Patterning of Cognitive and Somatic Processes in the Self-Regulation of Anxiety: Effects of Meditation versus Exercise

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Davidson and Schwartz (1) have proposed a psychobiological analysis of anxiety that emphasizes the patterning of multiple processes in the generation and self-regulation of this state. The present article specifically reviews recent research on cognitive and somatic components of anxiety. A dual component scale which separately assesses cognitive and somatic trait anxiety is described and applied to the study of the differential effects of a somatic (physical exercise) and a cognitive (meditation) relaxation procedure. A total of 77 subjects was employed; 44 regularly practiced physical exercise and 33 regularly practiced meditation for comparable periods of time. As predicted, subjects practicing physical exercise reported relatively less somatic and more cognitive anxiety than meditators. These data suggest that specific subcomponents of anxiety may be differentially associated with relaxation techniques engaging primarily cognitive versus somatic subsystems. It is proposed that relaxation consists of (1) a generalized reduction in multiple physiological systems (termed the relaxation response by Benson) and (2) a more specific pattern of changes superimposed upon this general reduction, which is elicited by the particular technique employed. The data from this retrospective study need to be followed up by prospective studies to establish the precise mechanisms for these effects.

INTRODUCTION

A variety of recent evidence has begun to challenge long-held assumptions concerning hypothetical, relatively global internal states such as anxiety and depression, which presumably result in particular biobehavioral dysfunctions. These findings have implications for both the assessment and treatment of psychosomatically based disorders. It is our intention in this article to selectively review these data and to present the results of a preliminary study designed to explore the differential effectiveness of two types of relaxation procedures in differentially attenuating different components of anxiety.

A number of writers have recently commented upon the multidimensional nature of fear and anxiety (e.g., 2, 3). When anxiety is elicited in an individual in response to a stressful event, the quality of feelings aroused in one situation may be different than in another. In addition, some people may experience anxiety in one predominant mode, while others might become anxious in a differ-

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ent manner. Unfortunately, most anxiety questionnaires provide but a single, global score reflecting an unknown mixture of typologically different forms of anxiety. The existence of these different dimensions of anxiety has been established psychometrically through factor-analytic studies of traditional anxiety questionnaires. For example, a number of investigators have uncovered partially independent, trait anxiety factors on the basis of factor analyzing the MAS (e.g., 4, 5). More recently, Barrett (6) has performed an item analysis of anxiety items from a large battery of commonly used scales. The analysis "indicated two major subsets: (1) awareness of somatic changes, for example, I blush often or I am often aware of my heart beating; (2) conscious awareness of unpleasant feelings about self or external stimuli, for example, I frequently find myself worrying about something . . ." (6, p. 202). Two similar factors emerged from studies using psychiatric patients as subjects. In factor analyses of self-ratings, Hamilton (7) and Buss (8) found that two factors, labeled psychic and somatic anxiety, accounted for the major portion of the variance in test performance.

On the basis of the results described above as well as upon a series of interviews with patients suffering from anxiety, Schalling and her colleagues (9) developed a multicomponent anxiety inventory consisting of separate psychic and somatic subscales with 20 items each. Unfortunately, the face validity of item assignment to each of the two subscales is not immediately apparent. The somatic anxiety scale "included items concerning autonomic disturbances ($N=9$), disquietable and mental discomfort of a diffuse kind and panic attacks ($N=9$), concentration difficulties and distractability ($N=2$). . . . The psychic anxiety scale included items referring to worrying and pronounced anticipatory reactions as well as prolonged post-stress reactions ($N=10$) and increased muscular tension ($N=4$), . . . the remaining six items concerned nervousness and lack of self-confidence in social situations" (9, p. 611). The item content overlap apparent to the present authors is borne out in Schalling et al.'s (9) finding of a 0.81 correlation between subscale scores in a group of psychiatric patients. However, it should be noted that although subscale scores were highly correlated, a different pattern of correlation was obtained between each subscale score and the Eysenck Personality Inventory Neuroticism and Extraversion Scales. Schalling et al. (9) found that both psychic and somatic anxiety were highly positively correlated with neuroticism (0.70 and 0.90, respectively). However, psychic anxiety was inversely related to extraversion (-0.50) while somatic anxiety was unrelated to this construct. Thus, psychic anxiety appears to be more prominent in introverts versus extroverts.

