Musical performance anxiety: The three-systems model and self-efficacy theory. *Behavior Research and Therapy, 22,* 267-280.

Delprato, D. J., & McGlynn, F. D. (1984). Behavioral theories of anxiety disorders. In S. M. Turner (Ed.), *Behavioral theories and treatment of anxiety* (pp. 1-49). New York: Plenum Press.

Eifert, G. H., & Wilson, P. H. (1991). The triple response approach to assessment: A conceptual and methodological reappraisal. *Behavior Research and Therapy, 29,* 283-292.

Eysenck, M. W. (1997). *Anxiety and cognition: A unified theory.* Hove, U.K.: Psychology Press.

Eysenck, M. W., & Calvo, M. G. (1992). Anxiety and performance: The processing efficiency theory. *Cognition and Emotion, 6,* 409-434.

Eysenck, M. W., & Berkum, J. van (1992). Trait anxiety, defensiveness, and the structure of worry. *Personality and Individual Differences, 13,* 1285-1290.

Fahrenberg, J. (1992). Psychophysiology of neuroticism and anxiety. In A. Gale & M. W. Eysenck (Eds.), *Handbook of individual differences: Biological perspectives* (pp. 179-227). London: Wiley.

Farabee, D. J., Holcom, M. L., Ramsey, S. L., & Cole, S. G. (1993). Social anxiety and speaker gaze in a persuasive atmosphere. *Journal of Research in Personality, 27,* 365-376.

Gilbert, B. O. (1991). Physiological and nonverbal correlates of extraversion, neuroticism, and psychoticism during active and passive coping. *Personality and Individual Differences, 12,* 1325-1331.

Glass, G., & Stanley, J. (1970). *Statistical methods in education and psychology.* Englewood Cliffs, NJ: Prentice Hall.

Heimberg, R. G., Gansler, D., Dodge, C. S., & Becker, R. E. (1987). Convergent and discriminant validity of the Cognitive-Somatic Anxiety Questionnaire in a social phobic population. *Behavioral Assessment, 9,* 379-388.

Hodgson, R., & Rachman, S. (1974). II. Desynchrony in measures of fear. *Behavior Research and Therapy, 12,* 319-326.

Lamb, L. (1978). Use of behavioral measures in anxiety research. *Psychological Reports, 43,* 1079-1085.

Lang, P. J. (1978). Anxiety: Toward a psychophysiological definition. In H. S. Akiskal & W. L. Webb (Eds.), *Psychiatric diagnosis: Exploration of biological predictors* (pp. 365-389). New York: Spectrum.

Lehrer, P. M., & Woolfolk, R. L. (1982). Self-report assessment of anxiety: Somatic, cognitive and behavioral modalities. *Behavioral Assessment, 4,* 167-177.

Leitenberg, H. (Ed.). (1990). *Handbook of social and evaluation anxiety.* New York: Plenum Press.

MacLeod, C., & Mathews, A. (1988). Anxiety and the allocation of attention to threat. *Quarterly Journal of Experimental Psychology, 40A,* 653-670.

Marks, I. M., & Nesse, R. M. (1994). Fear and fitness: An evolutionary analysis of anxiety disorders. *Ethology and Sociobiology, 15,* 247-261.

Miguel-Tobal, J. J. (1990). La ansiedad [Anxiety]. In J. Mayor & J. L. Pinillos (Eds.), *Motivación y emoción. Tratado de psicología general* (Vol. 8; pp. 309-344). Madrid: Alhambra.

Miguel-Tobal, J. J., & Cano-Vindel, A. (1986). *Manual del Inventario de Situaciones y Respuestas de Ansiedad (ISRA)* [Manual of the Anxiety Inventory of Situations and Responses]. Madrid: TEA Ediciones.

Mogg, K., Bradley, B., & Hallowell, N. (1994). Attentional bias to threat: Roles of trait anxiety, stressful events, and awareness. *Quarterly Journal of Experimental Psychology, 47A,* 841-864.

Mowrer, H. O. (1960). *Learning theory and behavior.* New York: Wiley.

Öhman, A. (1996). Preferential preattentive processing of threat in anxiety: Preparedness and attentional biases. In R. M. Rapee (Ed.), *Current controversies in the anxiety disorders* (pp. 253-290). New York: Guilford.

Sarason, I. G. (1984). Stress, anxiety and interference: Reactions to tests. *Journal of Personality and Social Psychology, 46,* 929-938.

Scholing, A., & Emmelkamp, P. M. G. (1992). Self report assessment of anxiety: A cross-validation of the Lehrer Woolfolk Anxiety Symptom Questionnaire in three populations. *Behavior Research and Therapy, 30,* 521-531.

Schwartz, G. E., Davidson, R. J., & Goleman, D. J. (1978). Patterning of cognitive and somatic processes in the self-regulation of anxiety: Effects of meditation versus exercise. *Psychosomatic Medicine, 40,* 321-328.

Silva, F. (1996). Algunas cuestiones metodológicas en la evaluación de la ansiedad [Some methodological issues in the assessment of anxiety]. *Ansiedad y Estrés, 2,* 119-130.

Spence, J. T., & Spence, K. W. (1966). The motivational components of manifest anxiety: Drive and drive stimuli. In C. D. Spielberger (Ed.), *Anxiety and behavior* (pp. 291-326). New York: Academic Press.

Spielberger, C. D., Gorsuch, R. L., & Lushene, R. E. (1982). *Cuestionario de Ansiedad Estado-Rasgo* [State-Trait Anxiety Inventory]. Madrid: TEA Ediciones.

Spielberger, C. D. (1980). *Test Anxiety Inventory.* Palo Alto, CA: Consulting Psychologists Press.

Spielberger, C. D., & Vagg, P. R. (Eds.). (1995). *Test anxiety: Theory, assessment and treatment.* Washington, DC: Taylor & Francis.

Steptoe, A., & Vogele, C. (1992). Individual differences in the perception of bodily sensations: The role of trait anxiety and coping style. *Behavior Research and Therapy, 30,* 597-607.

Tamaren, A. J., Carney, R. M., & Allen, T. W. (1985). Assessment of cognitive and somatic anxiety: A preliminary validation study. *Behavioral Assessment, 7,* 197-202.

Turpin, G. (1991). The psychological assessment of anxiety disorders: Three-systems measurement and beyond. *Psychological Assessment, 3,* 366-375.

Van Doornen, L. J. P. (1986). Sex differences in physiological reactions to real life stress and their relationship to psychological variables. *Psychophysiology, 23,* 657-662.

Van Heck, G. L. (1988). Modes and models in anxiety. *Anxiety Research, 1,* 199-214.

Walsh, J. J., Wilding, J. M., & Eysenck, M. W. (1994). Stress responsivity: The role of individual differences. *Personality and Individual Differences, 16,* 385-394.

Williams, J. M., Watts, F. N., MacLeod, C., & Mathews, A. (1997). *Cognitive psychology and emotional disorders* (2nd ed.). Chichester, U.K.: Wiley.

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