On the basis of both logical and empirical analyses of the anxiety construct, Borkovec (10) has arrived at a similar distinction with some minor modifications. He operationally defines anxiety by the multiple measurement of three separate but interacting response components: cognitive, overt behavioral, and physiological. He further suggests that each of these systems may be separately influenced by different environmental conditions and that individuals may differ "in the intensity and/or functional importance of the response from each component in reaction to a particular feared stimulus" (10, p. 267). The fact that anxiety may be defined by the meas-

urement of these three response components does not necessarily imply that an individual is capable of self-reporting on these separate systems. It rather appears that cognitive and behavioral symptoms, as well as more covert somatic ones such as perspiration, are most prominent in consciousness. Physiological parameters may be seen as providing independent measures sensitive to cognitive versus behavioral/somatic processes but not necessarily always a part of the phenomenology of anxiety.

The multidimensional nature of anxiety is also revealed in psychophysiological research on fear reduction. For example Hodgson and Rachman (3) have observed desynchrony in different physiological dependent measures which all have considerable face validity. In a study designed to explore the efficacy of learned control of alpha for reducing stress associated with an aversive stimulus, Orne and Paskewitz (11) observed significant psychophysiological fractionation and specificity. They found no significant decrement in learned control of occipital alpha presence when subjects were confronted with the possibility of receiving an electric shock, while heart rate and spontaneous skin conductance responses were elevated. Orne and Paskewitz conclude by suggesting that their data "demonstrate that it is possible for the subjects to report the experience of apprehension of fear as well as manifesting the autonomic concomitants of such experiences without associated changes in alpha density" (p. 460). Findings such as these raise important questions concerning the assumed undifferentiated nature of arousal, which was hypothesized to underlie such states as anxiety. Instead of assuming, as some activation theorists have occasionally done (12), that such fractionation is indicative of poor validity for the measures in question or inadequacies in the measurement procedures, we can view data such as these as reflecting meaningful patterns of physiological processes that are associated with particular behavioral and experiential states.

A number of clinical researchers have suggested, on the basis of findings such as those reviewed above, that different subsystems involved in dysfunctional states may be separately manipulated (2). Lazarus (13) has recently proposed that therapeutic regimes be individually constructed to reduce troublesome symptoms in the specific modes and systems that have gone awry. Although data are currently available that indicate that different relaxation procedures elicit distinct patterns of autonomic activity (14), little systematic work has been performed in specifying which particular therapeutic interventions should attenuate specific subcomponents of anxiety (1). Based on the psychometric and psychophysiological research reviewed above, Davidson and Schwartz (1) have developed a psychobiological model of subcomponents involved in anxiety and its reduction. These authors began with the assumption of two relatively independent types of anxiety: cognitive (psychic) and somatic.[1] It was further suggested that different procedures utilized in the reduction of anxiety differ in the degree to which they affect the cognitive versus somatic system. For ex-

[1]It should be emphasized that this is the most basic of all splits. For example, somatic may be further subdivided into skeletal and autonomic and cognitive may be dissected into right versus left hemisphere mediated (1).

ample, while physical exercise has been found to reduce global anxiety under certain situations (15), it was hypothesized that such an activity would specifically lead to reductions primarily in somatic anxiety with less of an effect upon cognitive anxiety. Alternatively, a technique requiring the self-generation of cognitive versus somatic activity is suggested to specifically attenuate anxiety in the cognitive system.

These predictions were based on well-known principles of psychobiological specificity. If we conceptualize particular biobehavioral systems as having a finite amount of channel space, and if we further assume that cognitive or somatic anxiety, for example, represents a recycling of unwanted information in each of the respective systems, then further activity of a neutral nature in a particular system will compete with the ongoing behavioral sequence for channel space. This competition results in an attenuation of the ongoing behavior. In the nonclinical realm, this basic principle has been observed consistently in research on cognitive processes. Segal and her colleagues (16, 17) have explored whether the active generation of imagery in a given mode (e.g., visual versus auditory) will inhibit the perception of stimuli in that mode more than in an irrelevant mode. Subjects were asked to generate both auditory and visual images, and their task involved detecting both auditory and visual signals. It was reliably demonstrated that auditory images interfered more with detection of auditory signals, and visual images with the detection of visual signals. Similar data have been obtained in the area of hemispheric-specific competition (18, 19).

One way of assessing the utility of subdividing anxiety into cognitive and somatic components is to examine the differential effects of relaxation procedures specifically hypothesized to reduce anxiety in one versus the other mode. Any such attempt necessitates a measuring instrument with separate cognitive and somatic subscales. Since the one existing scale of this nature has been found to consist of subscales that are highly correlated (9), one purpose of the present study was to develop an anxiety symptom checklist with separate cognitive and somatic scales. The second purpose was to determine the utility of such a dichotomy by assessing the efficacy of physical exercise (a somatic procedure) versus meditation (a cognitive procedure relative to physical exercise) (1) in the differential reduction of the cognitive and somatic components of anxiety.

METHODS

Subjects

A total of 77 persons was employed as subjects (Ss). Forty-four Ss were participants in a physical exercise class[2] and attended a mean of 3.56 one-hour sessions per week. Thirty-three Ss practiced cognitively based, passive meditation (1) at least once daily. The type of meditation practiced was primarily transcendental meditation (20) although a small number of Ss practiced other passive techniques such as attending to and counting breathing. All subjects were practicing either meditation or physical exercise for at least 1 month with the median duration of practice being approximately 6 months within each group.

The age and sex distributions of the two groups were beyond our control and hence not matched. The physical exercisers had a mean age of 27.36 years (SD = 6.03) while the meditators had a mean

[2]The exercise class was conducted by Maggie Letvin at MIT.

age of 20.86 years (SD = 2.74). The exercisers were predominantly female while the sex ratio of the meditators was approximately equal. However, since the findings for the total sample are observed in analyses based on smaller matched subgroups, it is likely that the age and sex differences are not responsible for the observed differences in patterns of cognitive and somatic anxiety. All subjects were solicited unpaid volunteers.

Cognitive-Somatic Anxiety Questionnaire (CSAQ)

A cognitive-somatic trait anxiety inventory was constructed by selecting items from well-known questionnaires that three independent judges unanimously agreed reflected cognitive or somatic anxiety. The 14 items comprising the inventory, half cognitive and half somatic, are presented in Table 1. Subjects were asked to "rate the degree to which you generally or typically experience this symptom when you are feeling anxious" by circling a number from 1 through 5 with 1 representing "not at all" and 5 representing "very much so." The sums of the circled ratings were separately computed for the cognitive and somatic items and constituted the main dependent measures. The cognitive and somatic items appeared in random order.

TABLE 1. Item Content of the Cognitive-Somatic Anxiety Questionnaire (CSAQ) Separately for Cognitive and Somatic Items.

Cognitive	Somatic
I find it difficult to concentrate because of uncontrollable thoughts.	My heart beats faster.
I worry too much over something that doesn't really matter.	I feel jittery in my body.
I imagine terrifying scenes.	I get diarrhea.
I can't keep anxiety provoking pictures out of my mind.	I feel tense in my stomach.
Some unimportant thought runs through my mind and bothers me.	I nervously pace.
I feel like I am losing out on things because I can't make up my mind soon enough.	I become immobilized.
I can't keep anxiety provoking thoughts out of my mind.	I perspire.

To ascertain the validity of the CSAQ, correlations were computed between the latter test and a standard measure of trait anxiety. The Speilberger State-Trait Anxiety Inventory (STAI) (21) was administered in the trait form to a sample of 78 nonexercisers, and it was observed that separate correlations between the cognitive and somatic scales of the CSAQ with the STAI were both highly significant ($r=0.67$ and 0.40, respectively, for both $P<0.001$).

The correlation between the cognitive and somatic scales of the CSAQ for the entire sample was $r=0.42$. This represents a substantially lower correlation than was obtained by Schalling (0.81) between the psychic and somatic subcomponents of her multicomponent anxiety inventory (9). These data indicate that the cognitive and somatic scales are modestly correlated, and that their shared variance is sufficiently low to allow for patterning of results as a function of different training techniques.

Procedure

Subjects were presented with the CSAQ in the context of a larger battery of tests. The subjects in the exercise group were asked to fill out the questionnaires at the end of a class while the remaining subjects were given the questionnaires in a classroom (at Harvard) and asked to complete them at home and return them the following day. All subjects were told that these questionnaires were part of a study on psychological concomitants of different forms of self-regulation techniques.

RESULTS

An analysis of variance with group (exercisers vs. meditators) as a between factor and mode of anxiety (cognitive vs. somatic) as a repeated factor revealed, as predicted, a significant interaction [F (1, 75) = 5.32, $P < 0.03$]. This interaction is

illustrated in Fig. 1 and indicates that meditators report less cognitive and more somatic anxiety than exercisers and, conversely, exercisers report less somatic and more cognitive anxiety than meditators. Importantly, the main effect for group was not significant ($F < 1$), indicating that the two groups did not differ on overall anxiety but rather on the specific patterning of anxiety subsystems. Interestingly, the significant interaction is largely a function of the significantly higher cognitive versus somatic anxiety within the exercisers ($t = 2.32$, $df = 43$, $P < 0.05$). The meditators revealed no significant difference between the two anxiety modes.

DISCUSSION

The present findings support the general thesis that anxiety is not a diffuse, undifferentiated internal state, but rather

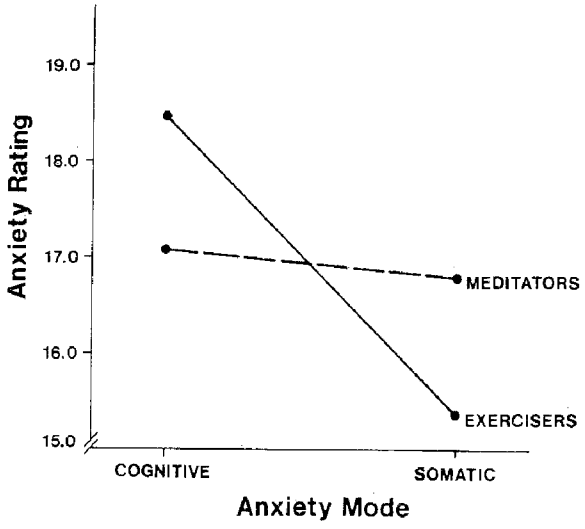

Fig. 1. Mean anxiety rating on the separate cognitive and somatic scales of the Cognitive-Somatic Anxiety Questionnaire (CSAQ) by group. For exercisers, $N = 44$; for meditators, $N = 33$.

reflects a set of patterns of specific psychobiological processes having important implications for the assessment and treatment of affective disorders. Clearly, subdividing anxiety into its cognitive and somatic components as measured by the present questionnaire is itself an oversimplification (1), but it is a useful starting point for stimulating theory and research. In a recent study, which emerged from the present findings, it was found that cognitive and somatic anxiety could be reliably distinguished on the basis of the patterning of cardiovascular, electrodermal, and electromyographic measures (22). More sophisticated psychobiological subdivisions of anxiety would include examination of hemispheric asymmetry in emotion (23, 24) and differential patterning of fundamental emotions in anxiety and depression (25). The relevance of the latter concept to the psychophysiological assessment of depression and anxiety has been recently documented by measuring patterns of facial muscle activity in different affective states (26). The systematic assessment and self-regulation of psychophysiological patterning and specificity is rapidly becoming an important tool in the understanding and treatment of a variety of clinical dysfunctions (27, 28).

The data generated in this study and the body of literature reviewed in the introduction question the notion of a generalized, relaxation response as a complete description of the nature of relaxation. The present findings suggest that different techniques employed for the elicitation of relaxation may be associated with specific consequences, which in turn may be a function of the underlying systems directly affected by the procedure in question. Just as recent psychophysiological research has chal-

lenged the adequacy of concepts of generalized arousal (28), so too in the clinical domain, conceptions of undifferentiated relaxation and anxiety are incomplete. Importantly, however, the patterning of biobehavioral systems may be superimposed upon a more nonspecific continuum of relaxation and anxiety and assessment may be made of both the general level of relaxation and anxiety as well as their specific subcomponents. We would propose that relaxation consists of (1) a generalized reduction in multiple physiological systems (termed the relaxation response by Benson) and (2) a more specific pattern of changes superimposed upon this general reduction, which is elicited by the particular technique employed. The present line of reasoning highlights the importance of considering these components in any complete account of anxiety and its reduction.

The findings obtained in the present study are consistent with the hypothesis that the practice of meditation versus exercise may be associated with the differential patterning of cognitive and somatic symptoms of anxiety (1). The regular practice of physical exercise, a somatic relaxer, was associated with less somatic and more cognitive anxiety than the regular practice of meditation, a technique believed to be associated with cognitive relaxation (1, 30). However, a cautionary note should be raised in interpreting the present data. Although the subjects practicing either physical exercise or meditation had been doing so on a regular basis for a median duration of approximately 6 months, the present retrospective design does not rule out the possibility of predispositional (including expectation) contributions to the observed effects (31). It may be the case that individuals attracted to the practice of meditation versus physical relaxation differ in their patterning of cognitive and somatic anxiety. The influence of such predispositional variables may be unambiguously disentangled in the future with longitudinal, prospective designs that include appropriate behavioral and physiological measures.

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